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# Foreword

This Technical Specification has been produced by the 3<sup>rd</sup> Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.



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# 1 Scope

The present document specifies the Radio Resource Control protocol for the radio interface between UE and NG-RAN.

The scope of the present document also includes:

- the radio related information transported in a transparent container between source gNB and target gNB upon inter gNB handover;
- the radio related information transported in a transparent container between a source or target gNB and another system upon inter RAT handover.
- the radio related information transported in a transparent container between a source eNB and target gNB during E-UTRA-NR Dual Connectivity.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 38.300: "NR; Overall description; Stage 2".
- [3] 3GPP TS 38.321: "NR; Medium Access Control (MAC); Protocol specification".
- [4] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".
- [5] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) protocol specification".
- [6] ITU-T Recommendation X.680 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation" (Same as the ISO/IEC International Standard 8824-1).
- [7] ITU-T Recommendation X.681 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Information object specification" (Same as the ISO/IEC International Standard 8824-2).
- [8] ITU-T Recommendation X.691 (08/2015) "Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)" (Same as the ISO/IEC International Standard 8825-2).
- [9] 3GPP TS 38.215: "NR; Physical layer measurements".
- [10] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol Specification".
- [11] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".
- [12] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

- [13] 3GPP TS 38.213: "NR; Physical layer procedures for control".
- [14] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".
- [15] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
- [16] 3GPP TS 38.211: "NR; Physical channels and modulation".
- [17] 3GPP TS 38.212: "NR; Multiplexing and channel coding".
- [18] ITU-T Recommendation X.683 (08/2015) "Information Technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications" (Same as the ISO/IEC International Standard 8824-4).
- [19] 3GPP TS 38.214: "NR; Physical layer procedures for data".
- [20] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in Idle mode and RRC Inactive state".
- [21] 3GPP TS 23.003: "Numbering, addressing and identification".
- [22] 3GPP TS 36.101: "E-UTRA; User Equipment (UE) radio transmission and reception".
- [23] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [24] 3GPP TS 37.324: "Service Data Adaptation Protocol (SDAP) specification".
- [25] 3GPP TS 22.261: "Service requirements for the 5G System".
- [26] 3GPP TS 38.306: "User Equipment (UE) radio access capabilities".
- [27] 3GPP TS 36.304: "E-UTRA; User Equipment (UE) procedures in idle mode".
- [28] ATIS 0700041: "WEA 3.0: Device-Based Geo-Fencing".
- [29] 3GPP TS 23.041: "Technical realization of Cell Broadcast Service (CBS)".
- [30] 3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security architecture".
- [31] 3GPP TS 36.211: "E-UTRA; Physical channels and modulation".
- [32] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [33] 3GPP TS 36.104: "E-UTRA; Base Station (BS) radio transmission and reception".
- [34] 3GPP TS 38.101-3 "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".
- [35] 3GPP TS 38.423: "NG-RAN, Xn application protocol (XnAP)".
- [36] 3GPP TS 38.473: "NG-RAN; F1 application protocol (F1AP)".
- [37] 3GPP TS 36.423: "E-UTRA; X2 application protocol (X2AP)".
- [38] 3GPP TS 24.008: "Mobile radio interface layer 3 specification; Core network protocols; Stage 3".
- [39] 3GPP TS 38.101-2 "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".
- [40] 3GPP TS 36.133: "E-UTRA; Requirements for support of radio resource management".
- [41] 3GPP TS 37.340: "E-UTRA and NR; Multi-connectivity; Stage 2".

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**CEIL:** Mathematical function used to 'round up' i.e. to the nearest integer having a higher or equal value.

**Dedicated signalling:** Signalling sent on DCCH logical channel between the network and a single UE.

**Field:** The individual contents of an information element are referred to as fields.

**FLOOR:** Mathematical function used to 'round down' i.e. to the nearest integer having a lower or equal value.

**Information element:** A structural element containing single or multiple fields is referred as information element.

**Primary Cell:** The MCG cell, operating on the primary frequency, in which the UE either performs the initial connection establishment procedure or initiates the connection re-establishment procedure.

**Primary SCG Cell:** For dual connectivity operation, the SCG cell in which the UE performs random access when performing the Reconfiguration with Sync procedure.

**Primary Timing Advance Group:** Timing Advance Group containing the SpCell.

**PUCCH SCell:** An SCell configured with PUCCH.

**RLC bearer configuration:** The lower layer part of the radio bearer configuration comprising the RLC and logical channel configurations.

**Secondary Cell:** For a UE configured with CA, a cell providing additional radio resources on top of Special Cell.

**Secondary Cell Group:** For a UE configured with dual connectivity, the subset of serving cells comprising of the PSCell and zero or more secondary cells.

**Serving Cell:** For a UE in RRC\_CONNECTED not configured with CA/DC there is only one serving cell comprising of the primary cell. For a UE in RRC\_CONNECTED configured with CA/ DC the term 'serving cells' is used to denote the set of cells comprising of the Special Cell(s) and all secondary cells.

**Special Cell:** For Dual Connectivity operation the term Special Cell refers to the PCell of the MCG or the PSCell of the SCG, otherwise the term Special Cell refers to the PCell.

**Split SRB:** In MR-DC, an SRB that supports transmission via MCG and SCG as well as duplication of RRC PDUs as defined in TS 37.340 [41].

**SSB Frequency:** Frequency referring to the position of resource element RE=#0 (subcarrier #0) of resource block RB#10 of the SS block.

**UE Inactive AS Context:** UE Inactive AS Context is stored when the connection is suspended and restored when the connection is resumed. It includes information as defined in clause 5.3.8.3.

### 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

|     |                          |
|-----|--------------------------|
| 5GC | 5G Core Network          |
| ACK | Acknowledgement          |
| AM  | Acknowledged Mode        |
| ARQ | Automatic Repeat Request |
| AS  | Access Stratum           |

|            |   |
|------------|---|
| ASN.1      | Abstract Syntax Notation One  |
| BLER       | Block Error Rate  |
| BWP        | Bandwidth Part  |
| CA         | Carrier Aggregation   |
| CCCH       | Common Control Channel  |
| CG         | Cell Group  |
| CMAS       | Commercial Mobile Alert Service                                       |
| CP         | Control Plane   |
| C-RNTI     | Cell RNTI   |
| CSI        | Channel State Information   |
| DC         | Dual Connectivity   |
| DCCH       | Dedicated Control Channel   |
| DCI        | Downlink Control Information  |
| DL         | Downlink  |
| DL-SCH     | Downlink Shared Channel   |
| DM-RS      | Demodulation Reference Signal   |
| DRB        | (user) Data Radio Bearer  |
| DRX        | Discontinuous Reception   |
| DTCH       | Dedicated Traffic Channel   |
| EN-DC      | E-UTRA NR Dual Connectivity with E-UTRA connected to EPC              |
| EPC        | Evolved Packet Core   |
| EPS        | Evolved Packet System   |
| ETWS       | Earthquake and Tsunami Warning System                                 |
| E-UTRA     | Evolved Universal Terrestrial Radio Access                            |
| E-UTRA/5GC | E-UTRA connected to 5GC   |
| E-UTRA/EPC | E-UTRA connected to EPC   |
| E-UTRAN    | Evolved Universal Terrestrial Radio Access Network                    |
| FDD        | Frequency Division Duplex   |
| FFS        | For Further Study   |
| GERAN      | GSM/EDGE Radio Access Network   |
| GNSS       | Global Navigation Satellite System                                    |
| GSM        | Global System for Mobile Communications                               |
| HARQ       | Hybrid Automatic Repeat Request                                       |
| IE         | Information element   |
| IMSI       | International Mobile Subscriber Identity                              |
| kB         | Kilobyte (1000 bytes)   |
| L1         | Layer 1   |
| L2         | Layer 2   |
| L3         | Layer 3   |
| MAC        | Medium Access Control   |
| MCG        | Master Cell Group   |
| MIB        | Master Information Block  |
| MR-DC      | Multi-Radio Dual Connectivity   |
| N/A        | Not Applicable  |
| NE-DC      | NR E-UTRA Dual Connectivity   |
| (NG)EN-DC  | E-UTRA NR Dual Connectivity (covering E-UTRA connected to EPC or 5GC) |
| NGEN-DC    | E-UTRA NR Dual Connectivity with E-UTRA connected to 5GC              |
| NR-DC      | NR-NR Dual Connectivity   |
| NR/5GC     | NR connected to 5GC   |
| PCell      | Primary Cell  |
| PDCP       | Packet Data Convergence Protocol                                      |
| PDU        | Protocol Data Unit  |
| PLMN       | Public Land Mobile Network  |
| PSCell     | Primary SCG Cell  |
| PWS        | Public Warning System   |
| QoS        | Quality of Service  |
| RAN        | Radio Access Network  |
| RAT        | Radio Access Technology   |
| RLC        | Radio Link Control  |
| RNA        | RAN-based Notification Area   |
| RNTI       | Radio Network Temporary Identifier                                    |
| ROHC       | Robust Header Compression   |

|        |                                 |
|--------|---------------------------------|
| RRC    | Radio Resource Control          |
| RS     | Reference Signal                |
| SCell  | Secondary Cell                  |
| SCG    | Secondary Cell Group            |
| SFN    | System Frame Number             |
| SFTD   | SFN and Frame Timing Difference |
| SI     | System Information              |
| SIB    | System Information Block        |
| SpCell | Special Cell                    |
| SRB    | Signalling Radio Bearer         |
| SSB    | Synchronization Signal Block    |
| TAG    | Timing Advance Group            |
| TDD    | Time Division Duplex            |
| TM     | Transparent Mode                |
| UE     | User Equipment                  |
| UL     | Uplink                          |
| UM     | Unacknowledged Mode             |
| UP     | User Plane                      |

In the ASN.1, lower case may be used for some (parts) of the above abbreviations e.g. c-RNTI.

---

## 4 General

### 4.1 Introduction

This specification is organised as follows:

- clause 4.2 describes the RRC protocol model;
- clause 4.3 specifies the services provided to upper layers as well as the services expected from lower layers;
- clause 4.4 lists the RRC functions;
- clause 5 specifies RRC procedures, including UE state transitions;
- clause 6 specifies the RRC messages in ASN.1 and description;
- clause 7 specifies the variables (including protocol timers and constants) and counters to be used by the UE;
- clause 8 specifies the encoding of the RRC messages;
- clause 9 specifies the specified and default radio configurations;
- clause 10 specifies generic error handling;
- clause 11 specifies the RRC messages transferred across network nodes;
- clause 12 specifies the UE capability related constraints and performance requirements.

### 4.2 Architecture

#### 4.2.1 UE states and state transitions including inter RAT

A UE is either in RRC\_CONNECTED state or in RRC\_INACTIVE state when an RRC connection has been established. If this is not the case, i.e. no RRC connection is established, the UE is in RRC\_IDLE state. The RRC states can further be characterised as follows:

- **RRC\_IDLE:**
  - A UE specific DRX may be configured by upper layers;

- UE controlled mobility based on network configuration;
  - The UE:
    - Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5);
    - Monitors a Paging channel for CN paging using 5G-S-TMSI;
    - Performs neighbouring cell measurements and cell (re-)selection;
    - Acquires system information and can send SI request (if configured).
  - **RRC\_INACTIVE:**
    - A UE specific DRX may be configured by upper layers or by RRC layer;
    - UE controlled mobility based on network configuration;
    - The UE stores the UE Inactive AS context;
    - A RAN-based notification area is configured by RRC layer;
- The UE:
- Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5);
  - Monitors a Paging channel for CN paging using 5G-S-TMSI and RAN paging using fullI-RNTI;
  - Performs neighbouring cell measurements and cell (re-)selection;
  - Performs RAN-based notification area updates periodically and when moving outside the configured RAN-based notification area;
  - Acquires system information and can send SI request (if configured).
- **RRC\_CONNECTED:**
    - The UE stores the AS context;
    - Transfer of unicast data to/from UE;
    - At lower layers, the UE may be configured with a UE specific DRX;
    - For UEs supporting CA, use of one or more SCells, aggregated with the SpCell, for increased bandwidth;
    - For UEs supporting DC, use of one SCG, aggregated with the MCG, for increased bandwidth;
    - Network controlled mobility within NR and to/from E-UTRA;
    - The UE:
      - Monitors Short Messages transmitted with P-RNTI over DCI (see clause 6.5), if configured;
      - Monitors control channels associated with the shared data channel to determine if data is scheduled for it;
      - Provides channel quality and feedback information;
      - Performs neighbouring cell measurements and measurement reporting;
      - Acquires system information.

Figure 4.2.1-1 illustrates an overview of UE RRC state machine and state transitions in NR. A UE has only one RRC state in NR at one time.

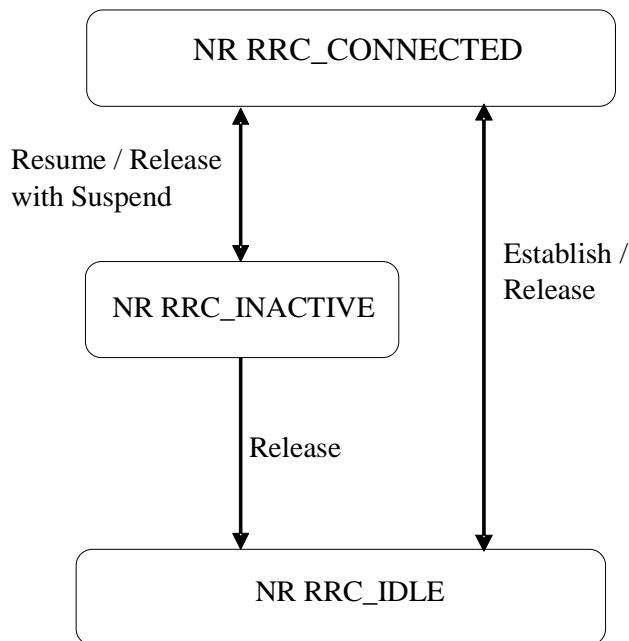


Figure 4.2.1-1: UE state machine and state transitions in NR

Figure 4.2.1-2 illustrates an overview of UE state machine and state transitions in NR as well as the mobility procedures supported between NR/5GC E-UTRA/EPC and E-UTRA/5GC.

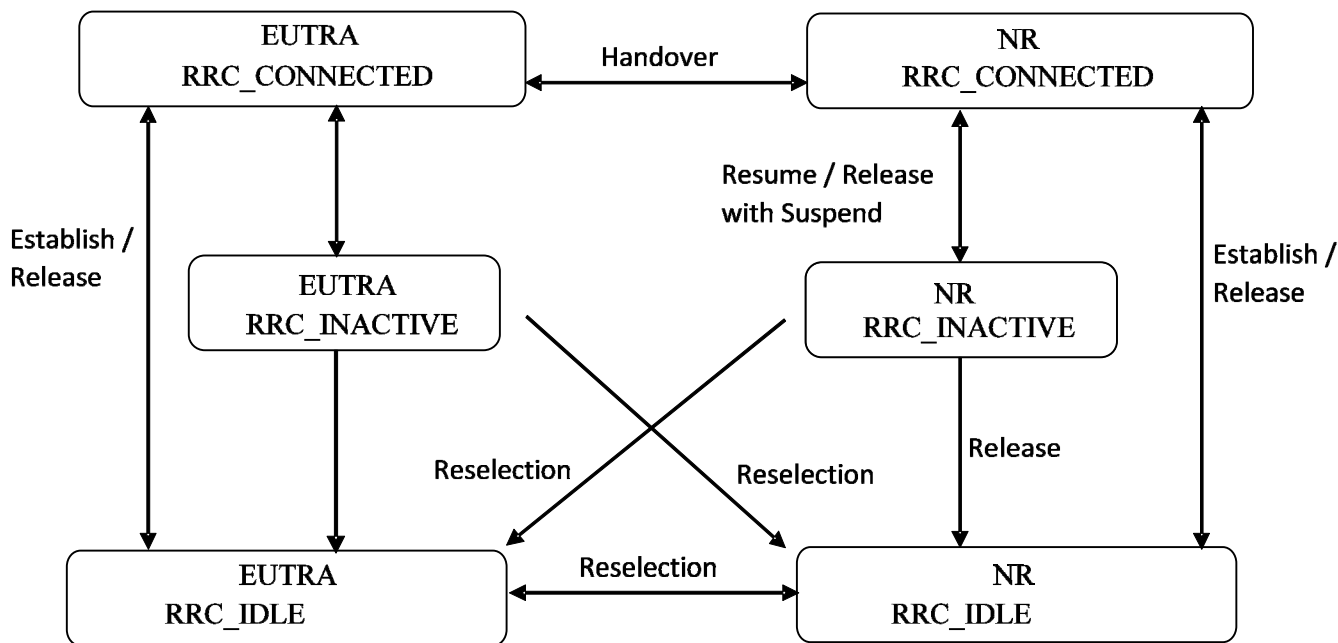


Figure 4.2.1-2: UE state machine and state transitions between NR/5GC, E-UTRA/EPC and E-UTRA/5GC

### 4.2.2 Signalling radio bearers

"Signalling Radio Bearers" (SRBs) are defined as Radio Bearers (RBs) that are used only for the transmission of RRC and NAS messages. More specifically, the following SRBs are defined:

- SRB0 is for RRC messages using the CCCH logical channel;

- SRB1 is for RRC messages (which may include a piggybacked NAS message) as well as for NAS messages prior to the establishment of SRB2, all using DCCH logical channel;
- SRB2 is for NAS messages, all using DCCH logical channel. SRB2 has a lower priority than SRB1 and may be configured by the network after AS security activation;
- SRB3 is for specific RRC messages when UE is in (NG)EN-DC or NR-DC, all using DCCH logical channel.

In downlink, piggybacking of NAS messages is used only for one dependant (i.e. with joint success/failure) procedure: bearer establishment/modification/release. In uplink piggybacking of NAS message is used only for transferring the initial NAS message during connection setup and connection resume.

NOTE 1: The NAS messages transferred via SRB2 are also contained in RRC messages, which however do not include any RRC protocol control information.

Once AS security is activated, all RRC messages on SRB1, SRB2 and SRB3, including those containing NAS messages, are integrity protected and ciphered by PDCP. NAS independently applies integrity protection and ciphering to the NAS messages, see TS 24.501 [23].

Split SRB is supported for all the MR-DC options in both SRB1 and SRB2 (split SRB is not supported for SRB0 and SRB3).

## 4.3 Services

### 4.3.1 Services provided to upper layers

The RRC protocol offers the following services to upper layers:

- Broadcast of common control information;
- Notification of UEs in RRC\_IDLE, e.g. about a mobile terminating call;
- Notification of UEs about ETWS and/or CMAS
- Transfer of dedicated signalling.

### 4.3.2 Services expected from lower layers

In brief, the following are the main services that RRC expects from lower layers:

- Integrity protection, ciphering and loss-less in-sequence delivery of information without duplication;

## 4.4 Functions

The RRC protocol includes the following main functions:

- Broadcast of system information:
  - Including NAS common information;
  - Information applicable for UEs in RRC\_IDLE and RRC\_INACTIVE (e.g. cell (re-)selection parameters, neighbouring cell information) and information (also) applicable for UEs in RRC\_CONNECTED (e.g. common channel configuration information);
  - Including ETWS notification, CMAS notification.
- RRC connection control:
  - Paging;



- Establishment/modification/suspension/resumption/release of RRC connection, including e.g. assignment/modification of UE identity (C-RNTI, fullI-RNTI, etc.), establishment/modification/suspension/resumption/release of SRBs (except for SRB0);
- Access barring;
- Initial AS security activation, i.e. initial configuration of AS integrity protection (SRBs, DRBs) and AS ciphering (SRBs, DRBs);
- RRC connection mobility including e.g. intra-frequency and inter-frequency handover, associated AS security handling, i.e. key/algorithm change, specification of RRC context information transferred between network nodes;
- Establishment/modification/suspension/resumption/release of RBs carrying user data (DRBs);
- Radio configuration control including e.g. assignment/modification of ARQ configuration, HARQ configuration, DRX configuration;
- In case of DC, cell management including e.g. change of PSCell, addition/modification/release of SCG cell(s);
- In case of CA, cell management including e.g. addition/modification/release of SCell(s);
- QoS control including assignment/ modification of semi-persistent scheduling (SPS) configuration and configured grant configuration for DL and UL respectively, assignment/ modification of parameters for UL rate control in the UE, i.e. allocation of a priority and a prioritised bit rate (PBR) for each RB.
- Recovery from radio link failure.
- Inter-RAT mobility including e.g. AS security activation, transfer of RRC context information;
- Measurement configuration and reporting:
  - Establishment/modification/release of measurement configuration (e.g. intra-frequency, inter-frequency and inter- RAT measurements);
  - Setup and release of measurement gaps;
  - Measurement reporting.
- Other functions including e.g. generic protocol error handling, transfer of dedicated NAS information, transfer of UE radio access capability information.

---

## 5 Procedures

### 5.1 General

#### 5.1.1 Introduction

This section covers the general requirements.

#### 5.1.2 General requirements

The UE shall:

- 1> process the received messages in order of reception by RRC, i.e. the processing of a message shall be completed before starting the processing of a subsequent message;

NOTE: Network may initiate a subsequent procedure prior to receiving the UE's response of a previously initiated procedure.

- 1> within a sub-clause execute the steps according to the order specified in the procedural description;
- 1> consider the term 'radio bearer' (RB) to cover SRBs and DRBs unless explicitly stated otherwise;
- 1> set the *rrc-TransactionIdentifier* in the response message, if included, to the same value as included in the message received from the network that triggered the response message;
- 1> upon receiving a choice value set to *setup*:
  - 2> apply the corresponding received configuration and start using the associated resources, unless explicitly specified otherwise;
- 1> upon receiving a choice value set to *release*:
  - 2> clear the corresponding configuration and stop using the associated resources;
- 1> in case the size of a list is extended, upon receiving an extension field comprising the entries in addition to the ones carried by the original field (regardless of whether the network signals more entries in total); apply the following generic behaviour unless explicitly stated otherwise:
  - 2> create a combined list by concatenating the additional entries included in the extension field to the original field while maintaining the order among both the original and the additional entries;
  - 2> for the combined list, created according to the previous, apply the same behaviour as defined for the original field.

### 5.1.3 Requirements for UE in MR-DC

In this specification, the UE considers itself to be in:

- EN-DC, if and only if it is configured with *nr-SecondaryCellGroupConfig* according to TS 36.331[10], and it is connected to EPC,
- NGEN-DC, if and only if it is configured with *nr-SecondaryCellGroupConfig* according to TS 36.331[10], and it is connected to 5GC,
- NE-DC, if and only if it is configured with *mrdc-SecondaryCellGroup* set to *eutra-SCG*,
- NR-DC, if and only if it is configured with *mrdc-SecondaryCellGroup* set to *nr-SCG*,
- MR-DC, if and only if it is in (NG)EN-DC, NE-DC or NR-DC.

NOTE: This use of these terms deviates from the definition in TS 37.340 [41] and other specifications. In TS 37.340, these terms include also the case where the UE is configured with E-UTRA or NR MCG only (i.e. no NR or E-UTRA SCG) but with one or more bearers terminated in a secondary node (i.e. using NR PDCP).

The UE in (NG)EN-DC only executes a sub-clause of clause 5 in this specification when the subclause:

- is referred to from a subclause under execution, either in this specification or in TS 36.331 [10]; or
- applies to a message received on SRB3 (if SRB3 is established); or
- applies to field(s), IE(s), UE variable(s) or timer(s) in this specification that the UE is configured with.

When executing a subclause of clause 5 in this specification, the UE follows the requirements in clause 5.1.2 and in all subclauses of this specification applicable to the messages (including processing time requirements), fields, IEs, timers and UE variables indicated in the subclause under execution.

## 5.2 System information

### 5.2.1 Introduction

System Information (SI) is divided into the *MIB* and a number of SIBs where:

- the *MIB* is always transmitted on the BCH with a periodicity of 80 ms and repetitions made within 80 ms (TS 38.212 [17], clause 7.1) and it includes parameters that are needed to acquire *SIB1* from the cell. The first transmission of the *MIB* is scheduled in subframes as defined in TS 38.213 [13], clause 4.1 and repetitions are scheduled according to the period of SSB;
- the *SIB1* is transmitted on the DL-SCH with a periodicity of 160 ms and variable transmission repetition periodicity within 160 ms as specified in TS 38.213 [13], clause 13. The default transmission repetition periodicity of *SIB1* is 20 ms but the actual transmission repetition periodicity is up to network implementation. For SSB and CORESET multiplexing pattern 1, *SIB1* repetition transmission period is 20 ms. For SSB and CORESET multiplexing pattern 2/3, *SIB1* transmission repetition period is the same as the SSB period (TS 38.213 [13], clause 13). *SIB1* includes information regarding the availability and scheduling (e.g. mapping of SIBs to SI message, periodicity, SI-window size) of other SIBs with an indication whether one or more SIBs are only provided on-demand and, in that case, the configuration needed by the UE to perform the SI request. *SIB1* is cell-specific SIB;
- SIBs other than *SIB1* are carried in *SystemInformation* (SI) messages, which are transmitted on the DL-SCH. Only SIBs having the same periodicity can be mapped to the same SI message. Each SI message is transmitted within periodically occurring time domain windows (referred to as SI-windows with same length for all SI messages). Each SI message is associated with an SI-window and the SI-windows of different SI messages do not overlap. That is, within one SI-window only the corresponding SI message is transmitted. An SI message may be transmitted a number of times within the SI-window. Any SIB except *SIB1* can be configured to be cell specific or area specific, using an indication in *SIB1*. The cell specific SIB is applicable only within a cell that provides the SIB while the area specific SIB is applicable within an area referred to as SI area, which consists of one or several cells and is identified by *systemInformationAreaID*;
- For a UE in RRC\_CONNECTED, the network can provide system information through dedicated signalling using the *RRCReconfiguration* message, e.g. if the UE has an active BWP with no common search space configured to monitor system information or paging.
- For PSCell and SCells, the network provides the required SI by dedicated signalling, i.e. within an *RRCReconfiguration* message. Nevertheless, the UE shall acquire *MIB* of the PSCell to get SFN timing of the SCG (which may be different from MCG). Upon change of relevant SI for SCell, the network releases and adds the concerned SCell. For PSCell, the required SI can only be changed with Reconfiguration with Sync.

NOTE: The physical layer imposes a limit to the maximum size a SIB can take. The maximum *SIB1* or *SI message* size is 2976 bits.

## 5.2.2 System information acquisition

### 5.2.2.1 General UE requirements

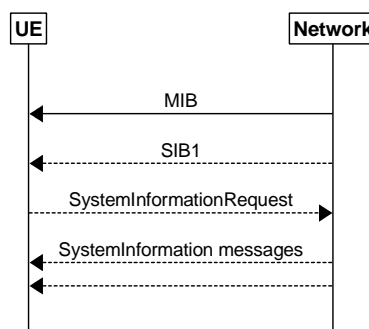


Figure 5.2.2.1-1: System information acquisition

The UE applies the SI acquisition procedure to acquire the AS- and NAS information. The procedure applies to UEs in RRC\_IDLE, in RRC\_INACTIVE and in RRC\_CONNECTED.

The UE in RRC\_IDLE and RRC\_INACTIVE shall ensure having a valid version of (at least) the *MIB*, *SIB1* through *SIB4* and *SIB5* (if the UE supports E-UTRA).

## 5.2.2.2 SIB validity and need to (re)-acquire SIB

### 5.2.2.2.1 SIB validity

The UE shall apply the SI acquisition procedure as defined in clause 5.2.2.3 upon cell selection (e.g. upon power on), cell-reselection, return from out of coverage, after reconfiguration with sync completion, after entering the network from another RAT, upon receiving an indication that the system information has changed, upon receiving a PWS notification; and whenever the UE does not have a valid version of a stored SIB.

When the UE acquires a *MIB* or a *SIB1* or an SI message in a serving cell as described in clause 5.2.2.3, and if the UE stores the acquired SIB, then the UE shall store the associated *areaScope*, if present, the first *PLMN-Identity* in the *PLMN-IdentityInfoList*, the *cellIdentity*, the *systemInformationAreaID*, if present, and the *valueTag*, if present, as indicated in the *si-SchedulingInfo* for the SIB. The UE may use a valid stored version of the SI except *MIB*, *SIB1*, *SIB6*, *SIB7* or *SIB8* e.g. after cell re-selection, upon return from out of coverage or after the reception of SI change indication.

NOTE: The storage and management of the stored SIBs in addition to the SIBs valid for the current serving cell is left to UE implementation.

The UE shall:

- 1> delete any stored version of a SIB after 3 hours from the moment it was successfully confirmed as valid;
- 1> for each stored version of a SIB:
  - 2> if the *areaScope* is associated and its value for the stored version of the SIB is the same as the value received in the *si-SchedulingInfo* for that SIB from the serving cell:
  - 3> if the first *PLMN-Identity* included in the *PLMN-IdentityInfoList*, the *systemInformationAreaID* and the *valueTag* that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to the *PLMN-Identity*, the *systemInformationAreaID* and the *valueTag* associated with the stored version of that SIB:
    - 4> consider the stored SIB as valid for the cell;
  - 2> if the *areaScope* is not present for the stored version of the SIB and the *areaScope* value is not included in the *si-SchedulingInfo* for that SIB from the serving cell:
  - 3> if the first *PLMN-Identity* in the *PLMN-IdentityInfoList*, the *cellIdentity* and *valueTag* that are included in the *si-SchedulingInfo* for the SIB received from the serving cell are identical to the *PLMN-Identity*, the *cellIdentity* and the *valueTag* associated with the stored version of that SIB:
    - 4> consider the stored SIB as valid for the cell;

### 5.2.2.2.2 SI change indication and PWS notification

A modification period is used, i.e. updated SI (other than for ETWS and CMAS) is broadcasted in the modification period following the one where SI change indication is transmitted. The modification period boundaries are defined by SFN values for which  $\text{SFN mod } m = 0$ , where  $m$  is the number of radio frames comprising the modification period. The modification period is configured by system information. The UE receives indications about SI modifications and/or PWS notifications using Short Message transmitted with P-RNTI over DCI (see clause 6.5). Repetitions of SI change indication may occur within preceding modification period.

UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for SI change indication in its own paging occasion every DRX cycle. UEs in RRC\_CONNECTED shall monitor for SI change indication in any paging occasion at least once per modification period if the UE is provided with common search space on the active BWP to monitor paging, as specified in TS 38.213 [13], clause 13.

ETWS or CMAS capable UEs in RRC\_IDLE or in RRC\_INACTIVE shall monitor for indications about PWS notification in its own paging occasion every DRX cycle. ETWS or CMAS capable UEs in RRC\_CONNECTED shall monitor for indication about PWS notification in any paging occasion at least once every *defaultPagingCycle* if the UE is provided with common search space on the active BWP to monitor paging.

For Short Message reception in a paging occasion, the UE monitors the PDCCH monitoring occasion(s) for paging as specified in TS 38.304 [20] and TS 38.213 [13].

If the UE receives a Short Message, the UE shall:

- 1> if the UE is ETWS capable or CMAS capable, the *etwsAndCmasIndication* bit of Short Message is set, and the UE is provided with *searchSpaceOtherSystemInformation* on the active BWP:
  - 2> immediately re-acquire the *SIB1*;
  - 2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB6*:
    - 3> acquire *SIB6*, as specified in sub-clause 5.2.2.3.2, immediately;
  - 2> if the UE is ETWS capable and *si-SchedulingInfo* includes scheduling information for *SIB7*:
    - 3> acquire *SIB7*, as specified in sub-clause 5.2.2.3.2, immediately;
  - 2> if the UE is CMAS capable and *si-SchedulingInfo* includes scheduling information for *SIB8*:
    - 3> acquire *SIB8*, as specified in sub-clause 5.2.2.3.2, immediately;
- 1> if the *systemInfoModification* bit of Short Message is set:
  - 2> apply the SI acquisition procedure as defined in sub-clause 5.2.2.3 from the start of the next modification period.

### 5.2.2.3 Acquisition of System Information

#### 5.2.2.3.1 Acquisition of *MIB* and *SIB1*

The UE shall:

- 1> apply the specified BCCH configuration defined in 9.1.1.1;
- 1> if the UE is in RRC\_IDLE or in RRC\_INACTIVE:
  - 2> acquire the *MIB*, which is scheduled as specified in TS 38.213 [13];
  - 2> if the UE is unable to acquire the *MIB*:
    - 3> perform the actions as specified in clause 5.2.2.5;
  - 2> else:
    - 3> perform the actions specified in clause 5.2.2.4.1.
- 1> if the UE is in RRC\_CONNECTED with an active BWP with common search space configured by *searchSpaceSIB1* and *pagingSearchSpace* and has received an indication about change of system information; or
- 1> if the UE is in RRC\_IDLE or in RRC\_INACTIVE:
  - 2> if *ssb-SubcarrierOffset* indicates *SIB1* is transmitted in the cell (TS 38.213 [13]) and if *SIB1* acquisition is required for the UE:
    - 3> acquire the *SIB1*, which is scheduled as specified in TS 38.213 [13];
    - 3> if the UE is unable to acquire the *SIB1*:
      - 4> perform the actions as specified in clause 5.2.2.5;
    - 3> else:
      - 4> upon acquiring *SIB1*, perform the actions specified in clause 5.2.2.4.2.
  - 2> else if *SIB1* acquisition is required for the UE and *ssb-SubcarrierOffset* indicates that *SIB1* is not scheduled in the cell:
    - 3> perform the actions as specified in clause 5.2.2.5.

NOTE: The UE in RRC\_CONNECTED is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.

### 5.2.2.3.2 Acquisition of an SI message

For SI message acquisition PDCCH monitoring occasion(s) are determined according to *searchSpaceOtherSystemInformation*. If *searchSpaceOtherSystemInformation* is set to zero, PDCCH monitoring occasions for SI message reception in SI-window are same as PDCCH monitoring occasions for *SIB1* where the mapping between PDCCH monitoring occasions and SSBs is specified in TS 38.213[13]. If *searchSpaceOtherSystemInformation* is not set to zero, PDCCH monitoring occasions for SI message are determined based on search space indicated by *searchSpaceOtherSystemInformation*. PDCCH monitoring occasions for SI message which are not overlapping with UL symbols (determined according to *tdd-UL-DL-ConfigurationCommon*) are sequentially numbered from one in the SI window. The  $[x \times N + K]^{\text{th}}$  PDCCH monitoring occasion (s) for SI message in SI-window corresponds to the  $K^{\text{th}}$  transmitted SSB, where  $x = 0, 1, \dots, X-1$ ,  $K = 1, 2, \dots, N$ ,  $N$  is the number of actual transmitted SSBs determined according to *ssb-PositionsInBurst* in *SIB1* and  $X$  is equal to  $\text{CEIL}(\text{number of PDCCH monitoring occasions in SI-window}/N)$ . The actual transmitted SSBs are sequentially numbered from one in ascending order of their SSB indexes. The UE assumes that, in the SI window, PDCCH for an SI message is transmitted in at least one PDCCH monitoring occasion corresponding to each transmitted SSB and thus the selection of SSB for the reception SI messages is up to UE implementation.

When acquiring an SI message, the UE shall:

- 1> determine the start of the SI-window for the concerned SI message as follows:
  - 2> for the concerned SI message, determine the number  $n$  which corresponds to the order of entry in the list of SI messages configured by *schedulingInfoList* in *si-SchedulingInfo* in *SIB1*;
  - 2> determine the integer value  $x = (n - 1) \times w$ , where  $w$  is the *si-WindowLength*;
  - 2> the SI-window starts at the slot  $\#a$ , where  $a = x \bmod N$ , in the radio frame for which  $\text{SFN} \bmod T = \text{FLOOR}(x/N)$ , where  $T$  is the *si-Periodicity* of the concerned SI message and  $N$  is the number of slots in a radio frame as specified in TS 38.213 [13];
- 1> receive the PDCCH containing the scheduling RNTI, i.e. SI-RNTI in the PDCCH monitoring occasion(s) for SI message acquisition, from the start of the SI-window and continue until the end of the SI-window whose absolute length in time is given by *si-WindowLength*, or until the SI message was received;
- 1> if the SI message was not received by the end of the SI-window, repeat reception at the next SI-window occasion for the concerned SI message in the current modification period;

NOTE 1: The UE is only required to acquire broadcasted SI message if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.

NOTE 2: The UE is not required to monitor PDCCH monitoring occasion(s) corresponding to each transmitted SSB in SI-window.

NOTE 3: If the concerned SI message was not received in the current modification period, handling of SI message acquisition is left to UE implementation.

- 1> perform the actions for the acquired SI message as specified in sub-clause 5.2.2.4.

### 5.2.2.3.3 Request for on demand system information

The UE shall:

- 1> if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfigSUL* and criteria to select supplementary uplink as defined in TS 38.321[13], clause 5.1.1 is met:
  - 2> trigger the lower layer to initiate the Random Access procedure on supplementary uplink in accordance with [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfigSUL* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;
  - 2> if acknowledgement for SI request is received from lower layers:

- 3> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2, immediately;
- 1> else if *SIB1* includes *si-SchedulingInfo* containing *si-RequestConfig* and criteria to select normal uplink as defined in TS 38.321[13], clause 5.1.1 is met:
  - 2> trigger the lower layer to initiate the random access procedure on normal uplink in accordance with TS 38.321 [3] using the PRACH preamble(s) and PRACH resource(s) in *si-RequestConfig* corresponding to the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*;
  - 2> if acknowledgement for SI request is received from lower layers:
    - 3> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2, immediately;
- 1> else:
  - 2> apply the *timeAlignmentTimerCommon* included in *SIB1*;
  - 2> apply the CCCH configuration as specified in 9.1.1.2;
  - 2> initiate transmission of the *RRCSystemInfoRequest* message in accordance with 5.2.2.3.4;
  - 2> if acknowledgement for *RRCSystemInfoRequest* message is received from lower layers:
    - 3> acquire the requested SI message(s) as defined in sub-clause 5.2.2.3.2, immediately;
- 1> if cell reselection occurs while waiting for the acknowledgment for SI request from lower layers:
  - 2> reset MAC;
  - 2> if SI request is based on *RRCSystemInfoRequest* message:
    - 3> release RLC entity for SRB0.

NOTE: After RACH failure for SI request it is up to UE implementation when to retry the SI request.

#### 5.2.2.3.4 Actions related to transmission of *RRCSystemInfoRequest* message

The UE shall set the contents of *RRCSystemInfoRequest* message as follows:

- 1> set the *requested-SI-List* to indicate the SI message(s) that the UE requires to operate within the cell, and for which *si-BroadcastStatus* is set to *notBroadcasting*.

The UE shall submit the *RRCSystemInfoRequest* message to lower layers for transmission.

#### 5.2.2.4 Actions upon receipt of System Information

##### 5.2.2.4.1 Actions upon reception of the *MIB*

Upon receiving the *MIB* the UE shall:

- 1> store the acquired *MIB*;
- 1> if the UE is in RRC\_IDLE or in RRC\_INACTIVE, or if the UE is in RRC\_CONNECTED while *T311* is running:
  - 2> if the *cellBarred* in the acquired *MIB* is set to *barred*:
    - 3> consider the cell as barred in accordance with TS 38.304 [20];
    - 3> if *intraFreqReselection* is set to *notAllowed*:
      - 4> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20].
- 3> else:

4> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20].

2> else:

3> apply the received *systemFrameNumber*, *pdccch-ConfigSIB1*, *subCarrierSpacingCommon*, *ssb-SubcarrierOffset* and *dmrs-TypeA-Position*.

#### 5.2.2.4.2 Actions upon reception of the *SIB1*

Upon receiving the *SIB1* the UE shall:

1> store the acquired *SIB1*;

1> if the *cellAccessRelatedInfo* contains an entry with the *PLMN-Identity* of the selected PLMN:

2> in the remainder of the procedures use *plmn-IdentityList*, *trackingAreaCode*, and *cellIdentity* for the cell as received in the corresponding *PLMN-IdentityInfo* containing the selected PLMN;

1> if in RRC\_CONNECTED while T311 is not running:

2> disregard the *frequencyBandList*, if received, while in RRC\_CONNECTED;

2> forward the *cellIdentity* to upper layers;

2> forward the *trackingAreaCode* to upper layers;

2> apply the configuration included in the *-servingCellConfigCommon*;

1> else:

2> if the UE supports one or more of the frequency bands indicated in the *frequencyBandList* for downlink, and one or more of the frequency bands indicated in the *frequencyBandList* for uplink for FDD, and they are not downlink only bands, and

2> if the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* for a supported band in the downlink and a supported band in uplink for FDD, and

2> if the UE supports the bandwidth of the initial uplink BWP and of the initial downlink BWPs indicated in the *locationAndBandwidth* fields in *uplinkConfigCommon*:

3> select the first frequency band in the *frequencyBandList* which the UE supports and for which the UE supports at least one of the *additionalSpectrumEmission* values in *nr-NS-PmaxList*, if present;

3> forward the *cellIdentity* to upper layers;

3> if *trackingAreaCode* is not provided for the selected PLMN nor the registered PLMN nor PLMN of the equivalent PLMN list:

4> consider the cell as barred in accordance with TS 38.304 [20];

4> if *intraFreqReselection* is set to notAllowed:

5> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20];

4> else:

5> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20];

3> else:

4> forward the *trackingAreaCode* to upper layers;

3> forward the PLMN identity to upper layers;



- 3> if in RRC\_INACTIVE and the forwarded information does not trigger message transmission by upper layers:
  - 4> if the serving cell does not belong to the configured *ran-NotificationAreaInfo*:
    - 5> initiate an RNA update as specified in 5.3.13.8;
- 3> forward the *ims-EmergencySupport* to upper layers, if present;
- 3> forward the *uac-AccessCategoryI-SelectionAssistanceInfo* to upper layers, if present;
- 3> apply the configuration included in the *servingCellConfigCommon*;
- 3> apply the specified PCCH configuration defined in 9.1.1.3;
- 3> if the UE has a stored valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, that the UE requires to operate within the cell in accordance with sub-clause 5.2.2.1:
  - 4> use the stored version of the required SIB;
- 3> if the UE has not stored a valid version of a SIB, in accordance with sub-clause 5.2.2.2.1, of one or several required SIB(s), in accordance with sub-clause 5.2.2.1:
  - 4> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to *broadcasting*:
    - 5> acquire the SI message(s) as defined in sub-clause 5.2.2.3.2;
  - 4> for the SI message(s) that, according to the *si-SchedulingInfo*, contain at least one required SIB and for which *si-BroadcastStatus* is set to *notBroadcasting*:
    - 5> trigger a request to acquire the SI message(s) as defined in sub-clause 5.2.2.3.3;
- 3> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList* in *uplinkConfigCommon*;
- 3> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:
  - 4> apply the *additionalPmax* in *uplinkConfigCommon* for UL;
- 3> else:
  - 4> apply the *p-Max* in *uplinkConfigCommon* for UL;
- 3> if *supplementaryUplink* is present in *servingCellConfigCommon*; and
- 3> if the UE supports one or more of the frequency bands indicated in the *frequencyBandList* of supplementary uplink; and
- 3> if the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* for a supported supplementary uplink band; and
- 3> if the UE supports the bandwidth of the initial uplink BWP indicated in the *locationAndBandwidth* fields of supplementary uplink:
  - 4> consider supplementary uplink as configured in the serving cell;
  - 4> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList* for the *supplementaryUplink*;
  - 4> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList* for the *supplementaryUplink*:
    - 5> apply the *additionalPmax* in *supplementaryUplink* for SUL;
- 4> else:

5> apply the *p-Max* in *supplementaryUplink* for SUL;

2> else:

3> consider the cell as barred in accordance with TS 38.304 [20]; and

3> perform barring as if *intraFreqReselection* is set to *notAllowed*;

#### 5.2.2.4.3 Actions upon reception of *SIB2*

Upon receiving *SIB2*, the UE shall:

1> if in *RRC\_IDLE* or in *RRC\_INACTIVE* or in *RRC\_CONNECTED* while T311 is running:

2> if, for the frequency band selected by the UE (from the procedure in clause 5.2.2.4.2) to represent the serving cell's carrier frequency, the *frequencyBandList* is present in *SIB2*, the *frequencyBandListSUL* is present in *SIB2* for supplementary uplink, if configured, and the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* within the *frequencyBandList*:

3> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList*;

3> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:

4> apply the *additionalPmax*;

3> else:

4> apply the *p-Max*;

2> else:

3> apply the *p-Max*;

#### 5.2.2.4.4 Actions upon reception of *SIB3*

No UE requirements related to the contents of this *SIB3* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

#### 5.2.2.4.5 Actions upon reception of *SIB4*

Upon receiving *SIB4* the UE shall:

1> if in *RRC\_IDLE*, or in *RRC\_INACTIVE* or in *RRC\_CONNECTED* while T311 is running:

2> for each entry in the *interFreqCarrierFreqList*:

3> select the first frequency band in the *frequencyBandList*, and *frequencyBandListSUL*, if present, which the UE supports and for which the UE supports at least one of the *additionalSpectrumEmission* values in *NR-NS-PmaxList*, if present:

3> if, the frequency band selected by the UE to represent a non-serving NR carrier frequency is not a downlink only band:

4> if, for the selected frequency band, the *frequencyBandListSUL* is present in *SIB4* for supplementary uplink, if configured, and the UE supports at least one *additionalSpectrumEmission* in the *NR-NS-PmaxList* within the *frequencyBandList*:

5> apply the first listed *additionalSpectrumEmission* which it supports among the values included in *NR-NS-PmaxList* within *frequencyBandList*;

5> if the *additionalPmax* is present in the same entry of the selected *additionalSpectrumEmission* within *NR-NS-PmaxList*:

- 6> apply the *additionalPmax*;
- 5> else:
  - 6> apply the *p-Max*;
- 4> else:
  - 5> apply the *p-Max*;

#### 5.2.2.4.6 Actions upon reception of *SIB5*

No UE requirements related to the contents of this *SIB5* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

#### 5.2.2.4.7 Actions upon reception of *SIB6*

Upon receiving the *SIB6* the UE shall:

- 1> forward the received *warningType*, *messageIdentifier* and *serialNumber* to upper layers;

#### 5.2.2.4.8 Actions upon reception of *SIB7*

Upon receiving the *SIB7* the UE shall:

- 1> if there is no current value for *messageIdentifier* and *serialNumber* for *SIB7*; or
- 1> if either the received value of *messageIdentifier* or of *serialNumber*, or of both *messageIdentifier* and *serialNumber* are different from the current values of *messageIdentifier* and *serialNumber* for *SIB7*:
  - 2> use the received values of *messageIdentifier* and *serialNumber* for *SIB7* as the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
  - 2> discard any previously buffered *warningMessageSegment*;
  - 2> if all segments of a warning message have been received:
    - 3> assemble the warning message from the received *warningMessageSegment(s)*;
    - 3> forward the received warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;
    - 3> stop reception of *SIB7*;
    - 3> discard the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
  - 2> else:
    - 3> store the received *warningMessageSegment*;
    - 3> continue reception of *SIB7*;
- 1> else if all segments of a warning message have been received:
  - 2> assemble the warning message from the received *warningMessageSegment(s)*;
  - 2> forward the received complete warning message, *messageIdentifier*, *serialNumber* and *dataCodingScheme* to upper layers;
  - 2> stop reception of *SIB7*;
  - 2> discard the current values of *messageIdentifier* and *serialNumber* for *SIB7*;
- 1> else:
  - 2> store the received *warningMessageSegment*;

- 2> continue reception of *SIB7*;

The UE should discard any stored *warningMessageSegment* and the current value of *messageIdentifier* and *serialNumber* for *SIB7* if the complete warning message has not been assembled within a period of 3 hours.

#### 5.2.2.4.9 Actions upon reception of *SIB8*

Upon receiving the *SIB8* the UE shall:

- 1> if the *SIB8* contains a complete warning message and the complete geographical area coordinates (if any):
  - 2> forward the received warning message, *messageIdentifier*, *serialNumber*, *dataCodingScheme* and the geographical area coordinates (if any) to upper layers;
  - 2> continue reception of *SIB8*;
- 1> else:
  - 2> if the received values of *messageIdentifier* and *serialNumber* are the same (each value is the same) as a pair for which a warning message and the geographical area coordinates (if any) are currently being assembled:
    - 3> store the received *warningMessageSegment*;
    - 3> store the received *warningAreaCoordinatesSegment* (if any);
    - 3> if all segments of a warning message and geographical area coordinates (if any) have been received:
      - 4> assemble the warning message from the received *warningMessageSegment*;
      - 4> assemble the geographical area coordinates from the received *warningAreaCoordinatesSegment* (if any);
      - 4> forward the received warning message, *messageIdentifier*, *serialNumber*, *dataCodingScheme* and geographical area coordinates (if any) to upper layers;
      - 4> stop assembling a warning message and geographical area coordinates (if any) for this *messageIdentifier* and *serialNumber* and delete all stored information held for it;
    - 3> continue reception of *SIB8*;
  - 2> else if the received values of *messageIdentifier* and/or *serialNumber* are not the same as any of the pairs for which a warning message is currently being assembled:
    - 3> start assembling a warning message for this *messageIdentifier* and *serialNumber* pair;
    - 3> start assembling the geographical area coordinates (if any) for this *messageIdentifier* and *serialNumber* pair;
    - 3> store the received *warningMessageSegment*;
    - 3> store the received *warningAreaCoordinatesSegment* (if any);
    - 3> continue reception of *SIB8*;

The UE should discard *warningMessageSegment* and *warningAreaCoordinatesSegment* (if any) and the associated values of *messageIdentifier* and *serialNumber* for *SIB8* if the complete warning message and the geographical area coordinates (if any) have not been assembled within a period of 3 hours.

NOTE: The number of warning messages that a UE can re-assemble simultaneously is a function of UE implementation.

#### 5.2.2.4.10 Actions upon reception of *SIB9*

No UE requirements related to the contents of this *SIB9* apply other than those specified elsewhere e.g. within procedures using the concerned system information, and/ or within the corresponding field descriptions.

### 5.2.2.5 Essential system information missing

The UE shall:

- 1> if in RRC\_IDLE or in RRC\_INACTIVE or in RRC\_CONNECTED while T311 is running:
  - 2> if the UE is unable to acquire the *MIB*:
    - 3> consider the cell as barred in accordance with TS 38.304 [20]; and
    - 3> perform barring as if *intraFreqReselection* is set to allowed;
  - 2> else if the UE is unable to acquire the *SIB1*:
    - 3> consider the cell as barred in accordance with TS 38.304 [20].
    - 3> if *intraFreqReselection* in *MIB* is set to *notAllowed*:
      - 4> consider cell re-selection to other cells on the same frequency as the barred cell as not allowed, as specified in TS 38.304 [20].
  - 3> else:
    - 4> consider cell re-selection to other cells on the same frequency as the barred cell as allowed, as specified in TS 38.304 [20].

## 5.3 Connection control

### 5.3.1 Introduction

#### 5.3.1.1 RRC connection control

RRC connection establishment involves the establishment of SRB1. The network completes RRC connection establishment prior to completing the establishment of the NG connection, i.e. prior to receiving the UE context information from the 5GC. Consequently, AS security is not activated during the initial phase of the RRC connection. During this initial phase of the RRC connection, the network may configure the UE to perform measurement reporting, but the UE only sends the corresponding measurement reports after successful AS security activation. However, the UE only accepts a re-configuration with sync message when AS security has been activated.

Upon receiving the UE context from the 5GC, the RAN activates AS security (both ciphering and integrity protection) using the initial AS security activation procedure. The RRC messages to activate AS security (command and successful response) are integrity protected, while ciphering is started only after completion of the procedure. That is, the response to the message used to activate AS security is not ciphered, while the subsequent messages (e.g. used to establish SRB2 and DRBs) are both integrity protected and ciphered. After having initiated the initial AS security activation procedure, the network may initiate the establishment of SRB2 and DRBs, i.e. the network may do this prior to receiving the confirmation of the initial AS security activation from the UE. In any case, the network will apply both ciphering and integrity protection for the RRC reconfiguration messages used to establish SRB2 and DRBs. The network should release the RRC connection if the initial AS security activation and/ or the radio bearer establishment fails.

The release of the RRC connection normally is initiated by the network. The procedure may be used to re-direct the UE to an NR frequency or an E-UTRA carrier frequency.

The suspension of the RRC connection is initiated by the network. When the RRC connection is suspended, the UE stores the UE Inactive AS context and any configuration received from the network, and transits to RRC\_INACTIVE state. If the UE is configured with SCG, the UE releases the SCG configuration upon initiating a RRC Connection Resume procedure. The RRC message to suspend the RRC connection is integrity protected and ciphered.

The resumption of a suspended RRC connection is initiated by upper layers when the UE needs to transit from RRC\_INACTIVE state to RRC\_CONNECTED state or by RRC layer to perform a RNA update or by RAN paging from NG-RAN. When the RRC connection is resumed, network configures the UE according to the RRC connection resume procedure based on the stored UE Inactive AS context and any RRC configuration received from the network. The RRC connection resume procedure re-activates AS security and re-establishes SRB(s) and DRB(s).

In response to a request to resume the RRC connection, the network may resume the suspended RRC connection and send UE to RRC\_CONNECTED, or reject the request to resume and send UE to RRC\_INACTIVE (with a wait timer), or directly re-suspend the RRC connection and send UE to RRC\_INACTIVE, or directly release the RRC connection and send UE to RRC\_IDLE, or instruct the UE to initiate NAS level recovery (in this case the network sends an RRC setup message).

### 5.3.1.2 AS Security

AS security comprises of the integrity protection and ciphering of RRC signalling (SRBs) and user data (DRBs).

RRC handles the configuration of the AS security parameters which are part of the AS configuration: the integrity protection algorithm, the ciphering algorithm, if integrity protection and/or ciphering is enabled for a DRB and two parameters, namely the *keySetChangeIndicator* and the *nextHopChainingCount*, which are used by the UE to determine the AS security keys upon reconfiguration with sync (with key change), connection re-establishment and/or connection resume.

The integrity protection and ciphering algorithm is common for signalling radio bearers SRB1 and SRB2. When not configured with any kind of MR-DC, the ciphering and integrity protection algorithm is common for all radio bearers (i.e. SRB1, SRB2 and DRBs). All DRBs related to the same PDU session have the same AS security configuration. For MR-DC, integrity protection is not enabled for DRBs terminated in eNB. Neither integrity protection nor ciphering applies for SRB0.

RRC integrity protection and ciphering are always activated together, i.e. in one message/procedure. RRC integrity protection and ciphering for SRBs are never de-activated. However, it is possible to switch to a 'NULL' ciphering algorithm (*nea0*).

The 'NULL' integrity protection algorithm (*nia0*) is used only for SRBs and for the UE in limited service mode, see TS 33.501 [11] and when used for SRBs, integrity protection is disabled for DRBs. In case the 'NULL' integrity protection algorithm is used, 'NULL' ciphering algorithm is also used.

NOTE 1: Lower layers discard RRC messages for which the integrity protection check has failed and indicate the integrity protection verification check failure to RRC.

The AS applies four different security keys: one for the integrity protection of RRC signalling ( $K_{\text{RRCint}}$ ), one for the ciphering of RRC signalling ( $K_{\text{RRCenc}}$ ), one for integrity protection of user data ( $K_{\text{UPint}}$ ) and one for the ciphering of user data ( $K_{\text{UPenc}}$ ). All four AS keys are derived from the  $K_{\text{gNB}}$  key. The  $K_{\text{gNB}}$  key is based on the  $K_{\text{AMF}}$  key (as specified in TS 33.501 [11]), which is handled by upper layers.

The integrity protection and ciphering algorithms can only be changed with reconfiguration with sync. The AS keys ( $K_{\text{gNB}}$ ,  $K_{\text{RRCint}}$ ,  $K_{\text{RRCenc}}$ ,  $K_{\text{UPint}}$  and  $K_{\text{UPenc}}$ ) change upon reconfiguration with sync (if *masterKeyUpdate* is included), and upon connection re-establishment and connection resume.

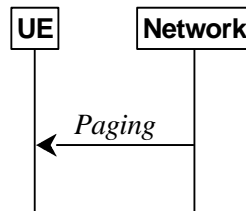
For each radio bearer an independent counter (*COUNT*, as specified in TS 38.323 [5]) is maintained for each direction. For each radio bearer, the *COUNT* is used as input for ciphering and integrity protection. It is not allowed to use the same *COUNT* value more than once for a given security key. In order to limit the signalling overhead, individual messages/ packets include a short sequence number (PDCP SN, as specified in TS 38.323 [5]). In addition, an overflow counter mechanism is used: the hyper frame number (*TX\_HFN* and *RX\_HFN*, as specified in TS 38.323 [5]). The HFN needs to be synchronized between the UE and the network. The network is responsible for avoiding reuse of the *COUNT* with the same RB identity and with the same key, e.g. due to the transfer of large volumes of data, release and establishment of new RBs, and multiple termination point changes for RLC-UM bearers. In order to avoid such re-use, the network may e.g. use different RB identities for RB establishments, change the AS security key, or an RRC\_CONNECTED to RRC\_IDLE/RRC\_INACTIVE and then to RRC\_CONNECTED transition.

For each SRB, the value provided by RRC to lower layers to derive the 5-bit BEARER parameter used as input for ciphering and for integrity protection is the value of the corresponding *srb-Identity* with the MSBs padded with zeroes.

For a UE provided with an *sk-counter*, *keyToUse* indicates whether the UE uses the master key ( $K_{\text{gNB}}$ ) or the secondary key ( $S\text{-}K_{\text{gNB}}$  or  $S\text{-}K_{\text{gNB}}$ ) for a particular DRB. The secondary key is derived from the master key and *sk-Counter*, as defined in 33.501[86]. Whenever there is a need to refresh the secondary key, e.g. upon change of MN with  $K_{\text{gNB}}$  change or to avoid COUNT wrap around, the security key update is used (see 5.3.5.7). When the UE is in NR-DC, the network may provide a UE configured with an SCG with an *sk-Counter* even when no DRB is setup using the secondary key ( $S\text{-}K_{\text{gNB}}$ ) in order to allow the configuration of SRB3. The network can also provide the UE with an *sk-Counter*, even if no SCG is configured, when using SN terminated MCG bearers.

## 5.3.2 Paging

### 5.3.2.1 General



**Figure 5.3.2.1-1: Paging**

The purpose of this procedure is:

- to transmit paging information to a UE in RRC\_IDLE or RRC\_INACTIVE.

### 5.3.2.2 Initiation

The network initiates the paging procedure by transmitting the *Paging* message at the UE's paging occasion as specified in TS 38.304 [20]. The network may address multiple UEs within a *Paging* message by including one *PagingRecord* for each UE.

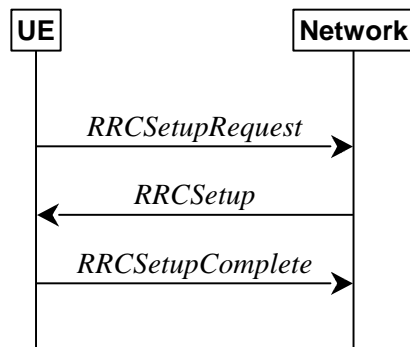
### 5.3.2.3 Reception of the *Paging* message by the UE

Upon receiving the *Paging* message, the UE shall:

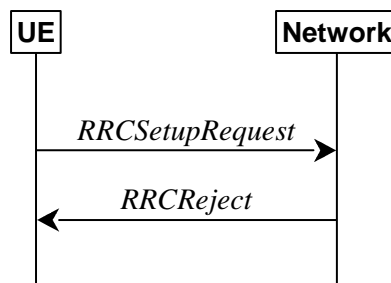
- 1> if in RRC\_IDLE, for each of the *PagingRecord*, if any, included in the *Paging* message:
  - 2> if the *ue-Identity* included in the *PagingRecord* matches the UE identity allocated by upper layers:
    - 3> forward the *ue-Identity* and *accessType* (if present) to the upper layers;
- 1> if in RRC\_INACTIVE, for each of the *PagingRecord*, if any, included in the *Paging* message:
  - 2> if the *ue-Identity* included in the *PagingRecord* matches the UE's stored *fullI-RNTI*:
    - 3> if the UE is configured by upper layers with Access Identity 1:
      - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mps-PriorityAccess*;
    - 3> else if the UE is configured by upper layers with Access Identity 2:
      - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mcs-PriorityAccess*;
    - 3> else if the UE is configured by upper layers with one or more Access Identities equal to 11-15:
      - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *highPriorityAccess*;
    - 3> else:
      - 4> initiate the RRC connection resumption procedure according to 5.3.13 with *resumeCause* set to *mt-Access*;
  - 2> else if the *ue-Identity* included in the *PagingRecord* matches the UE identity allocated by upper layers:
    - 3> forward the *ue-Identity* to upper layers and *accessType* (if present) to the upper layers;
    - 3> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'other'.

### 5.3.3 RRC connection establishment

#### 5.3.3.1 General



**Figure 5.3.3.1-1: RRC connection establishment, successful**



**Figure 5.3.3.1-2: RRC connection establishment, network reject**

The purpose of this procedure is to establish an RRC connection. RRC connection establishment involves SRB1 establishment. The procedure is also used to transfer the initial NAS dedicated information/ message from the UE to the network.

The network applies the procedure e.g.as follows:

- When establishing an RRC connection;
- When UE is resuming or re-establishing an RRC connection, and the network is not able to retrieve or verify the UE context. In this case, UE receives *RRCSetup* and responds with *RRCSetupComplete*.

#### 5.3.3.2 Initiation

The UE initiates the procedure when upper layers request establishment of an RRC connection while the UE is in RRC\_IDLE and it has acquired essential system information as described in 5.2.2.1.

The UE shall ensure having valid and up to date essential system information as specified in clause 5.2.2.2 before initiating this procedure.

Upon initiation of the procedure, the UE shall:

- 1> if the upper layers provide an Access Category and one or more Access Identities upon requesting establishment of an RRC connection:
  - 2> perform the unified access control procedure as specified in 5.3.14 using the Access Category and Access Identities provided by upper layers;
  - 3> if the access attempt is barred, the procedure ends;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;



- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> apply the CCCH configuration as specified in 9.1.1.2;
- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> start timer T300;
- 1> initiate transmission of the *RRCSetupRequest* message in accordance with 5.3.3.3;

### 5.3.3.3 Actions related to transmission of *RRCSetupRequest* message

The UE shall set the contents of *RRCSetupRequest* message as follows:

- 1> set the *ue-Identity* as follows:
  - 2> if upper layers provide a 5G-S-TMSI:
    - 3> set the *ue-Identity* to *ng-5G-S-TMSI-Part1*;
  - 2> else:
    - 3> draw a 39-bit random value in the range  $0..2^{39}-1$  and set the *ue-Identity* to this value;

NOTE 1: Upper layers provide the *5G-S-TMSI* if the UE is registered in the TA of the current cell.

- 1> set the *establishmentCause* in accordance with the information received from upper layers;

The UE shall submit the *RRCSetupRequest* message to lower layers for transmission.

The UE shall continue cell re-selection related measurements as well as cell re-selection evaluation. If the conditions for cell re-selection are fulfilled, the UE shall perform cell re-selection as specified in 5.3.3.6.

### 5.3.3.4 Reception of the *RRCSetup* by the UE

The UE shall perform the following actions upon reception of the *RRCSetup*:

- 1> if the *RRCSetup* is received in response to an *RRCReestablishmentRequest*; or
- 1> if the *RRCSetup* is received in response to an *RRCResumeRequest* or *RRCResumeRequest1*:
  - 2> discard any stored UE Inactive AS context and *suspendConfig*;
  - 2> discard any current AS security context including the  $K_{RRCEnc}$  key, the  $K_{RRCint}$  key, the  $K_{UPint}$  key and the  $K_{UPenc}$  key;
  - 2> release radio resources for all established RBs except SRB0, including release of the RLC entities, of the associated PDCP entities and of SDAP;
  - 2> release the RRC configuration except for the default L1 parameter values, default MAC Cell Group configuration and CCCH configuration;
  - 2> indicate to upper layers fallback of the RRC connection;
  - 2> stop timer T380, if running;
- 1> perform the cell group configuration procedure in accordance with the received *masterCellGroup* and as specified in 5.3.5.5;
- 1> perform the radio bearer configuration procedure in accordance with the received *radioBearerConfig* and as specified in 5.3.5.6;
- 1> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
- 1> stop timer T300, T301 or T319 if running;

- 1> if T390 is running:
  - 2> stop timer T390 for all access categories;
  - 2> perform the actions as specified in 5.3.14.4;
- 1> if T302 is running:
  - 2> stop timer T302;
  - 2> perform the actions as specified in 5.3.14.4;
- 1> stop timer T320, if running;
- 1> if the *RRCSetup* is received in response to an *RRCResumeRequest*, *RRCResumeRequest1* or *RRCSetupRequest*:
  - 2> enter *RRC\_CONNECTED*;
  - 2> stop the cell re-selection procedure;
- 1> consider the current cell to be the PCell;
- 1> set the content of *RRCSetupComplete* message as follows:
  - 2> if upper layers provide a 5G-S-TMSI:
    - 3> if the *RRCSetup* is received in response to an *RRCSetupRequest*:
      - 4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI-Part2*;
    - 3> else:
      - 4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI*;
  - 2> set the *selectedPLMN-Identity* to the PLMN selected by upper layers (TS 24.501 [23]) from the PLMN(s) included in the *plmn-IdentityList* in *SIB1*;
  - 2> if upper layers provide the 'Registered AMF':
    - 3> include and set the *registeredAMF* as follows:
      - 4> if the PLMN identity of the 'Registered AMF' is different from the PLMN selected by the upper layers:
        - 5> include the *plmnIdentity* in the *registeredAMF* and set it to the value of the PLMN identity in the 'Registered AMF' received from upper layers;
      - 4> set the *amf-Identifier* to the value received from upper layers;
    - 3> include and set the *guami-Type* to the value provided by the upper layers;
  - 2> if upper layers provide one or more S-NSSAI (see TS 23.003 [21]):
    - 3> include the *s-NSSAI-List* and set the content to the values provided by the upper layers;
    - 2> set the *dedicatedNAS-Message* to include the information received from upper layers;
- 1> submit the *RRCSetupComplete* message to lower layers for transmission, upon which the procedure ends

### 5.3.3.5 Reception of the *RRCReject* by the UE

The UE shall:

- 1> perform the actions as specified in 5.3.15;

### 5.3.3.6 Cell re-selection or cell selection while T390, T300 or T302 is running (UE in RRC\_IDLE)

The UE shall:

- 1> if cell reselection occurs while T300 or T302 is running:
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'RRC connection failure';
- 1> else if cell selection or reselection occurs while T390 is running:
  - 2> stop T390 for all access categories;
  - 2> perform the actions as specified in 5.3.14.4.

### 5.3.3.7 T300 expiry

The UE shall:

- 1> if timer T300 expires:
  - 2> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;
- 2> if the T300 has expired a consecutive *connEstFailCount* times on the same cell for which *connEstFailureControl* is included in *SIB1*:
  - 3> for a period as indicated by *connEstFailOffsetValidity*:
    - 4> use *connEstFailOffset* for the parameter *Qoffsettemp* for the concerned cell when performing cell selection and reselection according to TS 38.304 [20] and TS 36.304 [27];

NOTE: When performing cell selection, if no suitable or acceptable cell can be found, it is up to UE implementation whether to stop using *connEstFailOffset* for the parameter *Qoffsettemp* during *connEstFailOffsetValidity* for the concerned cell.

- 2> inform upper layers about the failure to establish the RRC connection, upon which the procedure ends;

### 5.3.3.8 Abortion of RRC connection establishment

If upper layers abort the RRC connection establishment procedure, due to a NAS procedure being aborted as specified in TS 37.324 [24], while the UE has not yet entered RRC\_CONNECTED, the UE shall:

- 1> stop timer T300, if running;
- 1> reset MAC, release the MAC configuration and re-establish RLC for all RBs that are established;

## 5.3.4 Initial AS security activation

### 5.3.4.1 General

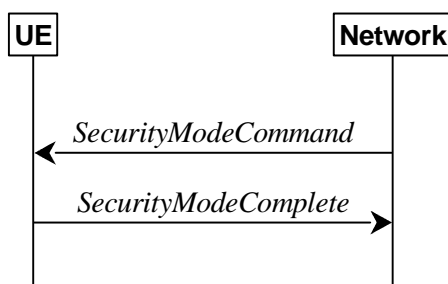
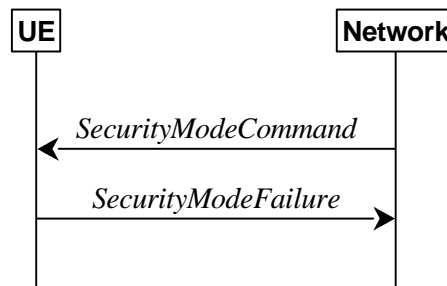


Figure 5.3.4.1-1: Security mode command, successful



**Figure 5.3.4.1-2: Security mode command, failure**

The purpose of this procedure is to activate AS security upon RRC connection establishment.

### 5.3.4.2 Initiation

The network initiates the security mode command procedure to a UE in RRC\_CONNECTED. Moreover, the network applies the procedure as follows:

- when only SRB1 is established, i.e. prior to establishment of SRB2 and/ or DRBs.

### 5.3.4.3 Reception of the *SecurityModeCommand* by the UE

The UE shall:

- 1> derive the  $K_{gNB}$  key, as specified in TS 33.501 [11];
- 1> derive the  $K_{RRcInt}$  key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
- 1> request lower layers to verify the integrity protection of the *SecurityModeCommand* message, using the algorithm indicated by the *integrityProtAlgorithm* as included in the *SecurityModeCommand* message and the  $K_{RRcInt}$  key;
- 1> if the *SecurityModeCommand* message passes the integrity protection check:
  - 2> derive the  $K_{RRcEnc}$  key and the  $K_{UPenc}$  key associated with the *cipheringAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
  - 2> derive the  $K_{UPint}$  key associated with the *integrityProtAlgorithm* indicated in the *SecurityModeCommand* message, as specified in TS 33.501 [11];
  - 2> configure lower layers to apply SRB integrity protection using the indicated algorithm and the  $K_{RRcInt}$  key immediately, i.e. integrity protection shall be applied to all subsequent messages received and sent by the UE, including the *SecurityModeComplete* message;
  - 2> configure lower layers to apply SRB ciphering using the indicated algorithm, the  $K_{RRcEnc}$  key after completing the procedure, i.e. ciphering shall be applied to all subsequent messages received and sent by the UE, except for the *SecurityModeComplete* message which is sent unciphered;
  - 2> consider AS security to be activated;
  - 2> submit the *SecurityModeComplete* message to lower layers for transmission, upon which the procedure ends;
- 1> else:
  - 2> continue using the configuration used prior to the reception of the *SecurityModeCommand* message, i.e. neither apply integrity protection nor ciphering.
  - 2> submit the *SecurityModeFailure* message to lower layers for transmission, upon which the procedure ends.

## 5.3.5 RRC reconfiguration

### 5.3.5.1 General

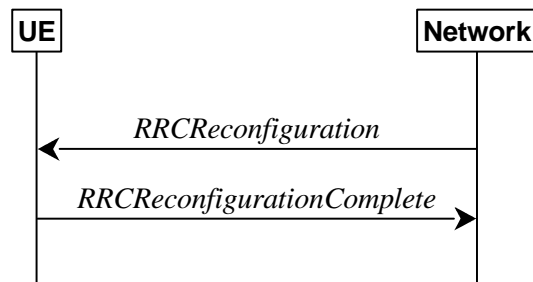


Figure 5.3.5.1-1: RRC reconfiguration, successful

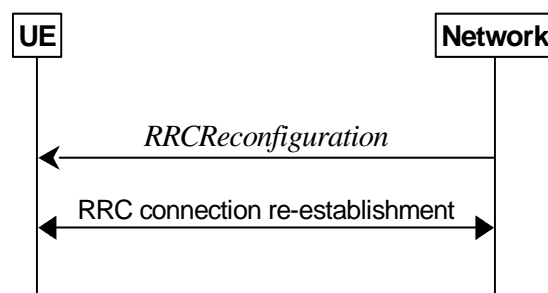


Figure 5.3.5.1-2: RRC reconfiguration, failure

The purpose of this procedure is to modify an RRC connection, e.g. to establish/modify/release RBs, to perform reconfiguration with sync, to setup/modify/release measurements, to add/modify/release SCells and cell groups. As part of the procedure, NAS dedicated information may be transferred from the Network to the UE.

RRC reconfiguration to perform reconfiguration with sync includes, but is not limited to, the following cases:

- reconfiguration with sync and security key refresh, involving RA to the PCell/PSCell, MAC reset, refresh of security and re-establishment of RLC and PDCP triggered by explicit L2 indicators;
- reconfiguration with sync but without security key refresh, involving RA to the PCell/PSCell, MAC reset and RLC re-establishment and PDCP data recovery (for AM DRB) triggered by explicit L2 indicators.

In (NG)EN-DC and NR-DC, SRB3 can be used for measurement configuration and reporting, to (re-)configure MAC, RLC, physical layer and RLF timers and constants of the SCG configuration, and to reconfigure PDCP for DRBs associated with the S-K<sub>gNB</sub> or SRB3, and to reconfigure SDAP for DRBs associated with S-K<sub>gNB</sub> in (NG)EN-DC and NR-DC, provided that the (re-)configuration does not require any MN involvement. In EN-DC, only *measConfig*, *radioBearerConfig* and/or *secondaryCellGroup* are included in *RRCReconfiguration* received via SRB3.

### 5.3.5.2 Initiation

The Network may initiate the RRC reconfiguration procedure to a UE in RRC\_CONNECTED. The Network applies the procedure as follows:

- the establishment of RBs (other than SRB1, that is established during RRC connection establishment) is performed only when AS security has been activated;
- the addition of Secondary Cell Group and SCells is performed only when AS security has been activated;
- the *reconfigurationWithSync* is included in *secondaryCellGroup* only when at least one DRB is setup in SCG;
- the *reconfigurationWithSync* is included in *masterCellGroup* only when AS security has been activated, and SRB2 with at least one DRB are setup and not suspended.

### 5.3.5.3 Reception of an *RRCReconfiguration* by the UE

The UE shall perform the following actions upon reception of the *RRCReconfiguration*:

- 1> if the *RRCReconfiguration* is received via other RAT (i.e., inter-RAT handover to NR):
  - 2> if the *RRCReconfiguration* does not include the *fullConfig* and the UE is connected to 5GC (i.e., delta signalling during intra 5GC handover):
    - 3> re-use the source RAT SDAP and PDCP configurations if available (i.e., current SDAP/PDCP configurations for all RBs from source E-UTRA RAT prior to the reception of the inter-RAT HO *RRCReconfiguration* message);
- 1> else:
  - 2> if the *RRCReconfiguration* includes the *fullConfig*:
    - 3> perform the full configuration procedure as specified in 5.3.5.11;
- 1> if the *RRCReconfiguration* includes the *masterCellGroup*:
  - 2> perform the cell group configuration for the received *masterCellGroup* according to 5.3.5.5;
- 1> if the *RRCReconfiguration* includes the *masterKeyUpdate*:
  - 2> perform AS security key update procedure as specified in 5.3.5.7;
- 1> if the *RRCReconfiguration* includes the *sk-Counter*:
  - 2> perform security key update procedure as specified in 5.3.5.7;
- 1> if the *RRCReconfiguration* includes the *secondaryCellGroup*:
  - 2> perform the cell group configuration for the SCG according to 5.3.5.5;
- 1> if the *RRCReconfiguration* includes the *mrdc-SecondaryCellGroupConfig*:
  - 2> if the *mrdc-SecondaryCellGroupConfig* is set to *setup*:
    - 3> if the *mrdc-SecondaryCellGroupConfig* includes *mrdc-ReleaseAndAdd*:
      - 4> perform MR-DC release as specified in section 5.3.5.10;
    - 3> if the received *mrdc-SecondaryCellGroup* is set to *nr-SCG*:
      - 4> perform the RRC reconfiguration according to 5.3.5.3 for the *RRCReconfiguration* message included in *nr-SCG*;
    - 3> if the received *mrdc-SecondaryCellGroup* is set to *eutra-SCG*:
      - 4> perform the RRC connection reconfiguration as specified in TS 36.331 [10], clause 5.3.5.3 for the *RRCConnectionReconfiguration* message included in *eutra-SCG*;
  - 2> else (*mrdc-SecondaryCellGroupConfig* is set to *release*):
    - 3> perform MR-DC release as specified in section 5.3.5.10;
- 1> if the *RRCReconfiguration* message includes the *radioBearerConfig*:
  - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the *RRCReconfiguration* message includes the *radioBearerConfig2*:
  - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the *RRCReconfiguration* message includes the *measConfig*:
  - 2> perform the measurement configuration procedure as specified in 5.5.2;

- 1> if the *RRCReconfiguration* message includes the *dedicatedNAS-MessageList*:
  - 2> forward each element of the *dedicatedNAS-MessageList* to upper layers in the same order as listed;
- 1> if the *RRCReconfiguration* message includes the *dedicatedSIB1-Delivery*:
  - 2> perform the action upon reception of *SIB1* as specified in 5.2.2.4.2;
- 1> if the *RRCReconfiguration* message includes the *dedicatedSystemInformationDelivery*:
  - 2> perform the action upon reception of System Information as specified in 5.2.2.4;
- 1> if the *RRCReconfiguration* message includes the *otherConfig*:
  - 2> perform the other configuration procedure as specified in 5.3.5.9;
- 1> set the content of *RRCReconfigurationComplete* message as follows:
  - 2> if the *RRCReconfiguration* includes the *masterCellGroup* containing the *reportUplinkTxDirectCurrent*; or
  - 2> if the *RRCReconfiguration* includes the *secondaryCellGroup* containing the *reportUplinkTxDirectCurrent*:
    - 3> include the *uplinkTxDirectCurrentList* for each serving cell with UL;
    - 3> if UE is configured with SUL carrier:
      - 4> include *uplinkDirectCurrentBWP-SUL* for each serving cell with SUL within the *uplinkTxDirectCurrentList*;
  - 2> if the received *RRCReconfiguration* message includes the *mrdc-SecondaryCellGroupConfig* with *mrdc-SecondaryCellGroup* set to *eutra-SCG*:
    - 3> include *eutra-SCG-Response* within *scg-Response* in accordance with TS 36.331 [10] clause 5.3.5.3;
  - 2> if the received *RRCReconfiguration* message includes the *mrdc-SecondaryCellGroupConfig* with *mrdc-SecondaryCellGroup* set to *nr-SCG*:
    - 3> include *nr-SCG-Response* within *scg-Response*;
- 1> if the UE is configured with E-UTRA *nr-SecondaryCellGroupConfig* (MCG is E-UTRA):
  - 2> if *RRCReconfiguration* was received via SRB1:
    - 3> submit the *RRCReconfigurationComplete* via the E-UTRA MCG embedded in E-UTRA RRC message *RRCConnectionReconfigurationComplete* as specified in TS 36.331 [10];
    - 3> if *reconfigurationWithSync* was included in *spCellConfig* of an SCG:
      - 4> initiate the Random Access procedure on the SpCell, as specified in TS 38.321 [3];
    - 3> else:
      - 4> the procedure ends;

NOTE 1: The order the UE sends the *RRCConnectionReconfigurationComplete* message and performs the Random Access procedure towards the SCG is left to UE implementation.

- 2> else (*RRCReconfiguration* was received via SRB3):

- 3> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration;

NOTE 2: In (NG)EN-DC and NR-DC, in the case *RRCReconfiguration* is received via SRB1, the random access is triggered by RRC layer itself as there is not necessarily other UL transmission. In the case *RRCReconfiguration* is received via SRB3, the random access is triggered by the MAC layer due to arrival of *RRCReconfigurationComplete*.

- 1> else if *RRCReconfiguration* message was received within the *nr-SCG* within *mrdc-SecondaryCellGroup* (NR SCG RRC Reconfiguration):
  - 2> if *reconfigurationWithSync* was included in *spCellConfig* in *nr-SCG*:
    - 3> initiate the Random Access procedure on the PSCell, as specified in TS 38.321 [3];
  - 2> else
    - 3> the procedure ends;
- 1> else if *RRCReconfiguration* was received via SRB3:
  - 2> submit the *RRCReconfigurationComplete* message via SRB3 to lower layers for transmission using the new configuration;
- 1> else (MCG RRCReconfiguration):
  - 2> submit the *RRCReconfigurationComplete* message via SRB1 to lower layers for transmission using the new configuration;
  - 2> if this is the first *RRCReconfiguration* message after successful completion of the RRC re-establishment procedure:
    - 3> resume SRB2 and DRBs that are suspended;
- 1> if *reconfigurationWithSync* was included in *spCellConfig* of an MCG or SCG, and when MAC of an NR cell group successfully completes a Random Access procedure triggered above:
  - 2> stop timer T304 for that cell group;
  - 2> apply the parts of the CQI reporting configuration, the scheduling request configuration and the sounding RS configuration that do not require the UE to know the SFN of the respective target SpCell, if any;
  - 2> apply the parts of the measurement and the radio resource configuration that require the UE to know the SFN of the respective target SpCell (e.g. measurement gaps, periodic CQI reporting, scheduling request configuration, sounding RS configuration), if any, upon acquiring the SFN of that target SpCell;
  - 2> if the *reconfigurationWithSync* was included in *spCellConfig* of an MCG:
    - 3> if T390 is running:
      - 4> stop timer T390 for all access categories;
      - 4> perform the actions as specified in 5.3.14.4.
    - 3> if *RRCReconfiguration* does not include *dedicatedSIB1-Delivery* and
      - 3> if the active downlink BWP, which is indicated by the *firstActiveDownlinkBWP-Id* for the target SpCell of the MCG, has a common search space configured by *searchSpaceSIB1*:
        - 4> acquire the *SIB1*, which is scheduled as specified in TS 38.213 [13], of the target SpCell of the MCG;
        - 4> upon acquiring *SIB1*, perform the actions specified in clause 5.2.2.4.2;
  - 2> the procedure ends.

NOTE 3: The UE is only required to acquire broadcasted *SIB1* if the UE can acquire it without disrupting unicast data reception, i.e. the broadcast and unicast beams are quasi co-located.

#### 5.3.5.4 Secondary cell group release

The UE shall:

- 1> as a result of SCG release triggered by E-UTRA, i.e. (NG)EN-DC case or NR i.e. NR-DC case:
  - 2> reset SCG MAC, if configured;



- 2> for each RLC bearer that is part of the SCG configuration:
  - 3> perform RLC bearer release procedure as specified in 5.3.5.5.3;
- 2> release the SCG configuration;
- 2> stop timer T310 for the corresponding SpCell, if running;
- 2> stop timer T304 for the corresponding SpCell, if running.

NOTE: Release of cell group means only release of the lower layer configuration of the cell group but the *RadioBearerConfig* may not be released.

## 5.3.5.5 Cell Group configuration

### 5.3.5.5.1 General

The network configures the UE with Master Cell Group (MCG), and zero or one Secondary Cell Group (SCG). In (NG)EN-DC, the MCG is configured as specified in TS 36.331 [10], and for NE-DC, the SCG is configured as specified in TS 36.331 [10]. The network provides the configuration parameters for a cell group in the *CellGroupConfig* IE.

The UE performs the following actions based on a received *CellGroupConfig* IE:

- 1> if the *CellGroupConfig* contains the *spCellConfig* with *reconfigurationWithSync*:
  - 2> perform Reconfiguration with sync according to 5.3.5.5.2;
  - 2> resume all suspended radio bearers and resume SCG transmission for all radio bearers, if suspended;
- 1> if the *CellGroupConfig* contains the *rlc-BearerToReleaseList*:
  - 2> perform RLC bearer release as specified in 5.3.5.5.3;
- 1> if the *CellGroupConfig* contains the *rlc-BearerToAddModList*:
  - 2> perform the RLC bearer addition/modification as specified in 5.3.5.5.4;
- 1> if the *CellGroupConfig* contains the *mac-CellGroupConfig*:
  - 2> configure the MAC entity of this cell group as specified in 5.3.5.5.5;
- 1> if the *CellGroupConfig* contains the *sCellToReleaseList*:
  - 2> perform SCell release as specified in 5.3.5.5.8;
- 1> if the *CellGroupConfig* contains the *spCellConfig*:
  - 2> configure the SpCell as specified in 5.3.5.5.7;
- 1> if the *CellGroupConfig* contains the *sCellToAddModList*:
  - 2> perform SCell addition/modification as specified in 5.3.5.5.9.

### 5.3.5.5.2 Reconfiguration with sync

The UE shall perform the following actions to execute a reconfiguration with sync.

- 1> if the AS security is not activated, perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause 'other' upon which the procedure ends;
- 1> stop timer T310 for the corresponding SpCell, if running;
- 1> start timer T304 for the corresponding SpCell with the timer value set to *t304*, as included in the *reconfigurationWithSync*;

- 1> if the *frequencyInfoDL* is included:
    - 2> consider the target SpCell to be one on the SSB frequency indicated by the *frequencyInfoDL* with a physical cell identity indicated by the *physCellId*;
  - 1> else:
    - 2> consider the target SpCell to be one on the SSB frequency of the source SpCell with a physical cell identity indicated by the *physCellId*;
  - 1> start synchronising to the DL of the target SpCell;
  - 1> apply the specified BCCH configuration defined in 9.1.1.1;
  - 1> acquire the *MIB*, which is scheduled as specified in TS 38.213 [13];
- NOTE 1: The UE should perform the reconfiguration with sync as soon as possible following the reception of the RRC message triggering the reconfiguration with sync, which could be before confirming successful reception (HARQ and ARQ) of this message.
- NOTE 2: The UE may omit reading the *MIB* if the UE already has the required timing information, or the timing information is not needed for random access.
- 1> reset the MAC entity of this cell group;
  - 1> consider the SCell(s) of this cell group, if configured, to be in deactivated state;
  - 1> apply the value of the *newUE-Identity* as the C-RNTI for this cell group;
  - 1> configure lower layers in accordance with the received *spCellConfigCommon*;
  - 1> configure lower layers in accordance with any additional fields, not covered in the previous, if included in the received *reconfigurationWithSync*.

### 5.3.5.5.3 RLC bearer release

The UE shall:

- 1> for each *logicalChannelIdentity* value included in the *rlc-BearerToReleaseList* that is part of the current UE configuration within the same cell group (LCH release); or
- 1> for each *logicalChannelIdentity* value that is to be released as the result of an SCG release according to 5.3.5.4:
  - 2> release the RLC entity or entities as specified in TS 38.322 [4], clause 5.1.3;
  - 2> release the corresponding logical channel.

### 5.3.5.5.4 RLC bearer addition/modification

For each *RLC-BearerConfig* received in the *rlc-BearerToAddModList* IE the UE shall:

- 1> if the UE's current configuration contains an RLC bearer with the received *logicalChannelIdentity* within the same cell group:
  - 2> if *reestablishRLC* is received:
    - 3> re-establish the RLC entity as specified in TS 38.322 [4];
  - 2> reconfigure the RLC entity or entities in accordance with the received *rlc-Config*;
  - 2> reconfigure the logical channel in accordance with the received *mac-LogicalChannelConfig*;

NOTE: The network does not re-associate an already configured logical channel with another radio bearer. Hence *servedRadioBearer* is not present in this case.

- 1> else (a logical channel with the given *logicalChannelIdentity* was not configured before within the same cell group):
  - 2> if the *servedRadioBearer* associates the logical channel with an SRB and *rlc-Config* is not included:
    - 3> establish an RLC entity in accordance with the default configuration defined in 9.2 for the corresponding SRB;
  - 2> else:
    - 3> establish an RLC entity in accordance with the received *rlc-Config*;
  - 2> if the *servedRadioBearer* associates the logical channel with an SRB and if *mac-LogicalChannelConfig* is not included:
    - 3> configure this MAC entity with a logical channel in accordance to the default configuration defined in 9.2 for the corresponding SRB;
  - 2> else:
    - 3> configure this MAC entity with a logical channel in accordance to the received *mac-LogicalChannelConfig*;
  - 2> associate this logical channel with the PDCP entity identified by *servedRadioBearer*.

#### 5.3.5.5.5 MAC entity configuration

The UE shall:

- 1> if SCG MAC is not part of the current UE configuration (i.e. SCG establishment):
  - 2> create an SCG MAC entity;
- 1> reconfigure the MAC main configuration of the cell group in accordance with the received *mac-CellGroupConfig* excluding *tag-ToReleaseList* and *tag-ToAddModList*;
- 1> if the received *mac-CellGroupConfig* includes the *tag-ToReleaseList*:
  - 2> for each *TAG-Id* value included in the *tag-ToReleaseList* that is part of the current UE configuration:
    - 3> release the TAG indicated by *TAG-Id*;
- 1> if the received *mac-CellGroupConfig* includes the *tag-ToAddModList*:
  - 2> for each *tag-Id* value included in *tag-ToAddModList* that is not part of the current UE configuration (TAG addition):
    - 3> add the TAG, corresponding to the *tag-Id*, in accordance with the received *timeAlignmentTimer*;
  - 2> for each *tag-Id* value included in *tag-ToAddModList* that is part of the current UE configuration (TAG modification):
    - 3> reconfigure the TAG, corresponding to the *tag-Id*, in accordance with the received *timeAlignmentTimer*.

#### 5.3.5.5.6 RLF Timers & Constants configuration

The UE shall:

- 1> if the received *rlf-TimersAndConstants* is set to *release*:
  - 2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;
- 1> else:
  - 2> (re-)configure the value of timers and constants in accordance with received *rlf-TimersAndConstants*;

- 2> stop timer T310 for this cell group, if running;
- 2> reset the counters N310 and N311.

#### 5.3.5.5.7 SpCell Configuration

The UE shall:

- 1> if the *SpCellConfig* contains the *rlf-TimersAndConstants*:
  - 2> configure the RLF timers and constants for this cell group as specified in 5.3.5.5.6;
- 1> else if *rlf-TimersAndConstants* is not configured for this cell group:
  - 2> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;
- 1> if the *SpCellConfig* contains *spCellConfigDedicated*:
  - 2> configure the SpCell in accordance with the *spCellConfigDedicated*;
  - 2> consider the bandwidth part indicated in *firstActiveUplinkBWP-Id* if configured to be the active uplink bandwidth part;
  - 2> consider the bandwidth part indicated in *firstActiveDownlinkBWP-Id* if configured to be the active downlink bandwidth part;
  - 2> if any of the reference signal(s) that are used for radio link monitoring are reconfigured by the received *spCellConfigDedicated*:
    - 3> stop timer T310 for the corresponding SpCell, if running;
    - 3> reset the counters N310 and N311.

#### 5.3.5.5.8 SCell Release

The UE shall:

- 1> if the release is triggered by reception of the *sCellToReleaseList*:
  - 2> for each *sCellIndex* value included in the *sCellToReleaseList*:
    - 3> if the current UE configuration includes an SCell with value *sCellIndex*:
      - 4> release the SCell.

#### 5.3.5.5.9 SCell Addition/Modification

The UE shall:

- 1> for each *sCellIndex* value included in the *sCellToAddModList* that is not part of the current UE configuration (SCell addition):
  - 2> add the SCell, corresponding to the *sCellIndex*, in accordance with the *sCellConfigCommon* and *sCellConfigDedicated*;
  - 2> configure lower layers to consider the SCell to be in deactivated state;
  - 2> for each *measId* included in the *measIdList* within *VarMeasConfig*:
    - 3> if SCells are not applicable for the associated measurement; and
    - 3> if the concerned SCell is included in *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*:

4> remove the concerned SCell from *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;

1> for each *sCellIndex* value included in the *sCellToAddModList* that is part of the current UE configuration (SCell modification):

2> modify the SCell configuration in accordance with the *sCellConfigDedicated*.

## 5.3.5.6 Radio Bearer configuration

### 5.3.5.6.1 General

The UE shall perform the following actions based on a received *RadioBearerConfig* IE:

1> if the *RadioBearerConfig* includes the *srb3-ToRelease*:

2> perform the SRB release as specified in 5.3.5.6.2;

1> if the *RadioBearerConfig* includes the *srb-ToAddModList*:

2> perform the SRB addition or reconfiguration as specified in 5.3.5.6.3;

1> if the *RadioBearerConfig* includes the *drb-ToReleaseList*:

2> perform DRB release as specified in 5.3.5.6.4;

1> if the *RadioBearerConfig* includes the *drb-ToAddModList*:

2> perform DRB addition or reconfiguration as specified in 5.3.5.6.5.

1> release all SDAP entities, if any, that have no associated DRB as specified in TS 37.324 [24] clause 5.1.2, and indicate the release of the user plane resources for PDU Sessions associated with the released SDAP entities to upper layers.

### 5.3.5.6.2 SRB release

The UE shall:

1> release the PDCP entity and the *srb-Identity* of the SRB3.

### 5.3.5.6.3 SRB addition/modification

The UE shall:

1> for each *srb-Identity* value included in the *srb-ToAddModList* that is not part of the current UE configuration (SRB establishment or reconfiguration from E-UTRA PDCP to NR PDCP):

2> establish a PDCP entity;

2> if AS security has been activated:

3> if target RAT of handover is E-UTRA/5GC; or

3> if the UE is connected to E-UTRA/5GC:

4> if the UE is capable of E-UTRA/5GC, but not capable of NGEN-DC:

5> configure the PDCP entity with the security algorithms and keys ( $K_{\text{RRCCenc}}$  and  $K_{\text{RRCCint}}$ ) configured/derived as specified in TS 36.331 [10];

4> else (i.e., UE capable of NGEN-DC):

5> configure the PDCP entity with the security algorithms according to *securityConfig* and apply the keys ( $K_{\text{RRCCenc}}$  and  $K_{\text{RRCCint}}$ ) associated with the master key ( $K_{\text{eNB}}$ ) or secondary key ( $S\text{-}K_{\text{gNB}}$ ) as indicated in *keyToUse*, if applicable;

- 3> else (i.e., UE connected to NR or UE in EN-DC):
  - 4> configure the PDCP entity with the security algorithms according to *securityConfig* and apply the keys ( $K_{RRCCenc}$  and  $K_{RRCint}$ ) associated with the master key ( $K_{eNB}/K_{gNB}$ ) or secondary key ( $S-K_{gNB}$ ) as indicated in *keyToUse*, if applicable;
- 2> if the current UE configuration as configured by E-UTRA in TS 36.331 [10] includes an SRB identified with the same *srb-Identity* value:
  - 3> associate the E-UTRA RLC entity and DCCH of this SRB with the NR PDCP entity;
  - 3> release the E-UTRA PDCP entity of this SRB;
- 2> if the *pdcp-Config* is included:
  - 3> configure the PDCP entity in accordance with the received *pdcp-Config*;
- 2> else:
  - 3> configure the PDCP entity in accordance with the default configuration defined in 9.2.1 for the corresponding SRB;
- 1> for each *srb-Identity* value included in the *srb-ToAddModList* that is part of the current UE configuration:
  - 2> if the *reestablishPDCP* is set:
    - 3> if target RAT of handover is E-UTRA/5GC; or
    - 3> if the UE is connected to E-UTRA/5GC:
      - 4> if the UE is capable of E-UTRA/5GC, but not capable of NGEN-DC:
        - 5> configure the PDCP entity to apply the integrity protection algorithm and  $K_{RRCint}$  key configured/derived as specified in TS 36.331 [10], i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
        - 5> configure the PDCP entity to apply the ciphering algorithm and  $K_{RRCCenc}$  key configured/derived as specified in TS 36.331 [10], i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
    - 4> else (i.e., a UE capable of NGEN-DC):
      - 5> configure the PDCP entity to apply the integrity protection algorithm and  $K_{RRCint}$  key associated with the master key ( $K_{eNB}$ ) or secondary key ( $S-K_{gNB}$ ), as indicated in *keyToUse*, i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
      - 5> configure the PDCP entity to apply the ciphering algorithm and  $K_{RRCCenc}$  key associated with the master key ( $K_{eNB}$ ) or secondary key ( $S-K_{gNB}$ ) as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 3> else (i.e., UE connected to NR or UE in EN-DC):
  - 4> configure the PDCP entity to apply the integrity protection algorithm and  $K_{RRCint}$  key associated with the master key ( $K_{eNB}/K_{gNB}$ ) or secondary key ( $S-K_{gNB}$ ), as indicated in *keyToUse*, i.e. the integrity protection configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
  - 4> configure the PDCP entity to apply the ciphering algorithm and  $K_{RRCCenc}$  key associated with the master key ( $K_{eNB}/K_{gNB}$ ) or secondary key ( $S-K_{gNB}$ ) as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;

- 3> re-establish the PDCP entity of this SRB as specified in TS 38.323 [5];
- 2> else, if the *discardOnPDCP* is set:
  - 3> trigger the PDCP entity to perform SDU discard as specified in TS 38.323 [5];
- 2> if the *pdcp-Config* is included:
  - 3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.

#### 5.3.5.6.4 DRB release

The UE shall:

- 1> for each *drb-Identity* value included in the *drb-ToReleaseList* that is part of the current UE configuration; or
- 1> for each *drb-Identity* value that is to be released as the result of full configuration according to 5.3.5.11:
  - 2> release the PDCP entity and the *drb-Identity*;
  - 2> if SDAP entity associated with this DRB is configured:
    - 3> indicate the release of the DRB to SDAP entity associated with this DRB (TS 37.324 [24], clause 5.3.3);
  - 2> if the DRB is associated with an *eps-BearerIdentity*:
    - 3> if a new bearer is not added either with NR or E-UTRA with same *eps-BearerIdentity*:
      - 4> indicate the release of the DRB and the *eps-BearerIdentity* of the released DRB to upper layers.

NOTE 1: The UE does not consider the message as erroneous if the *drb-ToReleaseList* includes any *drb-Identity* value that is not part of the current UE configuration.

NOTE 2: Whether or not the RLC and MAC entities associated with this PDCP entity are reset or released is determined by the *CellGroupConfig*.

#### 5.3.5.6.5 DRB addition/modification

The UE shall:

- 1> for each *drb-Identity* value included in the *drb-ToAddModList* that is not part of the current UE configuration (DRB establishment including the case when full configuration option is used):
  - 2> establish a PDCP entity and configure it in accordance with the received *pdcp-Config*;
  - 2> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
    - 3> if target RAT of handover is E-UTRA/5GC; or
    - 3> if the UE is connected to E-UTRA/5GC:
      - 4> if the UE is capable of E-UTRA/5GC but not capable of NGEN-DC:
        - 5> configure the PDCP entity with the ciphering algorithm and  $K_{UPenc}$  key configured/derived as specified in TS 36.331 [10];
      - 4> else (i.e., a UE capable of NGEN-DC):
        - 5> configure the PDCP entity with the security algorithms according to *securityConfig* and apply the keys ( $K_{UPenc}$  and  $K_{UPint}$ ) associated with the master key ( $K_{eNB}$ ) or secondary key ( $S-K_{gNB}$ ) as indicated in *keyToUse*, if applicable;
    - 3> else (i.e., UE connected to NR or UE in EN-DC):
      - 4> configure the PDCP entity with the ciphering algorithms according to *securityConfig* and apply the  $K_{UPenc}$  key associated with the master key ( $K_{eNB}/K_{gNB}$ ) or the secondary key ( $S-K_{gNB}/S-K_{eNB}$ ) as indicated in *keyToUse*;

- 2> if the PDCP entity of this DRB is configured with *integrityProtection*:
  - 3> configure the PDCP entity with the integrity protection algorithms according to *securityConfig* and apply the  $K_{UPint}$  key associated with the master ( $K_{eNB}/K_{gNB}$ ) or the secondary key ( $S-K_{gNB}/S-K_{eNB}$ ) as indicated in *keyToUse*;
- 2> if an *sdap-Config* is included:
  - 3> if an SDAP entity with the received *pdu-Session* does not exist:
    - 4> establish an SDAP entity as specified in TS 37.324 [24] clause 5.1.1;
    - 4> if an SDAP entity with the received *pdu-Session* did not exist prior to receiving this reconfiguration:
      - 5> indicate the establishment of the user plane resources for the *pdu-Session* to upper layers;
  - 3> configure the SDAP entity in accordance with the received *sdap-Config* as specified in TS 37.324 [24] and associate the DRB with the SDAP entity;
- 2> if the DRB is associated with an *eps-BearerIdentity*:
  - 3> if the DRB was configured with the same *eps-BearerIdentity* either by NR or E-UTRA prior to receiving this reconfiguration:
    - 4> associate the established DRB with the corresponding *eps-BearerIdentity*;
  - 3> else:
    - 4> indicate the establishment of the DRB(s) and the *eps-BearerIdentity* of the established DRB(s) to upper layers;
- 1> for each *drb-Identity* value included in the *drb-ToAddModList* that is part of the current UE configuration:
  - 2> if the *reestablishPDCP* is set:
    - 3> if target RAT of handover is E-UTRA/5GC; or
    - 3> if the UE is connected to E-UTRA/5GC:
      - 4> if the UE is capable of E-UTRA/5GC but not capable of NGEN-DC:
        - 5> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
          - 6> configure the PDCP entity with the ciphering algorithm and  $K_{UPenc}$  key configured/derived as specified in TS 36.331 [10], clause 5.4.2.3, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
      - 4> else (i.e., a UE capable of NGEN-DC):
        - 5> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
          - 6> configure the PDCP entity with the ciphering algorithm and  $K_{UPenc}$  key associated with the master key ( $K_{eNB}$ ) or the secondary key ( $S-K_{gNB}$ ), as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
    - 3> else (i.e., UE connected to NR or UE in EN-DC):
      - 4> if the PDCP entity of this DRB is not configured with *cipheringDisabled*:
        - 5> configure the PDCP entity with the ciphering algorithm and  $K_{UPenc}$  key associated with the master key ( $K_{eNB}/K_{gNB}$ ) or the secondary key ( $S-K_{gNB}/S-K_{eNB}$ ), as indicated in *keyToUse*, i.e. the ciphering configuration shall be applied to all subsequent PDCP PDUs received and sent by the UE;
      - 4> if the PDCP entity of this DRB is configured with *integrityProtection*:



- 5> configure the PDCP entity with the integrity protection algorithms according to *securityConfig* and apply the  $K_{UPint}$  key associated with the master key ( $K_{eNB}/K_{gNB}$ ) or the secondary key ( $S-K_{gNB}/S-K_{eNB}$ ) as indicated in *keyToUse*;
- 3> if *drb-ContinueROHC* is included in *pdcp-Config*:
  - 4> indicate to lower layer that *drb-ContinueROHC* is configured;
- 3> re-establish the PDCP entity of this DRB as specified in TS 38.323 [5], clause 5.1.2;
- 2> else, if the *recoverPDCP* is set:
  - 3> trigger the PDCP entity of this DRB to perform data recovery as specified in TS 38.323 [5];
- 2> if the *pdcp-Config* is included:
  - 3> reconfigure the PDCP entity in accordance with the received *pdcp-Config*.
- 2> if the *sdap-Config* is included:
  - 3> reconfigure the SDAP entity in accordance with the received *sdap-Config* as specified in TS37.324 [24];
  - 3> for each QFI value added in *mappedQoS-FlowsToAdd*, if the QFI value is previously configured, the QFI value is released from the old DRB;

NOTE 1: Void.

NOTE 2: When determining whether a *drb-Identity* value is part of the current UE configuration, the UE does not distinguish which *RadioBearerConfig* and *DRB-ToAddModList* that DRB was originally configured in. To re-associate a DRB with a different key ( $K_{eNB}$  to  $S-K_{gNB}$  or vice versa), the network provides the *drb-Identity* value in the (target) *drb-ToAddModList* and sets the *reestablishPDCP* flag. The network does not list the *drb-Identity* in the (source) *drb-ToReleaseList*.

NOTE 3: When setting the *reestablishPDCP* flag for a radio bearer, the network ensures that the RLC receiver entities do not deliver old PDCP PDUs to the re-established PDCP entity. It does that e.g. by triggering a reconfiguration with sync of the cell group hosting the old RLC entity or by releasing the old RLC entity.

NOTE 4: In this specification, UE configuration refers to the parameters configured by NR RRC unless otherwise stated.

NOTE 5: Ciphering and integrity protection can be enabled or disabled for a DRB. The enabling/disabling of ciphering or integrity protection can be changed only by releasing and adding the DRB.

### 5.3.5.7 AS Security key update

The UE shall:

- 1> if UE is connected to E-UTRA/EPC or E-UTRA/5GC:
  - 2> upon reception of *sk-Counter* as specified in TS 36.331 [10]:
    - 3> update the  $S-K_{gNB}$  key based on the  $K_{eNB}$  key and using the received *sk-Counter* value, as specified in TS 33.401 [30] for EN-DC, or TS 33.501 [11] for NGEN-DC;
    - 3> derive the  $K_{RRCenc}$  and  $K_{UPenc}$  keys as specified in TS 33.401 [30] for EN-DC, or TS 33.501 [11] for NGEN-DC;
    - 3> derive the  $K_{RRCint}$  and  $K_{UPint}$  keys as specified in TS 33.401 [30] for EN-DC or TS 33.501 [11] for NGEN-DC.
- 1> else:
  - 2> if the *nas-Container* is included in the received *masterKeyUpdate*:
    - 3> forward the *nas-Container* to the upper layers;
  - 2> if the *keySetChangeIndicator* is set to *true*:

- 3> derive or update the  $K_{gNB}$  key based on the  $K_{AMF}$  key, as specified in TS 33.501 [11];
- 2> else:
  - 3> derive or update the  $K_{gNB}$  key based on the current  $K_{gNB}$  key or the NH, using the *nextHopChainingCount* value indicated in the received *masterKeyUpdate*, as specified in TS 33.501 [11];
  - 2> store the *nextHopChainingCount* value;
  - 2> derive the keys associated with the  $K_{gNB}$  key as follows:
    - 3> if the *securityAlgorithmConfig* is included in *SecurityConfig*:
      - 4> derive the  $K_{RRCEnc}$  and  $K_{UPenc}$  keys associated with the *cipheringAlgorithm* indicated in the *securityAlgorithmConfig*, as specified in TS 33.501 [11];
      - 4> derive the  $K_{RRCint}$  and  $K_{UPint}$  keys associated with the *integrityProtAlgorithm* indicated in the *securityAlgorithmConfig*, as specified in TS 33.501 [11];
    - 3> else:
      - 4> derive the  $K_{RRCEnc}$  and  $K_{UPenc}$  keys associated with the current *cipheringAlgorithm*, as specified in TS 33.501 [11];
      - 4> derive the  $K_{RRCint}$  and  $K_{UPint}$  keys associated with the current *integrityProtAlgorithm*, as specified in TS 33.501 [11].

NOTE: Ciphering and integrity protection are optional to configure for the DRBs.

- 2> if the *sk-Counter* is included in the *RRCReconfiguration* message or in *RRCResume* message (UE is in NE-DC, or NR-DC, or is configured with SN terminated bearer(s)):
  - 3> derive or update the secondary key ( $S-K_{gNB}$  or  $S-K_{eNB}$ ) based on the  $K_{gNB}$  key and using the received *sk-Counter* value, as specified in TS 33.501 [11];
  - 3> derive the  $K_{RRCEnc}$  key and the  $K_{UPenc}$  key as specified in TS 33.501 [11] using the ciphering algorithms indicated in the *RadioBearerConfig* associated with the secondary key ( $S-K_{gNB}$  or  $S-K_{eNB}$ ) as indicated by *keyToUse*;
  - 3> derive the  $K_{RRCint}$  key and the  $K_{UPint}$  key as specified in TS 33.501 [11] using the integrity protection algorithms indicated in the *RadioBearerConfig* associated with the secondary key ( $S-K_{gNB}$  or  $S-K_{eNB}$ ) as indicated by *keyToUse*;

### 5.3.5.8 Reconfiguration failure

#### 5.3.5.8.1 Void

#### 5.3.5.8.2 Inability to comply with RRCReconfiguration

The UE shall:

- 1> if the UE is in (NG)EN-DC:
  - 2> if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB3;
    - 3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;
    - 3> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;
  - 2> else, if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB1;
    - 3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> initiate the connection re-establishment procedure as specified in TS 36.331 [10], clause 5.3.7, upon which the connection reconfiguration procedure ends.

1> else if *RRCReconfiguration* is received via NR (i.e., NR standalone, NE-DC, or NR-DC):

2> if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over SRB3;

NOTE 0: This case does not apply in NE-DC.

3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration error, upon which the connection reconfiguration procedure ends;

2> else if the UE is unable to comply with (part of) the configuration included in the *RRCReconfiguration* message received over the SRB1;

NOTE 0a: The compliance also covers the SCG configuration carried within octet strings e.g. field *mrdc-SecondaryCellGroupConfig*. I.e. the failure behaviour defined also applies in case the UE cannot comply with the embedded SCG configuration or with the combination of (parts of) the MCG and SCG configurations.

3> continue using the configuration used prior to the reception of *RRCReconfiguration* message;

3> if AS security has not been activated:

4> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'other'

3> else if AS security has been activated but SRB2 and at least one DRB have not been setup:

4> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure';

3> else:

4> initiate the connection re-establishment procedure as specified in 5.3.7, upon which the reconfiguration procedure ends;

1> else if *RRCReconfiguration* is received via other RAT (Handover to NR failure):

2> if the UE is unable to comply with any part of the configuration included in the *RRCReconfiguration* message:

3> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT.

NOTE 1: The UE may apply above failure handling also in case the *RRCReconfiguration* message causes a protocol error for which the generic error handling as defined in clause 10 specifies that the UE shall ignore the message.

NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/failure.

### 5.3.5.8.3 T304 expiry (Reconfiguration with sync Failure)

The UE shall:

1> if T304 of the MCG expires:

2> release dedicated preambles provided in *rach-ConfigDedicated* if configured;

2> revert back to the UE configuration used in the source PCell;

2> initiate the connection re-establishment procedure as specified in subclause 5.3.7.

NOTE 1: In the context above, "the UE configuration" includes state variables and parameters of each radio bearer.

- 1> else if T304 of a secondary cell group expires:
  - 2> release dedicated preambles provided in *rach-ConfigDedicated*, if configured;
  - 2> initiate the SCG failure information procedure as specified in subclause 5.7.3 to report SCG reconfiguration with sync failure, upon which the RRC reconfiguration procedure ends;
- 1> else if T304 expires when *RRCReconfiguration* is received via other RAT (HO to NR failure):
  - 2> reset MAC;
  - 2> perform the actions defined for this failure case as defined in the specifications applicable for the other RAT.

### 5.3.5.9 Other configuration

The UE shall:

- 1> if the received *otherConfig* includes the *delayBudgetReportingConfig*:
  - 2> if *delayBudgetReportingConfig* is set to *setup*:
    - 3> consider itself to be configured to send delay budget reports in accordance with 5.7.4;
  - 2> else:
    - 3> consider itself not to be configured to send delay budget reports and stop timer T342, if running.
- 1> if the received *otherConfig* includes the *overheatingAssistanceConfig*:
  - 2> if *overheatingAssistanceConfig* is set to *setup*:
    - 3> consider itself to be configured to provide overheating assistance information in accordance with 5.7.4;
  - 2> else:
    - 3> consider itself not to be configured to provide overheating assistance information and stop timer T345, if running;

### 5.3.5.10 MR-DC release

The UE shall:

- 1> as a result of MR-DC release triggered by E-UTRA or NR:
  - 2> release SRB3 (configured according to *radioBearerConfig*), if present, as specified in 5.3.5.6.2;
  - 2> release *measConfig* associated with SCG;
  - 2> if the UE is configured with NR SCG:
    - 3> release the SCG configuration as specified in clause 5.3.5.4;
  - 2> else if the UE is configured with E-UTRA SCG:
    - 3> release the SCG configuration as specified in TS 36.331 [10], section 5.3.10.19 to release the E-UTRA SCG;

### 5.3.5.11 Full configuration

The UE shall:

- 1> release/ clear all current dedicated radio configurations except the MCG C-RNTI and the AS security configurations associated with the master key;

NOTE 1: Radio configuration is not just the resource configuration but includes other configurations like *MeasConfig*. In case NR-DC or NE-DC is configured, this also includes the entire NR or E-UTRA SCG configuration which are released according to the MR-DC release procedure as specified in 5.3.5.10. The radio configuration does not include SRB configurations and DRB configurations as configured by *radioBearerConfig* or *radioBearerConfig2*.

1> if the *spCellConfig* in the *masterCellGroup* includes the *reconfigurationWithSync* (i.e., SpCell change):

2> release/ clear all current common radio configurations;

2> use the default values specified in 9.2.3 for timers T310, T311 and constants N310, N311;

1> else (full configuration after re-establishment or during RRC resume):

2> if *ue-TimersAndConstants* are included in the *SIB1*:

3> use values for timers T301, T310, T311 and constants N310, N311, as included in *ue-TimersAndConstants* received in *SIB1*;

2> else:

3> use the default values specified in 9.2.3 for timers T310, T311 and constants N310, N311;

1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;

1> apply the default MAC Cell Group configuration as specified in 9.2.2;

1> for each *srb-Identity* value included in the *srb-ToAddModList* (SRB reconfiguration):

2> apply the default SRB configuration defined in 9.2.1 for the corresponding SRB;

NOTE 2: This is to get the SRBs (SRB1 and SRB2 for reconfiguration with sync and SRB2 for reconfiguration after re-establishment) to a known state from which the reconfiguration message can do further configuration.

1> for each *pdu-Session* that is part of the current UE configuration:

2> release the SDAP entity (clause 5.1.2 in TS 37.324 [24]);

2> release each DRB associated to the *pdu-Session* as specified in 5.3.5.6.4;

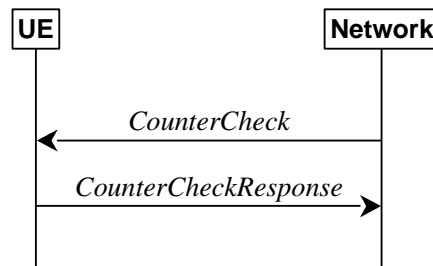
NOTE 3: This will retain the *pdu-Session* but remove the DRBs including *drb-identity* of these bearers from the current UE configuration. Setup of the DRBs within the AS is described in clause 5.3.5.6.5 using the new configuration. The *pdu-Session* acts as the anchor for associating the released and re-setup DRB. In the AS the DRB re-setup is equivalent with a new DRB setup (including new PDCP and logical channel configurations).

1> for each *pdu-Session* that is part of the current UE configuration but not added with same *pdu-Session* in the *drb-ToAddModList*:

2> indicate the release of the user plane resources for the *pdu-Session* to upper layers;

## 5.3.6 Counter check

### 5.3.6.1 General



**Figure 5.3.6.1-1: Counter check procedure**

The counter check procedure is used by the network to request the UE to verify the amount of data sent/ received on each DRB. More specifically, the UE is requested to check if, for each DRB, the most significant bits of the COUNT match with the values indicated by the network.

NOTE: The procedure enables the network to detect packet insertion by an intruder (a 'man in the middle').

### 5.3.6.2 Initiation

The network initiates the procedure by sending a *CounterCheck* message.

NOTE: The network may initiate the procedure when any of the COUNT values reaches a specific value.

### 5.3.6.3 Reception of the *CounterCheck* message by the UE

Upon receiving the *CounterCheck* message, the UE shall:

- 1> for each DRB that is established:
  - 2> if no COUNT exists for a given direction (uplink or downlink) because it is a uni-directional bearer configured only for the other direction:
    - 3> assume the COUNT value to be 0 for the unused direction;
  - 2> if the *drb-Identity* is not included in the *drb-CountMSB-InfoList*:
    - 3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of TX\_NEXT – 1 and RX\_NEXT – 1 (specified in TS 38.323 [5]), respectively;
  - 2> else if, for at least one direction, the most significant bits of the COUNT are different from the value indicated in the *drb-CountMSB-InfoList*:
    - 3> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* set to the value of TX\_NEXT – 1 and RX\_NEXT – 1 (specified in TS 38.323 [5]), respectively;
- 1> for each DRB that is included in the *drb-CountMSB-InfoList* in the *CounterCheck* message that is not established:
  - 2> include the DRB in the *drb-CountInfoList* in the *CounterCheckResponse* message by including the *drb-Identity*, the *count-Uplink* and the *count-Downlink* with the most significant bits set identical to the corresponding values in the *drb-CountMSB-InfoList* and the least significant bits set to zero;
- 1> submit the *CounterCheckResponse* message to lower layers for transmission upon which the procedure ends.

## 5.3.7 RRC connection re-establishment

### 5.3.7.1 General

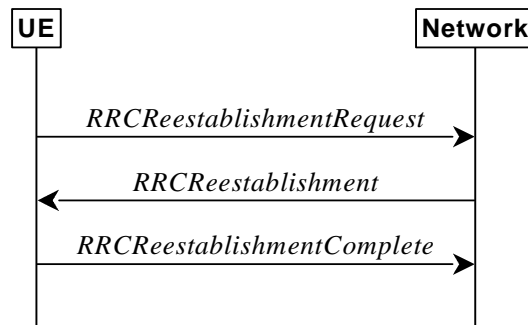


Figure 5.3.7.1-1: RRC connection re-establishment, successful

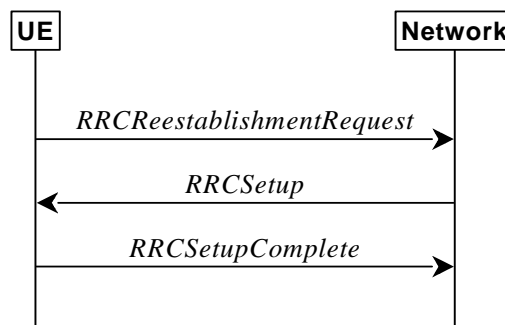


Figure 5.3.7.1-2: RRC re-establishment, fallback to RRC establishment, successful

The purpose of this procedure is to re-establish the RRC connection. A UE in RRC\_CONNECTED, for which AS security has been activated with SRB2 and at least one DRB setup, may initiate the procedure in order to continue the RRC connection. The connection re-establishment succeeds if the network is able to find and verify a valid UE context or, if the UE context cannot be retrieved, and the network responds with an *RRCSetup* according to clause 5.3.3.4.

The network applies the procedure e.g as follows:

- When AS security has been activated and the network retrieves or verifies the UE context:
  - to re-activate AS security without changing algorithms;
  - to re-establish and resume the SRB1;
- When UE is re-establishing an RRC connection, and the network is not able to retrieve or verify the UE context:
  - to discard the stored AS Context and release all RBs;
  - to fallback to establish a new RRC connection.

If AS security has not been activated, the UE shall not initiate the procedure but instead moves to RRC\_IDLE directly, with release cause 'other'. If AS security has been activated, but SRB2 and at least one DRB are not setup, the UE does not initiate the procedure but instead moves to RRC\_IDLE directly, with release cause 'RRC connection failure'.

### 5.3.7.2 Initiation

The UE initiates the procedure when one of the following conditions is met:

- 1> upon detecting radio link failure of the MCG, in accordance with 5.3.10; or

- 1> upon re-configuration with sync failure of the MCG, in accordance with sub-clause 5.3.5.8.3; or
- 1> upon mobility from NR failure, in accordance with sub-clause 5.4.3.5; or
- 1> upon integrity check failure indication from lower layers concerning SRB1 or SRB2, except if the integrity check failure is detected on the *RRCReestablishment* message; or
- 1> upon an RRC connection reconfiguration failure, in accordance with sub-clause 5.3.5.8.2.

Upon initiation of the procedure, the UE shall:

- 1> stop timer T310, if running;
- 1> stop timer T304, if running;
- 1> start timer T311;
- 1> suspend all RBs, except SRB0;
- 1> reset MAC;
- 1> release the MCG SCell(s), if configured;
- 1> release *spCellConfig*, if configured;
- 1> if MR-DC is configured:
  - 2> perform MR-DC release, as specified in section 5.3.5.10;
- 1> release *delayBudgetReportingConfig*, if configured, and stop timer T342, if running;
- 1> release *overheatingAssistanceConfig*, if configured, and stop timer T345, if running;
- 1> perform cell selection in accordance with the cell selection process as specified in TS 38.304 [20], clause 5.2.6.

### 5.3.7.3 Actions following cell selection while T311 is running

Upon selecting a suitable NR cell, the UE shall:

- 1> ensure having valid and up to date essential system information as specified in clause 5.2.2.2;
- 1> stop timer T311;
- 1> start timer T301;
- 1> if T390 is running:
  - 2> stop timer T390 for all access categories;
  - 2> perform the actions as specified in 5.3.14.4;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> apply the CCCH configuration as specified in 9.1.1.2;
- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> initiate transmission of the *RRCReestablishmentRequest* message in accordance with 5.3.7.4;

NOTE: This procedure applies also if the UE returns to the source PCell.

Upon selecting an inter-RAT cell, the UE shall:

- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.



#### 5.3.7.4 Actions related to transmission of *RRCReestablishmentRequest* message

The UE shall set the contents of *RRCReestablishmentRequest* message as follows:

- 1> set the *ue-Identity* as follows:
    - 2> set the *c-RNTI* to the C-RNTI used in the source PCell (reconfiguration with sync or mobility from NR failure) or used in the PCell in which the trigger for the re-establishment occurred (other cases);
    - 2> set the *physCellId* to the physical cell identity of the source PCell (reconfiguration with sync or mobility from NR failure) or of the PCell in which the trigger for the re-establishment occurred (other cases);
    - 2> set the *shortMAC-I* to the 16 least significant bits of the MAC-I calculated:
      - 3> over the ASN.1 encoded as per clause 8 (i.e., a multiple of 8 bits) *VarShortMAC-Input*;
      - 3> with the  $K_{RRCint}$  key and integrity protection algorithm that was used in the source PCell (reconfiguration with sync or mobility from NR failure) or of the PCell in which the trigger for the re-establishment occurred (other cases); and
      - 3> with all input bits for COUNT, BEARER and DIRECTION set to binary ones;
  - 1> set the *reestablishmentCause* as follows:
    - 2> if the re-establishment procedure was initiated due to reconfiguration failure as specified in 5.3.5.8.2:
      - 3> set the *reestablishmentCause* to the value *reconfigurationFailure*;
    - 2> else if the re-establishment procedure was initiated due to reconfiguration with sync failure as specified in 5.3.5.8.3 (intra-NR handover failure) or 5.4.3.5 (inter-RAT mobility from NR failure):
      - 3> set the *reestablishmentCause* to the value *handoverFailure*;
    - 2> else:
      - 3> set the *reestablishmentCause* to the value *otherFailure*;
  - 1> re-establish PDCP for SRB1;
  - 1> re-establish RLC for SRB1;
  - 1> apply the specified configuration defined in 9.2.1 for SRB1;
  - 1> configure lower layers to suspend integrity protection and ciphering for SRB1;
- NOTE: Ciphering is not applied for the subsequent *RRCReestablishment* message used to resume the connection. An integrity check is performed by lower layers, but merely upon request from RRC.
- 1> resume SRB1;
  - 1> submit the *RRCReestablishmentRequest* message to lower layers for transmission.

#### 5.3.7.5 Reception of the *RRCReestablishment* by the UE

The UE shall:

- 1> stop timer T301;
- 1> consider the current cell to be the PCell;
- 1> store the *nextHopChainingCount* value indicated in the *RRCReestablishment* message;
- 1> update the  $K_{gNB}$  key based on the current  $K_{gNB}$  key or the NH, using the stored *nextHopChainingCount* value, as specified in TS 33.501 [11];
- 1> derive the  $K_{RRCenc}$  and  $K_{UPenc}$  keys associated with the previously configured *cipheringAlgorithm*, as specified in TS 33.501 [11];

- 1> derive the  $K_{\text{RRCint}}$  and  $K_{\text{UPint}}$  keys associated with the previously configured *integrityProtAlgorithm*, as specified in TS 33.501 [11].
- 1> request lower layers to verify the integrity protection of the *RRCReestablishment* message, using the previously configured algorithm and the  $K_{\text{RRCint}}$  key;
- 1> if the integrity protection check of the *RRCReestablishment* message fails:
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure', upon which the procedure ends;
- 1> configure lower layers to resume integrity protection for SRB1 using the previously configured algorithm and the  $K_{\text{RRCint}}$  key immediately, i.e., integrity protection shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 1> configure lower layers to resume ciphering for SRB1 using the previously configured algorithm and, the  $K_{\text{RRCenc}}$  key immediately, i.e., ciphering shall be applied to all subsequent messages received and sent by the UE, including the message used to indicate the successful completion of the procedure;
- 1> release the measurement gap configuration indicated by the *measGapConfig*, if configured;
- 1> submit the *RRCReestablishmentComplete* message to lower layers for transmission;
- 1> the procedure ends.

### 5.3.7.6 T311 expiry

Upon T311 expiry, the UE shall:

- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

### 5.3.7.7 T301 expiry or selected cell no longer suitable

The UE shall:

- 1> if timer T301 expires; or
- 1> if the selected cell becomes no longer suitable according to the cell selection criteria as specified in TS 38.304 [20]:
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

### 5.3.7.8 Reception of the *RRCSetup* by the UE

The UE shall:

- 1> perform the RRC connection establishment procedure as specified in 5.3.3.4.

## 5.3.8 RRC connection release

### 5.3.8.1 General

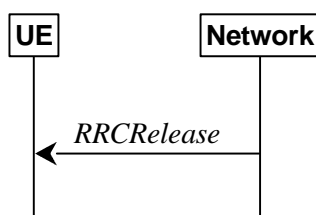


Figure 5.3.8.1-1: RRC connection release, successful

The purpose of this procedure is:

- to release the RRC connection, which includes the release of the established radio bearers as well as all radio resources; or
- to suspend the RRC connection only if SRB2 and at least one DRB are setup, which includes the suspension of the established radio bearers.

### 5.3.8.2 Initiation

The network initiates the RRC connection release procedure to transit a UE in RRC\_CONNECTED to RRC\_IDLE; or to transit a UE in RRC\_CONNECTED to RRC\_INACTIVE only if SRB2 and at least one DRB is setup in RRC\_CONNECTED; or to transit a UE in RRC\_INACTIVE back to RRC\_INACTIVE when the UE tries to resume; or to transit a UE in RRC\_INACTIVE to RRC\_IDLE when the UE tries to resume. The procedure can also be used to release and redirect a UE to another frequency.

### 5.3.8.3 Reception of the *RRCRelease* by the UE

The UE shall:

- 1> delay the following actions defined in this sub-clause 60 ms from the moment the *RRCRelease* message was received or optionally when lower layers indicate that the receipt of the *RRCRelease* message has been successfully acknowledged, whichever is earlier;
- 1> stop timer T380, if running;
- 1> stop timer T320, if running;
- 1> if the AS security is not activated:
  - 2> ignore any field included in *RRCRelease* message except *waitTime*;
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with the release cause 'other' upon which the procedure ends;
- 1> if the *RRCRelease* message includes *redirectedCarrierInfo* indicating redirection to *eutra*:
  - 2> if *cnType* is included:
    - 3> after the cell selection, indicate the available CN Type(s) and the received *cnType* to upper layers;

NOTE: Handling the case if the E-UTRA cell selected after the redirection does not support the core network type specified by the *cnType*, is up to UE implementation.
- 1> if the *RRCRelease* message includes the *cellReselectionPriorities*:
  - 2> store the cell reselection priority information provided by the *cellReselectionPriorities*;
  - 2> if the *t320* is included:
    - 3> start timer T320, with the timer value set according to the value of *t320*;
- 1> else:
  - 2> apply the cell reselection priority information broadcast in the system information;
- 1> if *deprioritisationReq* is included:
  - 2> start or restart timer T325 with the timer value set to the *deprioritisationTimer* signalled;
  - 2> store the *deprioritisationReq* until T325 expiry;
- 1> if the *RRCRelease* includes *suspendConfig*:
  - 2> apply the received *suspendConfig*;

- 2> reset MAC and release the default MAC Cell Group configuration, if any;
- 2> re-establish RLC entities for SRB1;
- 2> if the *RRCRelease* message with *suspendConfig* was received in response to an *RRCResumeRequest* or an *RRCResumeRequest1*:
  - 3> stop the timer T319 if running;
  - 3> in the stored UE Inactive AS context:
    - 4> replace the  $K_{gNB}$  and  $K_{RRCint}$  keys with the current  $K_{gNB}$  and  $K_{RRCint}$  keys;
    - 4> replace the C-RNTI with the temporary C-RNTI in the cell the UE has received the *RRCRelease* message;
    - 4> replace the *cellIdentity* with the *cellIdentity* of the cell the UE has received the *RRCRelease* message;
    - 4> replace the physical cell identity with the physical cell identity of the cell the UE has received the *RRCRelease* message;
- 2> else:
  - 3> store in the UE Inactive AS Context the current  $K_{gNB}$  and  $K_{RRCint}$  keys, the ROHC state, the C-RNTI used in the source PCell, the *cellIdentity* and the physical cell identity of the source PCell, and all other parameters configured except for the ones within *ReconfigurationWithSync* and *servingCellConfigCommonSIB*;
- 2> suspend all SRB(s) and DRB(s), except SRB0;
- 2> indicate PDCP suspend to lower layers of all DRBs;
- 2> if the *t380* is included:
  - 3> start timer T380, with the timer value set to *t380*;
- 2> if the *RRCRelease* message is including the *waitTime*:
  - 3> start timer T302 with the value set to the *waitTime*;
  - 3> inform upper layers that access barring is applicable for all access categories except categories '0' and '2';
- 2> if T390 is running:
  - 3> stop timer T390 for all access categories;
  - 3> perform the actions as specified in 5.3.14.4;
- 2> indicate the suspension of the RRC connection to upper layers;
- 2> enter RRC\_INACTIVE and perform cell selection as specified in TS 38.304 [20];
- 1> else
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with the release cause 'other'.

#### 5.3.8.4 T320 expiry

The UE shall:

- 1> if T320 expires:
  - 2> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
  - 2> apply the cell reselection priority information broadcast in the system information.

### 5.3.8.5 UE actions upon the expiry of *DataInactivityTimer*

Upon receiving the expiry of *DataInactivityTimer* from lower layers while in RRC\_CONNECTED, the UE shall:

- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.

## 5.3.9 RRC connection release requested by upper layers

### 5.3.9.1 General

The purpose of this procedure is to release the RRC connection. Access to the current PCell may be barred as a result of this procedure.

### 5.3.9.2 Initiation

The UE initiates the procedure when upper layers request the release of the RRC connection as specified in TS 24.501 [23]. The UE shall not initiate the procedure for power saving purposes.

The UE shall:

- 1> if the upper layers indicate barring of the PCell:
  - 2> treat the PCell used prior to entering RRC\_IDLE as barred according to TS 38.304 [20];
- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'other'.

## 5.3.10 Radio link failure related actions

### 5.3.10.1 Detection of physical layer problems in RRC\_CONNECTED

The UE shall:

- 1> upon receiving N310 consecutive "out-of-sync" indications for the SpCell from lower layers while neither T300, T301, T304, T311 nor T319 are running:
  - 2> start timer T310 for the corresponding SpCell.

### 5.3.10.2 Recovery of physical layer problems

Upon receiving N311 consecutive "in-sync" indications for the SpCell from lower layers while T310 is running, the UE shall:

- 1> stop timer T310 for the corresponding SpCell.

NOTE 1: In this case, the UE maintains the RRC connection without explicit signalling, i.e. the UE maintains the entire radio resource configuration.

NOTE 2: Periods in time where neither "in-sync" nor "out-of-sync" is reported by L1 do not affect the evaluation of the number of consecutive "in-sync" or "out-of-sync" indications.

### 5.3.10.3 Detection of radio link failure

The UE shall:

- 1> upon T310 expiry in PCell; or
- 1> upon random access problem indication from MCG MAC while neither T300, T301, T304, T311 nor T319 are running; or
- 1> upon indication from MCG RLC that the maximum number of retransmissions has been reached:

- 2> if the indication is from MCG RLC and CA duplication is configured and activated, and for the corresponding logical channel *allowedServingCells* only includes SCell(s):
  - 3> initiate the failure information procedure as specified in 5.7.5 to report RLC failure.
- 2> else:
  - 3> consider radio link failure to be detected for the MCG i.e. RLF;
  - 3> if AS security has not been activated:
    - 4> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'other';-
  - 3> else if AS security has been activated but SRB2 and at least one DRB have not been setup:
    - 4> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure';
  - 3> else:
    - 4> initiate the connection re-establishment procedure as specified in 5.3.7.

The UE shall:

- 1> upon T310 expiry in PSCell; or
- 1> upon random access problem indication from SCG MAC; or
- 1> upon indication from SCG RLC that the maximum number of retransmissions has been reached:
  - 2> if the indication is from SCG RLC and CA duplication is configured and activated; and for the corresponding logical channel *allowedServingCells* only includes SCell(s):
    - 3> initiate the failure information procedure as specified in 5.7.5 to report RLC failure.
  - 2> else:
    - 3> consider radio link failure to be detected for the SCG, i.e. SCG RLF;
    - 3> initiate the SCG failure information procedure as specified in 5.7.3 to report SCG radio link failure.

### 5.3.11 UE actions upon going to RRC\_IDLE

The UE shall:

- 1> reset MAC;
- 1> if going to RRC\_IDLE was triggered by reception of the *RRCRelease* message including a *waitTime*:
  - 2> if T302 is running:
    - 3> stop timer T302;
  - 2> start timer T302 with the value set to the *waitTime*;
  - 2> inform upper layers that access barring is applicable for all access categories except categories '0' and '2'.
- 1> else:
  - 2> if T302 is running:
    - 3> stop timer T302;
    - 3> perform the actions as specified in 5.3.14.4;
- 1> if T390 is running:
  - 2> stop timer T390 for all access categories;

- 2> perform the actions as specified in 5.3.14.4;
- 1> if the UE is leaving RRC\_INACTIVE:
  - 2> if going to RRC\_IDLE was not triggered by reception of the *RRCRelease* message:
    - 3> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities*;
    - 3> stop the timer T320, if running;
- 1> stop all timers that are running except T302, T320 and T325;
- 1> discard the UE Inactive AS context, if any;
- 1> release the *suspendConfig*, if configured;
- 1> set the variable *pendingRnaUpdate* to *false*, if that is set to *true*;
- 1> discard the  $K_{gNB}$  key, the  $S-K_{gNB}$  key, the  $S-K_{eNB}$  key, the  $K_{RRCenc}$  key, the  $K_{RRCint}$  key, the  $K_{UPint}$  key and the  $K_{UPenc}$  key, if any;
- 1> release all radio resources, including release of the RLC entity, the MAC configuration and the associated PDCP entity and SDAP for all established RBs;
- 1> indicate the release of the RRC connection to upper layers together with the release cause;
- 1> enter RRC\_IDLE and perform cell selection as specified in TS 38.304 [20], except if going to RRC\_IDLE was triggered by inter-RAT cell reselection while the UE is in RRC\_INACTIVE or when selecting an inter-RAT cell while T311 was running;

### 5.3.12 UE actions upon PUCCH/SRS release request

Upon receiving a PUCCH release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

- 1> release PUCCH-CSI-Resources configured in *CSI-ReportConfig*;
- 1> release *SchedulingRequestResourceConfig* instances configured in *PUCCH-Config*.

Upon receiving an SRS release request from lower layers, for all bandwidth parts of an indicated serving cell the UE shall:

- 1> release *SRS-Resource* instances configured in *SRS-Config*.

### 5.3.13 RRC connection resume

#### 5.3.13.1 General

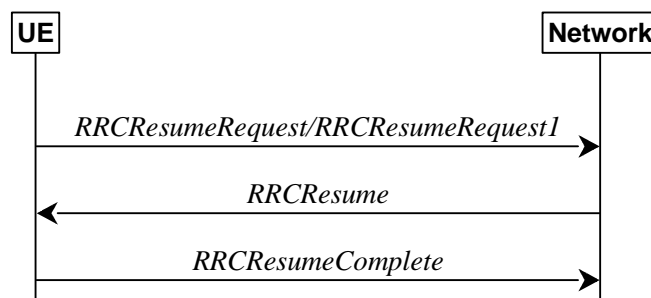


Figure 5.3.13.1-1: RRC connection resume, successful

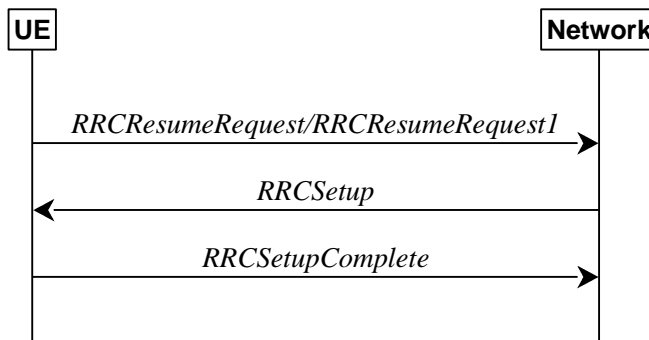


Figure 5.3.13.1-2: RRC connection resume fallback to RRC connection establishment, successful

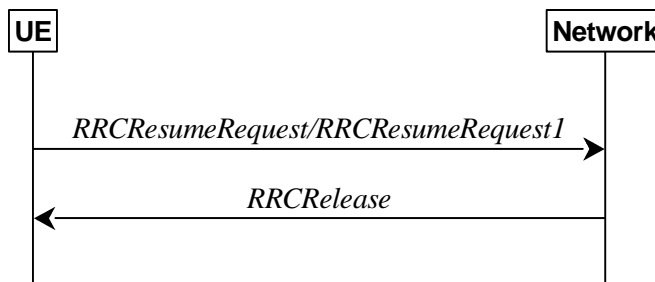


Figure 5.3.13.1-3: RRC connection resume followed by network release, successful

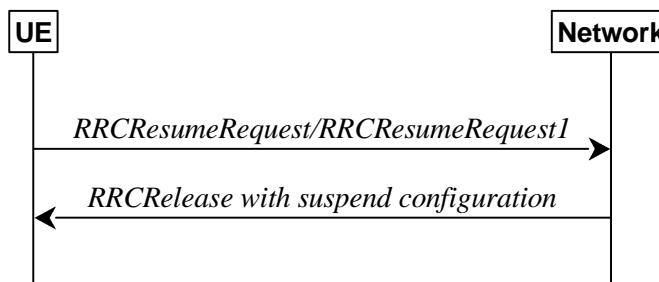


Figure 5.3.13.1-4: RRC connection resume followed by network suspend, successful

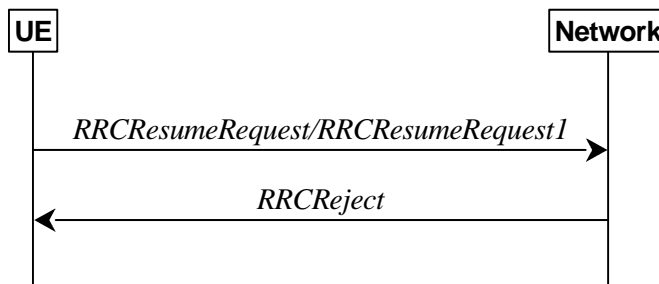


Figure 5.3.13.1-5: RRC connection resume, network reject

The purpose of this procedure is to resume a suspended RRC connection, including resuming SRB(s) and DRB(s) or perform an RNA update.

### 5.3.13.2 Initiation

The UE initiates the procedure when upper layers or AS (when responding to RAN paging or upon triggering RNA updates while the UE is in RRC\_INACTIVE) requests the resume of a suspended RRC connection.

The UE shall ensure having valid and up to date essential system information as specified in clause 5.2.2.2 before initiating this procedure.



Upon initiation of the procedure, the UE shall:

- 1> if the resumption of the RRC connection is triggered by response to NG-RAN paging:
  - 2> select '0' as the Access Category;
  - 2> perform the unified access control procedure as specified in 5.3.14 using the selected Access Category and one or more Access Identities provided by upper layers;
  - 3> if the access attempt is barred, the procedure ends;
- 1> else if the resumption of the RRC connection is triggered by upper layers:
  - 2> if the upper layers provide an Access Category and one or more Access Identities:
    - 3> perform the unified access control procedure as specified in 5.3.14 using the Access Category and Access Identities provided by upper layers;
    - 4> if the access attempt is barred, the procedure ends;
  - 2> set the *resumeCause* in accordance with the information received from upper layers;
- 1> else if the resumption of the RRC connection is triggered due to an RNA update as specified in 5.3.13.8:
  - 2> if an emergency service is ongoing:

NOTE: How the RRC layer in the UE is aware of an ongoing emergency service is up to UE implementation.

- 3> select '2' as the Access Category;
- 3> set the *resumeCause* to *emergency*;
- 2> else:
  - 3> select '8' as the Access Category;
  - 2> perform the unified access control procedure as specified in 5.3.14 using the selected Access Category and one or more Access Identities to be applied as specified in TS 24.501 [23];
  - 3> if the access attempt is barred:
    - 4> set the variable *pendingRnaUpdate* to *true*;
    - 4> the procedure ends;
- 1> if the UE is in NE-DC or NR-DC:
  - 2> release the MR-DC related configurations (i.e., as specified in 5.3.5.10) from the UE Inactive AS context, if stored;
- 1> release the MCG SCell(s) from the UE Inactive AS context, if stored;
- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications, except for the parameters for which values are provided in *SIB1*;
- 1> apply the default SRB1 configuration as specified in 9.2.1;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> release *delayBudgetReportingConfig* from the UE Inactive AS context, if stored;
- 1> stop timer T342, if running;
- 1> release *overheatingAssistanceConfig* from the UE Inactive AS context, if stored;
- 1> stop timer T345, if running;
- 1> apply the CCCH configuration as specified in 9.1.1.2;

- 1> apply the *timeAlignmentTimerCommon* included in *SIB1*;
- 1> start timer T319;
- 1> set the variable *pendingRnaUpdate* to *false*;
- 1> initiate transmission of the *RRCResumeRequest* message or *RRCResumeRequest1* in accordance with 5.3.13.3.

### 5.3.13.3 Actions related to transmission of *RRCResumeRequest* or *RRCResumeRequest1* message

The UE shall set the contents of *RRCResumeRequest* or *RRCResumeRequest1* message as follows:

- 1> if field *useFullResumeID* is signalled in *SIB1*:
  - 2> select *RRCResumeRequest1* as the message to use;
  - 2> set the *resumeIdentity* to the stored *fullI-RNTI* value;
- 1> else:
  - 2> select *RRCResumeRequest* as the message to use;
  - 2> set the *resumeIdentity* to the stored *shortI-RNTI* value;
- 1> restore the RRC configuration and the  $K_{gNB}$  and  $K_{RRcInt}$  keys from the stored UE Inactive AS context except the *masterCellGroup* and *pdcp-Config*;
- 1> set the *resumeMAC-I* to the 16 least significant bits of the MAC-I calculated:
  - 2> over the ASN.1 encoded as per clause 8 (i.e., a multiple of 8 bits) *VarResumeMAC-Input*;
  - 2> with the  $K_{RRcInt}$  key in the UE Inactive AS Context and the previously configured integrity protection algorithm; and
  - 2> with all input bits for COUNT, BEARER and DIRECTION set to binary ones;
- 1> derive the  $K_{gNB}$  key based on the current  $K_{gNB}$  key or the NH, using the stored *nextHopChainingCount* value, as specified in TS 33.501 [11];
- 1> derive the  $K_{RRcEnc}$  key, the  $K_{RRcInt}$  key, the  $K_{UPint}$  key and the  $K_{UPenc}$  key;
- 1> configure lower layers to apply integrity protection for all radio bearers except SRB0 using the configured algorithm and the  $K_{RRcInt}$  key and  $K_{UPint}$  key derived in this subclause immediately, i.e., integrity protection shall be applied to all subsequent messages received and sent by the UE;

NOTE 1: Only DRBs with previously configured UP integrity protection shall resume integrity protection.

- 1> configure lower layers to apply ciphering for all radio bearers except SRB0 and to apply the configured ciphering algorithm, the  $K_{RRcEnc}$  key and the  $K_{UPenc}$  key derived in this subclause, i.e. the ciphering configuration shall be applied to all subsequent messages received and sent by the UE;

- 1> re-establish PDCP entities for SRB1;

- 1> resume SRB1;

- 1> submit the selected message *RRCResumeRequest* or *RRCResumeRequest1* for transmission to lower layers.

NOTE 2: Only DRBs with previously configured UP ciphering shall resume ciphering.

If lower layers indicate an integrity check failure while T319 is running, perform actions specified in 5.3.13.5.

The UE shall continue cell re-selection related measurements as well as cell re-selection evaluation.

#### 5.3.13.4 Reception of the *RRCResume* by the UE

The UE shall:

- 1> stop timer T319;
- 1> stop timer T380, if running;
- 1> if the *RRCResume* includes the *fullConfig*:
  - 2> perform the full configuration procedure as specified in 5.3.5.11;
- 1> else:
  - 2> restore the *masterCellGroup* and *pdcp-Config* from the UE Inactive AS context;
- 1> discard the UE Inactive AS context;
- 1> release the *suspendConfig* except the *ran-NotificationAreaInfo*;
- 1> if the *RRCResume* includes the *masterCellGroup*:
  - 2> perform the cell group configuration for the received *masterCellGroup* according to 5.3.5.5;
- 1> if the *RRCResume* includes the *radioBearerConfig*:
  - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> if the *RRCResume* message includes the *sk-Counter*:
  - 2> perform security key update procedure as specified in 5.3.5.7;
- 1> if the *RRCResume* message includes the *radioBearerConfig2*:
  - 2> perform the radio bearer configuration according to 5.3.5.6;
- 1> resume SRB2 and all DRBs;
- 1> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;
- 1> stop timer T320, if running;
- 1> if the *RRCResume* message includes the *measConfig*:
  - 2> perform the measurement configuration procedure as specified in 5.5.2;
- 1> resume measurements if suspended;
- 1> if T390 is running:
  - 2> stop timer T390 for all access categories;
  - 2> perform the actions as specified in 5.3.14.4;
- 1> if T302 is running:
  - 2> stop timer T302;
  - 2> perform the actions as specified in 5.3.14.4;
- 1> enter RRC\_CONNECTED;
- 1> indicate to upper layers that the suspended RRC connection has been resumed;
- 1> stop the cell re-selection procedure;
- 1> consider the current cell to be the PCell;

- 1> set the content of the of *RRCResumeComplete* message as follows:
  - 2> if the upper layer provides NAS PDU, set the *dedicatedNAS-Message* to include the information received from upper layers;
  - 2> if the upper layer provides a PLMN, set the *selectedPLMN-Identity* to PLMN selected by upper layers (TS 24.501 [23]) from the PLMN(s) included in the *plmn-IdentityList* in *SIB1*;
  - 2> if the *masterCellGroup* contains the *reportUplinkTxDirectCurrent*:
    - 3> include the *uplinkTxDirectCurrentList* for each serving cell with UL;
    - 3> if UE is configured with SUL carrier:
      - 4> include *uplinkDirectCurrentBWP-SUL* for each serving cell with SUL within the *uplinkTxDirectCurrentList*;
- 1> submit the *RRCResumeComplete* message to lower layers for transmission;
- 1> the procedure ends.

### 5.3.13.5 T319 expiry or Integrity check failure from lower layers while T319 is running

The UE shall:

- 1> if timer T319 expires or upon receiving Integrity check failure indication from lower layers while T319 is running:
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure'.

### 5.3.13.6 Cell re-selection or cell selection while T390, T319 or T302 is running (UE in RRC\_INACTIVE)

The UE shall:

- 1> if cell reselection occurs while T319 or T302 is running:
  - 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure';
- 1> else if cell selection or reselection occurs while T390 is running:
  - 2> stop T390 for all access categories;
  - 2> perform the actions as specified in 5.3.14.4.

### 5.3.13.7 Reception of the *RRCSetup* by the UE

The UE shall:

- 1> perform the RRC connection setup procedure as specified in 5.3.3.4.

### 5.3.13.8 RNA update

In RRC\_INACTIVE state, the UE shall:

- 1> if T380 expires; or
- 1> if RNA Update is triggered at reception of SIB1, as specified in 5.2.2.4.2:
  - 2> initiate RRC connection resume procedure in 5.3.13.2 with *resumeCause* set to *rna-Update*;
- 1> if barring is alleviated for Access Category '8', as specified in 5.3.14.4:

- 2> if upper layers do not request RRC the resumption of an RRC connection, and
- 2> if the variable *pendingRnaUpdate* is set to *true*:

- 3> initiate RRC connection resume procedure in 5.3.13.2 with *resumeCause* value set to *rna-Update*.

If the UE in RRC\_INACTIVE state fails to find a suitable cell and camps on the acceptable cell to obtain limited service as defined in TS 38.304 [20], the UE shall:

- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'other'.

NOTE: It is left to UE implementation how to behave when T380 expires while the UE is camped neither on a suitable nor on an acceptable cell.

### 5.3.13.9 Reception of the *RRCRelease* by the UE

The UE shall:

- 1> perform the actions as specified in 5.3.8.

### 5.3.13.10 Reception of the *RRCReject* by the UE

The UE shall:

- 1> perform the actions as specified in 5.3.15.

### 5.3.13.11 Inability to comply with *RRCResume*

The UE shall:

- 1> if the UE is unable to comply with (part of) the configuration included in the *RRCResume* message;
- 2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'RRC Resume failure'.

NOTE 1: The UE may apply above failure handling also in case the *RRCResume* message causes a protocol error for which the generic error handling as defined in 10 specifies that the UE shall ignore the message.

NOTE 2: If the UE is unable to comply with part of the configuration, it does not apply any part of the configuration, i.e. there is no partial success/failure.

### 5.3.13.12 Inter RAT cell reselection

Upon reselecting to an inter-RAT cell, the UE shall:

- 1> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'other'.

## 5.3.14 Unified Access Control

### 5.3.14.1 General

The purpose of this procedure is to perform access barring check for an access attempt associated with a given Access Category and one or more Access Identities upon request from upper layers according to TS 24.501 [23] or the RRC layer.

After a PCell change in RRC\_CONNECTED the UE shall defer access barring checks until it has obtained *SIB1* (as specified in 5.2.2.2) from the target cell.

### 5.3.14.2 Initiation

Upon initiation of the procedure, the UE shall:

- 1> if timer T390 is running for the Access Category:
  - 2> consider the access attempt as barred;
- 1> else if timer T302 is running and the Access Category is neither '2' nor '0':
  - 2> consider the access attempt as barred;
- 1> else:
  - 2> if the Access Category is '0':
    - 3> consider the access attempt as allowed;
  - 2> else:
    - 3> if *SIB1* includes *uac-BarringPerPLMN-List* and the *uac-BarringPerPLMN-List* contains an *UAC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers (see TS 24.501 [23]):
      - 4> select the *UAC-BarringPerPLMN* entry with the *plmn-IdentityIndex* corresponding to the PLMN selected by upper layers;
      - 4> in the remainder of this procedure, use the selected *UAC-BarringPerPLMN* entry (i.e. presence or absence of access barring parameters in this entry) irrespective of the *uac-BarringForCommon* included in *SIB1*;
    - 3> else if *SIB1* includes *uac-BarringForCommon*:
      - 4> in the remainder of this procedure use the *uac-BarringForCommon* (i.e. presence or absence of these parameters) included in *SIB1*;
    - 3> else:
      - 4> consider the access attempt as allowed;
    - 3> if *uac-BarringForCommon* is applicable or the *uac-ACBarringListType* indicates that *uac-ExplicitACBarringList* is used:
      - 4> if the corresponding *UAC-BarringPerCatList* contains a *UAC-BarringPerCat* entry corresponding to the Access Category:
        - 5> select the *UAC-BarringPerCat* entry;
        - 5> if the *uac-BarringInfoSetList* contains a *UAC-BarringInfoSet* entry corresponding to the selected *uac-barringInfoSetIndex* in the *UAC-BarringPerCat*:
          - 6> select the *UAC-BarringInfoSet* entry;
          - 6> perform access barring check for the Access Category as specified in 5.3.14.5, using the selected *UAC-BarringInfoSet* as "UAC barring parameter";
        - 5> else:
          - 6> consider the access attempt as allowed;
      - 4> else:
        - 5> consider the access attempt as allowed;
    - 3> else if the *uac-ACBarringListType* indicates that *uac-ImplicitACBarringList* is used:
      - 4> select the *uac-BarringInfoSetIndex* corresponding to the Access Category in the *uac-ImplicitACBarringList*;
      - 4> if the *uac-BarringInfoSetList* contains the *UAC-BarringInfoSet* entry corresponding to the selected *uac-BarringInfoSetIndex*:

- 5> select the *UAC-BarringInfoSet* entry;
- 5> perform access barring check for the Access Category as specified in 5.3.14.5, using the selected *UAC-BarringInfoSet* as "UAC barring parameter";
- 4> else:
  - 5> consider the access attempt as allowed;
- 3> else:
  - 4> consider the access attempt as allowed;
- 1> if the access barring check was requested by upper layers:
  - 2> if the access attempt is considered as barred:
    - 3> if timer T302 is running:
      - 4> if timer T390 is running for Access Category '2':
        - 5> inform the upper layer that access barring is applicable for all access categories except categories '0', upon which the procedure ends;
      - 4> else
        - 5> inform the upper layer that access barring is applicable for all access categories except categories '0' and '2', upon which the procedure ends;
    - 3> else:
      - 4> inform upper layers that the access attempt for the Access Category is barred, upon which the procedure ends;
    - 2> else:
      - 3> inform upper layers that the access attempt for the Access Category is allowed, upon which the procedure ends;
  - 1> else:
    - 2> the procedure ends.

### 5.3.14.3 Void

### 5.3.14.4 T302, T390 expiry or stop (Barring alleviation)

The UE shall:

- 1> if timer T302 expires or is stopped:
  - 2> for each Access Category for which T390 is not running:
    - 3> consider the barring for this Access Category to be alleviated;
- 1> else if timer T390 corresponding to an Access Category other than '2' expires or is stopped, and if timer T302 is not running:
  - 2> consider the barring for this Access Category to be alleviated;
- 1> else if timer T390 corresponding to the Access Category '2' expires or is stopped:
  - 2> consider the barring for this Access Category to be alleviated;
- 1> when barring for an Access Category is considered being alleviated:
  - 2> if the Access Category was informed to upper layers as barred:

- 3> inform upper layers about barring alleviation for the Access Category.
- 2> if barring is alleviated for Access Category '8':
  - 3> perform actions specified in 5.3.13.8;

### 5.3.14.5 Access barring check

The UE shall:

- 1> if one or more Access Identities are indicated according to TS 24.501 [23], and
  - 1> if for at least one of these Access Identities the corresponding bit in the *uac-BarringForAccessIdentity* contained in "UAC barring parameter" is set to *zero*:
    - 2> consider the access attempt as allowed;
  - 1> else:
    - 2> draw a random number '*rand*' uniformly distributed in the range:  $0 \leq rand < 1$ ;
    - 2> if '*rand*' is lower than the value indicated by *uac-BarringFactor* included in "UAC barring parameter":
      - 3> consider the access attempt as allowed;
    - 2> else:
      - 3> consider the access attempt as barred;
- 1> if the access attempt is considered as barred:
  - 2> draw a random number '*rand*' that is uniformly distributed in the range  $0 \leq rand < 1$ ;
  - 2> start timer T390 for the Access Category with the timer value calculated as follows, using the *uac-BarringTime* included in "AC barring parameter":
 
$$T390 = (0.7 + 0.6 * rand) * uac-BarringTime.$$

## 5.3.15 RRC connection reject

### 5.3.15.1 Initiation

The UE initiates the procedure upon the reception of *RRCReject* when the UE tries to establish or resume an RRC connection.

### 5.3.15.2 Reception of the *RRCReject* by the UE

The UE shall:

- 1> stop timer T300, if running;
- 1> stop timer T319, if running;
- 1> stop timer T302, if running;
- 1> reset MAC and release the default MAC Cell Group configuration;
- 1> if *waitTime* is configured in the *RRCReject*:
  - 2> start timer T302, with the timer value set to the *waitTime*;
- 1> if *RRCReject* is received in response to a request from upper layers:
  - 2> inform the upper layer that access barring is applicable for all access categories except categories '0' and '2';



- 1> if *RRCReject* is received in response to an *RRCSetupRequest*:
  - 2> inform upper layers about the failure to setup the RRC connection, upon which the procedure ends;
- 1> else if *RRCReject* is received in response to an *RRCResumeRequest* or an *RRCResumeRequest1*:
  - 2> if resume is triggered by upper layers:
    - 3> inform upper layers about the failure to resume the RRC connection;
  - 2> if resume is triggered due to an RNA update:
    - 3> set the variable *pendingRnaUpdate* to *true*;
  - 2> discard the current  $K_{gNB}$  key, the  $K_{RRCenc}$  key, the  $K_{RRCint}$  key, the  $K_{UPint}$  key and the  $K_{UPenc}$  key derived in accordance with 5.3.13.3;
  - 2> suspend SRB1, upon which the procedure ends;

The RRC\_INACTIVE UE shall continue to monitor paging while the timer T302 is running.

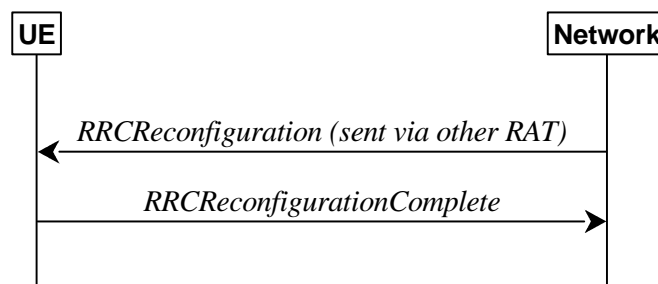
## 5.4 Inter-RAT mobility

### 5.4.1 Introduction

Network controlled inter-RAT mobility between NR and E-UTRA is supported, where E-UTRA can be connected to either EPC or 5GC.

### 5.4.2 Handover to NR

#### 5.4.2.1 General



**Figure 5.4.2.1-1: Handover to NR, successful**

The purpose of this procedure is to, under the control of the network, transfer a connection between the UE and another Radio Access Network (e.g. E-UTRAN) to NR.

The handover to NR procedure applies when SRBs, possibly in combination with DRBs, are established in another RAT. Handover from E-UTRA to NR applies only after integrity has been activated in E-UTRA.

#### 5.4.2.2 Initiation

The RAN using another RAT initiates the handover to NR procedure, in accordance with the specifications applicable for the other RAT, by sending the *RRCReconfiguration* message via the radio access technology from which the inter-RAT handover is performed.

The network applies the procedure as follows:

- to activate ciphering, possibly using NULL algorithm, if not yet activated in the other RAT;
- to re-establish SRBs and one or more DRBs;

### 5.4.2.3 Reception of the *RRCReconfiguration* by the UE

The UE shall:

- 1> apply the default L1 parameter values as specified in corresponding physical layer specifications except for the parameters for which values are provided in *SIB1*;
- 1> apply the default MAC Cell Group configuration as specified in 9.2.2;
- 1> perform RRC reconfiguration procedure as specified in 5.3.5;

NOTE: If the UE is connected to 5GC of the source E-UTRA cell, the delta configuration for PDCP and SDAP can be used for intra-system inter-RAT handover. For other cases, source RAT configuration is not considered when the UE applies the reconfiguration message of target RAT.

## 5.4.3 Mobility from NR

### 5.4.3.1 General



Figure 5.4.3.1-1: Mobility from NR, successful

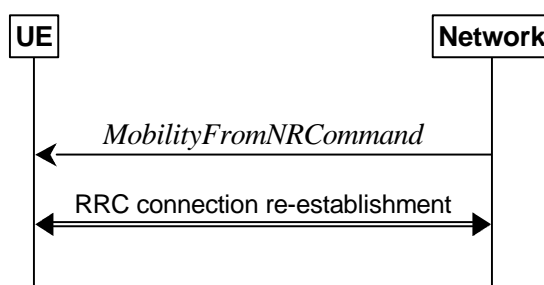


Figure 5.4.3.1-2: Mobility from NR, failure

The purpose of this procedure is to move a UE in RRC\_CONNECTED to a cell using other RAT, e.g. E-UTRA. The mobility from NR procedure covers the following type of mobility:

- handover, i.e. the *MobilityFromNRCommand* message includes radio resources that have been allocated for the UE in the target cell;

### 5.4.3.2 Initiation

The network initiates the mobility from NR procedure to a UE in RRC\_CONNECTED, possibly in response to a *MeasurementReport* message, by sending a *MobilityFromNRCommand* message. The network applies the procedure as follows:

- the procedure is initiated only when AS security has been activated, and SRB2 with at least one DRB are setup and not suspended.

### 5.4.3.3 Reception of the *MobilityFromNRCommand* by the UE

The UE shall:

- 1> if T390 is running:

- 2> stop timer T390 for all access categories;
- 2> perform the actions as specified in 5.3.14.4;
- 1> if the *targetRAT-Type* is set to *eutra*:
  - 2> consider inter-RAT mobility as initiated towards E-UTRA;
  - 2> forward the *nas-SecurityParamFromNR* to the upper layers, if included;
- 1> access the target cell indicated in the inter-RAT message in accordance with the specifications of the target RAT.

#### 5.4.3.4 Successful completion of the mobility from NR

Upon successfully completing the handover, at the source side the UE shall:

- 1> reset MAC;
- 1> stop all timers that are running;
- 1> release *ran-NotificationAreaInfo*, if stored;
- 1> release the AS security context including the  $K_{RRCEnc}$  key, the  $K_{RRCint}$  key, the  $K_{UPint}$  key and the  $K_{UPenc}$  key, if stored;
- 1> release all radio resources, including release of the RLC entity and the MAC configuration;
- 1> release the associated PDCP entity and SDAP entity for all established RBs;

NOTE : PDCP and SDAP configured by the source RAT prior to the handover that are reconfigured and re-used by target RAT when delta signalling (i.e., during inter-RAT intra-system handover when *fullConfig* is not present) is used, are not released as part of this procedure.

- 1> indicate the release of the RRC connection to upper layers together with the release cause 'other'.

#### 5.4.3.5 Mobility from NR failure

The UE shall:

- 1> if the UE does not succeed in establishing the connection to the target radio access technology; or
- 1> if the UE is unable to comply with any part of the configuration included in the *MobilityFromNRCommand* message; or
- 1> if there is a protocol error in the inter RAT information included in the *MobilityFromNRCommand* message, causing the UE to fail the procedure according to the specifications applicable for the target RAT:
  - 2> revert back to the configuration used in the source PCell;
  - 2> initiate the connection re-establishment procedure as specified in subclause 5.3.7.

## 5.5 Measurements

### 5.5.1 Introduction

The network may configure an RRC\_CONNECTED UE to perform measurements and report them in accordance with the measurement configuration. The measurement configuration is provided by means of dedicated signalling i.e. using the *RRCReconfiguration* or *RRCResume*.

The network may configure the UE to perform the following types of measurements:

- NR measurements;
- Inter-RAT measurements of E-UTRA frequencies.

The network may configure the UE to report the following measurement information based on SS/PBCH block(s):

- Measurement results per SS/PBCH block;
- Measurement results per cell based on SS/PBCH block(s);
- SS/PBCH block(s) indexes.

The network may configure the UE to report the following measurement information based on CSI-RS resources:

- Measurement results per CSI-RS resource;
- Measurement results per cell based on CSI-RS resource(s);
- CSI-RS resource measurement identifiers.

The measurement configuration includes the following parameters:

**1. Measurement objects:** A list of objects on which the UE shall perform the measurements.

- For intra-frequency and inter-frequency measurements a measurement object indicates the frequency/time location and subcarrier spacing of reference signals to be measured. Associated with this measurement object, the network may configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.
- The *measObjectId* of the MO which corresponds to each serving cell is indicated by *-servingCellMO* within the serving cell configuration.
- For inter-RAT E-UTRA measurements a measurement object is a single E-UTRA carrier frequency. Associated with this E-UTRA carrier frequency, the network can configure a list of cell specific offsets, a list of 'blacklisted' cells and a list of 'whitelisted' cells. Blacklisted cells are not applicable in event evaluation or measurement reporting. Whitelisted cells are the only ones applicable in event evaluation or measurement reporting.

**2. Reporting configurations:** A list of reporting configurations where there can be one or multiple reporting configurations per measurement object. Each reporting configuration consists of the following:

- Reporting criterion: The criterion that triggers the UE to send a measurement report. This can either be periodical or a single event description.
- RS type: The RS that the UE uses for beam and cell measurement results (SS/PBCH block or CSI-RS).
- Reporting format: The quantities per cell and per beam that the UE includes in the measurement report (e.g. RSRP) and other associated information such as the maximum number of cells and the maximum number beams per cell to report.

**3. Measurement identities:** A list of measurement identities where each measurement identity links one measurement object with one reporting configuration. By configuring multiple measurement identities, it is possible to link more than one measurement object to the same reporting configuration, as well as to link more than one reporting configuration to the same measurement object. The measurement identity is also included in the measurement report that triggered the reporting, serving as a reference to the network.

**4. Quantity configurations:** The quantity configuration defines the measurement filtering configuration used for all event evaluation and related reporting, and for periodical reporting of that measurement. For NR measurements, the network may configure up to 2 quantity configurations with a reference in the NR measurement object to the configuration that is to be used. In each configuration, different filter coefficients can be configured for different measurement quantities, for different RS types, and for measurements per cell and per beam.

**5. Measurement gaps:** Periods that the UE may use to perform measurements.

A UE in RRC\_CONNECTED maintains a measurement object list, a reporting configuration list, and a measurement identities list according to signalling and procedures in this specification. The measurement object list possibly includes NR measurement object(s) and inter-RAT objects. Similarly, the reporting configuration list includes NR and inter-RAT reporting configurations. Any measurement object can be linked to any reporting configuration of the same RAT

type. Some reporting configurations may not be linked to a measurement object. Likewise, some measurement objects may not be linked to a reporting configuration.

The measurement procedures distinguish the following types of cells:

1. The NR serving cell(s) – these are the SpCell and one or more SCells.
2. Listed cells – these are cells listed within the measurement object(s).
3. Detected cells – these are cells that are not listed within the measurement object(s) but are detected by the UE on the SSB frequency(ies) and subcarrier spacing(s) indicated by the measurement object(s).

For NR measurement object(s), the UE measures and reports on the serving cell(s), listed cells and/or detected cells. For inter-RAT measurements object(s) of E-UTRA, the UE measures and reports on listed cells and detected cells.

Whenever the procedural specification, other than contained in sub-clause 5.5.2, refers to a field it concerns a field included in the *VarMeasConfig* unless explicitly stated otherwise i.e. only the measurement configuration procedure covers the direct UE action related to the received *measConfig*.

In NR-DC, the UE may receive two independent *measConfig*:

- a *measConfig*, associated with MCG, that is included in the *RRCReconfiguration* message received via SRB1; and
- a *measConfig*, associated with SCG, that is included in the *RRCReconfiguration* message received via SRB3, or, alternatively, included within a *RRCReconfiguration* message embedded in a *RRCReconfiguration* message received via SRB1.

In this case, the UE maintains two independent *VarMeasConfig* and *VarMeasReportList*, one associated with each *measConfig*, and independently performs all the procedures in clause 5.5 for each *measConfig* and the associated *VarMeasConfig* and *VarMeasReportList*, unless explicitly stated otherwise.

## 5.5.2 Measurement configuration

### 5.5.2.1 General

The network applies the procedure as follows:

- to ensure that, whenever the UE has a *measConfig* associated with a CG, it includes a *measObject* for the SpCell and for each NR SCell of the CG to be measured;
- to configure at most one measurement identity across all CGs using a reporting configuration with the *reportType* set to *reportCGI*;
- to ensure that, in the *measConfig* associated with a CG:
  - for all SSB based measurements there is at most one measurement object with the same *ssbFrequency*;
  - an *smtc1* included in any measurement object with the same *ssbFrequency* has the same value and that an *smtc2* included in any measurement object with the same *ssbFrequency* has the same value;
- to ensure that all measurement objects configured in this specification and in TS 36.331 [10] with the same *ssbFrequency* have the same *ssbSubcarrierSpacing*;
- to ensure that, if a measurement object associated with the MCG has the same *ssbFrequency* as a measurement object associated with the SCG:
  - for that *ssbFrequency*, the measurement window according to the *smtc1* configured by the MCG includes the measurement window according to the *smtc1* configured by the SCG, or vice-versa, with an accuracy of the maximum receive timing difference specified in TS 38.133 [14].
  - if both measurement objects are used for RSSI measurements, bits in *measurementSlots* in both objects corresponding to the same slot are set to the same value. Also, the *endSymbol* is the same in both objects.

- to ensure that, if a measurement object has the same *ssbFrequency* as a measurement object configured in TS 36.331 [10]:
  - for that *ssbFrequency*, the measurement window according to the *smtc* configured in TS 36.331 [10] includes the measurement window according to the *smtc1* configured in TS 38.331, or vice-versa, with an accuracy of the maximum receive timing difference specified in TS 38.133 [14].
  - if both measurement objects are used for RSSI measurements, bits in *measurementSlots* in both objects corresponding to the same slot are set to the same value. Also, the *endSymbol* is the same in both objects.
- when the UE is in NE-DC or NR-DC, to configure at most one measurement identity using a reporting configuration with the *reportType* set to *reportSFTD*;

For CSI-RS resources, the network applies the procedure as follows:

- to ensure that all CSI-RS resources configured in each measurement object have the same center frequency, ( $startPRB + \text{floor}(nrofPRBs/2)$ )

The UE shall:

- 1> if the received *measConfig* includes the *measObjectToRemoveList*:
  - 2> perform the measurement object removal procedure as specified in 5.5.2.4;
- 1> if the received *measConfig* includes the *measObjectToAddModList*:
  - 2> perform the measurement object addition/modification procedure as specified in 5.5.2.5;
- 1> if the received *measConfig* includes the *reportConfigToRemoveList*:
  - 2> perform the reporting configuration removal procedure as specified in 5.5.2.6;
- 1> if the received *measConfig* includes the *reportConfigToAddModList*:
  - 2> perform the reporting configuration addition/modification procedure as specified in 5.5.2.7;
- 1> if the received *measConfig* includes the *quantityConfig*:
  - 2> perform the quantity configuration procedure as specified in 5.5.2.8;
- 1> if the received *measConfig* includes the *measIdToRemoveList*:
  - 2> perform the measurement identity removal procedure as specified in 5.5.2.2;
- 1> if the received *measConfig* includes the *measIdToAddModList*:
  - 2> perform the measurement identity addition/modification procedure as specified in 5.5.2.3;
- 1> if the received *measConfig* includes the *measGapConfig*:
  - 2> perform the measurement gap configuration procedure as specified in 5.5.2.9;
- 1> if the received *measConfig* includes the *measGapSharingConfig*:
  - 2> perform the measurement gap sharing configuration procedure as specified in 5.5.2.11;
- 1> if the received *measConfig* includes the *s-MeasureConfig*:
  - 2> if *s-MeasureConfig* is set to *ssb-RSRP*, set parameter *ssb-RSRP* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*;
  - 2> else, set parameter *csi-RSRP* of *s-MeasureConfig* within *VarMeasConfig* to the lowest value of the RSRP ranges indicated by the received value of *s-MeasureConfig*.

### 5.5.2.2 Measurement identity removal

The UE shall:

- 1> for each *measId* included in the received *measIdToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:
  - 2> remove the entry with the matching *measId* from the *measIdList* within the *VarMeasConfig*;
  - 2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
  - 2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *measIdToRemoveList* includes any *measId* value that is not part of the current UE configuration.

### 5.5.2.3 Measurement identity addition/modification

The network applies the procedure as follows:

- configure a *measId* only if the corresponding measurement object, the corresponding reporting configuration and the corresponding quantity configuration, are configured.

The UE shall:

- 1> for each *measId* included in the received *measIdToAddModList*:
  - 2> if an entry with the matching *measId* exists in the *measIdList* within the *VarMeasConfig*:
    - 3> replace the entry with the value received for this *measId*;
  - 2> else:
    - 3> add a new entry for this *measId* within the *VarMeasConfig*;
  - 2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
  - 2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;
  - 2> if the *reportType* is set to *reportCGI* in the *reportConfig* associated with this *measId*:
    - 3> if the *measObject* associated with this *measId* concerns E-UTRA:
      - 4> start timer T321 with the timer value set to 1 second for this *measId*;
    - 3> if the *measObject* associated with this *measId* concerns NR:
      - 4> if the *measObject* associated with this *measId* concerns FR1:
        - 5> start timer T321 with the timer value set to 2 seconds for this *measId*;
      - 4> if the *measObject* associated with this *measId* concerns FR2:
        - 5> start timer T321 with the timer value set to 16 seconds for this *measId*.

### 5.5.2.4 Measurement object removal

The UE shall:

- 1> for each *measObjectId* included in the received *measObjectToRemoveList* that is part of *measObjectList* in *VarMeasConfig*:
  - 2> remove the entry with the matching *measObjectId* from the *measObjectList* within the *VarMeasConfig*;
  - 2> remove all *measId* associated with this *measObjectId* from the *measIdList* within the *VarMeasConfig*, if any;
  - 2> if a *measId* is removed from the *measIdList*:
    - 3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;

- 3> stop the periodical reporting timer or timer T321, whichever is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *measObjectToRemoveList* includes any *measObjectId* value that is not part of the current UE configuration.

### 5.5.2.5 Measurement object addition/modification

The UE shall:

- 1> for each *measObjectId* included in the received *measObjectToAddModList*:
    - 2> if an entry with the matching *measObjectId* exists in the *measObjectList* within the *VarMeasConfig*, for this entry:
      - 3> reconfigure the entry with the value received for this *measObject*, except for the fields *cellsToAddModList*, *blackCellsToAddModList*, *whiteCellsToAddModList*, *cellsToRemoveList*, *blackCellsToRemoveList* and *whiteCellsToRemoveList*;
    - 3> if the received *measObject* includes the *cellsToRemoveList*:
      - 4> for each *physCellId* included in the *cellsToRemoveList*:
        - 5> remove the entry with the matching *physCellId* from the *cellsToAddModList*;
    - 3> if the received *measObject* includes the *cellsToAddModList*:
      - 4> for each *physCellId* value included in the *cellsToAddModList*:
        - 5> if an entry with the matching *physCellId* exists in the *cellsToAddModList*:
          - 6> replace the entry with the value received for this *physCellId*;
        - 5> else:
          - 6> add a new entry for the received *physCellId* to the *cellsToAddModList*;
    - 3> if the received *measObject* includes the *blackCellsToRemoveList*:
      - 4> for each *pci-RangeIndex* included in the *blackCellsToRemoveList*:
        - 5> remove the entry with the matching *pci-RangeIndex* from the *blackCellsToAddModList*;
- NOTE: For each *pci-RangeIndex* included in the *blackCellsToRemoveList* that concerns overlapping ranges of cells, a cell is removed from the blacklist of cells only if all PCI ranges containing it are removed.
- 3> if the received *measObject* includes the *blackCellsToAddModList*:
    - 4> for each *pci-RangeIndex* included in the *blackCellsToAddModList*:
      - 5> if an entry with the matching *pci-RangeIndex* is included in the *blackCellsToAddModList*:
        - 6> replace the entry with the value received for this *pci-RangeIndex*;
      - 5> else:
        - 6> add a new entry for the received *pci-RangeIndex* to the *blackCellsToAddModList*;
  - 3> if the received *measObject* includes the *whiteCellsToRemoveList*:
    - 4> for each *pci-RangeIndex* included in the *whiteCellsToRemoveList*:
      - 5> remove the entry with the matching *pci-RangeIndex* from the *whiteCellsToAddModList*;
  - 3> if the received *measObject* includes the *whiteCellsToAddModList*:
    - 4> for each *pci-RangeIndex* included in the *whiteCellsToAddModList*:



- 5> if an entry with the matching *pci-RangeIndex* is included in the *whiteCellsToAddModList*:
  - 6> replace the entry with the value received for this *pci-RangeIndex*;
- 5> else:
  - 6> add a new entry for the received *pci-RangeIndex* to the *whiteCellsToAddModList* for each *measId* associated with this *measObjectId* in the *measIdList* within the *VarMeasConfig*, if any;
  - 4> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
  - 4> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;
- 2> else:
  - 3> add a new entry for the received *measObject* to the *measObjectList* within *VarMeasConfig*.

### 5.5.2.6 Reporting configuration removal

The UE shall:

- 1> for each *reportConfigId* included in the received *reportConfigToRemoveList* that is part of the current UE configuration in *VarMeasConfig*:
  - 2> remove the entry with the matching *reportConfigId* from the *reportConfigList* within the *VarMeasConfig*;
  - 2> remove all *measId* associated with the *reportConfigId* from the *measIdList* within the *VarMeasConfig*, if any;
  - 2> if a *measId* is removed from the *measIdList*:
    - 3> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
    - 3> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

NOTE: The UE does not consider the message as erroneous if the *reportConfigToRemoveList* includes any *reportConfigId* value that is not part of the current UE configuration.

### 5.5.2.7 Reporting configuration addition/modification

The UE shall:

- 1> for each *reportConfigId* included in the received *reportConfigToAddModList*:
  - 2> if an entry with the matching *reportConfigId* exists in the *reportConfigList* within the *VarMeasConfig*, for this entry:
    - 3> reconfigure the entry with the value received for this *reportConfig*;
    - 3> for each *measId* associated with this *reportConfigId* included in the *measIdList* within the *VarMeasConfig*, if any:
      - 4> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
      - 4> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*;
  - 2> else:
    - 3> add a new entry for the received *reportConfig* to the *reportConfigList* within the *VarMeasConfig*.

NOTE: UE does not need to retain the *reportConfig* with the associated *cellForWhichToReportCGI* and *measId* after reporting *cgi-Info*.

### 5.5.2.8 Quantity configuration

The UE shall:

- 1> for each RAT for which the received *quantityConfig* includes parameter(s):
  - 2> set the corresponding parameter(s) in *quantityConfig* within *VarMeasConfig* to the value of the received *quantityConfig* parameter(s);
- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
  - 2> remove the measurement reporting entry for this *measId* from the *VarMeasReportList*, if included;
  - 2> stop the periodical reporting timer or timer T321, whichever one is running, and reset the associated information (e.g. *timeToTrigger*) for this *measId*.

### 5.5.2.9 Measurement gap configuration

The UE shall:

- 1> if *gapFR1* is set to *setup*:
  - 2> if an FR1 measurement gap configuration is already setup, release the FR1 measurement gap configuration;
  - 2> setup the FR1 measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:
 
$$\text{SFN mod } T = \text{FLOOR}(\text{gapOffset}/10);$$

$$\text{subframe} = \text{gapOffset mod } 10;$$
 with  $T = \text{MGRP}/10$  as defined in TS 38.133 [14];
  - 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);
- 1> else if *gapFR1* is set to *release*:
  - 2> release the FR1 measurement gap configuration;
- 1> if *gapFR2* is set to *setup*:
  - 2> if an FR2 measurement gap configuration is already setup, release the FR2 measurement gap configuration;
  - 2> setup the FR2 measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:
 
$$\text{SFN mod } T = \text{FLOOR}(\text{gapOffset}/10);$$

$$\text{subframe} = \text{gapOffset mod } 10;$$
 with  $T = \text{MGRP}/10$  as defined in TS 38.133 [14];
  - 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);
- 1> else if *gapFR2* is set to *release*:
  - 2> release the FR2 measurement gap configuration;
- 1> if *gapUE* is set to *setup*:
  - 2> if a per UE measurement gap configuration is already setup, release the per UE measurement gap configuration;

- 2> setup the per UE measurement gap configuration indicated by the *measGapConfig* in accordance with the received *gapOffset*, i.e., the first subframe of each gap occurs at an SFN and subframe meeting the following condition:

$$\text{SFN mod } T = \text{FLOOR}(\text{gapOffset}/10);$$

$$\text{subframe} = \text{gapOffset mod } 10;$$

with  $T = \text{MGRP}/10$  as defined in TS 38.133 [14];

- 2> apply the specified timing advance *mgta* to the gap occurrences calculated above (i.e. the UE starts the measurement *mgta* ms before the gap subframe occurrences);

1> else if *gapUE* is set to *release*:

- 2> release the per UE measurement gap configuration.

NOTE 1: For *gapFR2* configuration, for the UE in NE-DC or NR-DC, the SFN and subframe of the serving cell indicated by the *refServCellIndicator* in *gapFR2* is used in the gap calculation. Otherwise, the SFN and subframe of a serving cell on FR2 frequency is used in the gap calculation

NOTE 2: For *gapFR1* or *gapUE* configuration, for the UE in NE-DC or NR-DC, the SFN and subframe of the serving cell indicated by the *refServCellIndicator* in corresponding *gapFR1* or *gapUE* is used in the gap calculation. Otherwise, the SFN and subframe of the PCell is used in the gap calculation.

### 5.5.2.10 Reference signal measurement timing configuration

The UE shall setup the first SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicityAndOffset* parameter (providing *Periodicity* and *Offset* value for the following condition) in the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the following condition:

$$\text{SFN mod } T = (\text{FLOOR}(\text{Offset}/10));$$

if the *Periodicity* is larger than *sf5*:

$$\text{subframe} = \text{Offset mod } 10;$$

else:

$$\text{subframe} = \text{Offset or } (\text{Offset} + 5);$$

with  $T = \text{CEIL}(\text{Periodicity}/10)$ .

If *smtc2* is present, for cells indicated in the *pci-List* parameter in *smtc2* in the same *MeasObjectNR*, the UE shall setup an additional SS/PBCH block measurement timing configuration (SMTC) in accordance with the received *periodicity* parameter in the *smtc2* configuration and use the *Offset* (derived from parameter *periodicityAndOffset*) and *duration* parameter from the *smtc1* configuration. The first subframe of each SMTC occasion occurs at an SFN and subframe of the NR SpCell meeting the above condition.

On the indicated *ssbFrequency*, the UE shall not consider SS/PBCH block transmission in subframes outside the SMTC occasion for RRM measurements based on SS/PBCH blocks and for RRM measurements based on CSI-RS.

### 5.5.2.11 Measurement gap sharing configuration

The UE shall:

- 1> if *gapSharingFR1* is set to *setup*:
- 2> if an FR1 measurement gap sharing configuration is already setup:
  - 3> release the FR1 measurement gap sharing configuration;
- 2> setup the FR1 measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingFR1* as defined in TS 38.133 [14];

- 1> else if *gapSharingFR1* is set to *release*:
  - 2> release the FR1 measurement gap sharing configuration;
- 1> if *gapSharingFR2* is set to *setup*:
  - 2> if an FR2 measurement gap sharing configuration is already setup:
    - 3> release the FR2 measurement gap sharing configuration;
  - 2> setup the FR2 measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingFR2* as defined in TS 38.133 [14];
- 1> else if *gapSharingFR2* is set to *release*:
  - 2> release the FR2 measurement gap sharing configuration.
- 1> if *gapSharingUE* is set to *setup*:
  - 2> if a per UE measurement gap sharing configuration is already setup:
    - 3> release the per UE measurement gap sharing configuration;
  - 2> setup the per UE measurement gap sharing configuration indicated by the *measGapSharingConfig* in accordance with the received *gapSharingUE* as defined in TS 38.133 [14];
- 1> else if *gapSharingUE* is set to *release*:
  - 2> release the per UE measurement gap sharing configuration.

## 5.5.3 Performing measurements

### 5.5.3.1 General

An RRC\_CONNECTED UE shall derive cell measurement results by measuring one or multiple beams associated per cell as configured by the network, as described in 5.5.3.3. For all cell measurement results in RRC\_CONNECTED the UE applies the layer 3 filtering as specified in 5.5.3.2, before using the measured results for evaluation of reporting criteria and measurement reporting. For cell measurements, the network can configure RSRP, RSRQ or SINR as trigger quantity. Reporting quantities can be any combination of quantities (i.e. only RSRP; only RSRQ; only SINR; RSRP and RSRQ; RSRP and SINR; RSRQ and SINR; RSRP, RSRQ and SINR), irrespective of the trigger quantity.

The network may also configure the UE to report measurement information per beam (which can either be measurement results per beam with respective beam identifier(s) or only beam identifier(s)), derived as described in 5.5.3.3a. If beam measurement information is configured to be included in measurement reports, the UE applies the layer 3 beam filtering as specified in 5.5.3.2. On the other hand, the exact L1 filtering of beam measurements used to derive cell measurement results is implementation dependent.

The UE shall:

- 1> whenever the UE has a *measConfig*, perform RSRP and RSRQ measurements for each serving cell for which *servingCellMO* is configured as follows:
  - 2> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *ssb* and *ssb-ConfigMobility* is configured in the *measObject* indicated by the *servingCellMO*:
    - 3> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* and contains an *rsType* set to *ssb*:
      - 4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;
    - 3> derive serving cell measurement results based on SS/PBCH block, as described in 5.5.3.3;

- 2> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains an *rsType* set to *csi-rs* and *CSI-RS-ResourceConfigMobility* is configured in the *measObject* indicated by the *servingCellMO*:
  - 3> if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* and contains an *rsType* set to *csi-rs*:
    - 4> derive layer 3 filtered RSRP and RSRQ per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;
  - 3> derive serving cell measurement results based on CSI-RS, as described in 5.5.3.3;
- 1> for each serving cell for which *servingCellMO* is configured, if the *reportConfig* associated with at least one *measId* included in the *measIdList* within *VarMeasConfig* contains SINR as trigger quantity and/or reporting quantity:
  - 2> if the *reportConfig* contains *rsType* set to *ssb* and *ssb-ConfigMobility* is configured in the *servingCellMO*:
    - 3> if the *reportConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
      - 4> derive layer 3 filtered SINR per beam for the serving cell based on SS/PBCH block, as described in 5.5.3.3a;
    - 3> derive serving cell SINR based on SS/PBCH block, as described in 5.5.3.3;
  - 2> if the *reportConfig* contains *rsType* set to *csi-rs* and *CSI-RS-ResourceConfigMobility* is configured in the *servingCellMO*:
    - 3> if the *reportConfig* contains a *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
      - 4> derive layer 3 filtered SINR per beam for the serving cell based on CSI-RS, as described in 5.5.3.3a;
    - 3> derive serving cell SINR based on CSI-RS, as described in 5.5.3.3;
- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
  - 2> if the *reportType* for the associated *reportConfig* is set to *reportCGI*:
    - 3> perform the corresponding measurements on the frequency and RAT indicated in the associated *measObject* using available idle periods;
    - 3> if the cell indicated by *reportCGI* field for the associated *measObject* is an NR cell and that indicated cell is broadcasting *SIB1* (see TS 38.213 [13], clause 13):
      - 4> try to acquire *SIB1* in the concerned cell;
    - 3> if the cell indicated by *reportCGI* field is an E-UTRA cell:
      - 4> try to acquire *SystemInformationBlockType1* in the concerned cell;
  - 2> if the *reportType* for the associated *reportConfig* is *periodical* or *eventTriggered*:
    - 3> if a measurement gap configuration is setup, or
    - 3> if the UE does not require measurement gaps to perform the concerned measurements:
      - 4> if *s-MeasureConfig* is not configured, or
      - 4> if *s-MeasureConfig* is set to *ssb-RSRP* and the NR SpCell RSRP based on SS/PBCH block, after layer 3 filtering, is lower than *ssb-RSRP*, or
      - 4> if *s-MeasureConfig* is set to *csi-RSRP* and the NR SpCell RSRP based on CSI-RS, after layer 3 filtering, is lower than *csi-RSRP*:
      - 5> if the *measObject* is associated to NR and the *rsType* is set to *csi-rs*:

- 6> if *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* for the associated *reportConfig* are configured:
  - 7> derive layer 3 filtered beam measurements only based on CSI-RS for each measurement quantity indicated in *reportQuantityRS-Indexes*, as described in 5.5.3.3a;
- 6> derive cell measurement results based on CSI-RS for the trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;
- 5> if the *measObject* is associated to NR and the *rsType* is set to *ssb*:
  - 6> if *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* for the associated *reportConfig* are configured:
    - 7> derive layer 3 beam measurements only based on SS/PBCH block for each measurement quantity indicated in *reportQuantityRS-Indexes*, as described in 5.5.3.3a;
  - 6> derive cell measurement results based on SS/PBCH block for the trigger quantity and each measurement quantity indicated in *reportQuantityCell* using parameters from the associated *measObject*, as described in 5.5.3.3;
- 5> if the *measObject* is associated to E-UTRA:
  - 6> perform the corresponding measurements associated to neighbouring cells on the frequencies indicated in the concerned *measObject*;
- 2> if the *reportType* for the associated *reportConfig* is set to *reportSFTD*:
  - 3> if the *reportSFTD-Meas* is set to *true*:
    - 4> if the *measObject* is associated to E-UTRA:
      - 5> perform SFTD measurements between the PCell and the E-UTRA PSCell;
      - 5> if the *reportRSRP* is set to *true*;
        - 6> perform RSRP measurements for the E-UTRA PSCell;
    - 4> else if the *measObject* is associated to NR:
      - 5> perform SFTD measurements between the PCell and the NR PSCell;
      - 5> if the *reportRSRP* is set to *true*;
        - 6> perform RSRP measurements for the NR PSCell;
  - 2> perform the evaluation of reporting criteria as specified in 5.5.4.

### 5.5.3.2 Layer 3 filtering

The UE shall:

- 1> for each cell measurement quantity and for each beam measurement quantity that the UE performs measurements according to 5.5.3.1:
- 2> filter the measured result, before using for evaluation of reporting criteria or for measurement reporting, by the following formula:

$$F_n = (1 - a) * F_{n-1} + a * M_n$$

where

$M_n$  is the latest received measurement result from the physical layer;

$F_n$  is the updated filtered measurement result, that is used for evaluation of reporting criteria or for measurement reporting;

$F_{n-1}$  is the old filtered measurement result, where  $F_0$  is set to  $M_1$  when the first measurement result from the physical layer is received; and  $a = 1/2^{(ki^4)}$ , where  $k_i$  is the *filterCoefficient* for the corresponding measurement quantity of the  $i$ :th *QuantityConfigNR* in *quantityConfigNR-List*, and  $i$  is indicated by *quantityConfigIndex* in *MeasObjectNR*;

- 2> adapt the filter such that the time characteristics of the filter are preserved at different input rates, observing that the *filterCoefficient*  $k$  assumes a sample rate equal to  $X$  ms; The value of  $X$  is equivalent to one intra-frequency L1 measurement period as defined in TS 38.133 [14] assuming non-DRX operation, and depends on frequency range.

NOTE 1: If  $k$  is set to 0, no layer 3 filtering is applicable.

NOTE 2: The filtering is performed in the same domain as used for evaluation of reporting criteria or for measurement reporting, i.e., logarithmic filtering for logarithmic measurements.

NOTE 3: The filter input rate is implementation dependent, to fulfil the performance requirements set in TS 38.133 [14]. For further details about the physical layer measurements, see TS 38.133 [14].

### 5.5.3.3 Derivation of cell measurement results

The network may configure the UE to derive RSRP, RSRQ and SINR measurement results per cell associated to NR measurement objects based on parameters configured in the *measObject* (e.g. maximum number of beams to be averaged and beam consolidation thresholds) and in the *reportConfig* (*rsType* to be measured, SS/PBCH block or CSI-RS).

The UE shall:

- 1> for each cell measurement quantity to be derived based on SS/PBCH block:
  - 2> if *nrofSS-BlocksToAverage* in the associated *measObject* is not configured; or
  - 2> if *absThreshSS-BlocksConsolidation* in the associated *measObject* is not configured; or
  - 2> if the highest beam measurement quantity value is below or equal to *absThreshSS-BlocksConsolidation*:
    - 3> derive each cell measurement quantity based on SS/PBCH block as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];
  - 2> else:
    - 3> derive each cell measurement quantity based on SS/PBCH block as the linear power scale average of the highest beam measurement quantity values above *absThreshSS-BlocksConsolidation* where the total number of averaged beams shall not exceed *nrofSS-BlocksToAverage*;
  - 2> apply layer 3 cell filtering as described in 5.5.3.2;
- 1> for each cell measurement quantity to be derived based on CSI-RS:
  - 2> consider a CSI-RS resource to be applicable for deriving cell measurements when the concerned CSI-RS resource is included in the *csi-rs-CellMobility* including the *physCellId* of the cell in the *CSI-RS-ResourceConfigMobility* in the associated *measObject*;
  - 2> if *nrofCSI-RS-ResourcesToAverage* in the associated *measObject* is not configured; or
  - 2> if *absThreshCSI-RS-Consolidation* in the associated *measObject* is not configured; or
  - 2> if the highest beam measurement quantity value is below or equal to *absThreshCSI-RS-Consolidation*:
    - 3> derive each cell measurement quantity based on applicable CSI-RS resources for the cell as the highest beam measurement quantity value, where each beam measurement quantity is described in TS 38.215 [9];
  - 2> else:
    - 3> derive each cell measurement quantity based on CSI-RS as the linear power scale average of the highest beam measurement quantity values above *absThreshCSI-RS-Consolidation* where the total number of averaged beams shall not exceed *nrofCSI-RS-ResourcesToAverage*;

- 2> apply layer 3 cell filtering as described in 5.5.3.2.

### 5.5.3.3a Derivation of layer 3 beam filtered measurement

The UE shall:

- 1> for each layer 3 beam filtered measurement quantity to be derived based on SS/PBCH block;
  - 2> derive each configured beam measurement quantity based on SS/PBCH block as described in TS 38.215[9], and apply layer 3 beam filtering as described in 5.5.3.2;
- 1> for each layer 3 beam filtered measurement quantity to be derived based on CSI-RS;
  - 2> derive each configured beam measurement quantity based on CSI-RS as described in TS 38.215 [9], and apply layer 3 beam filtering as described in 5.5.3.2.

## 5.5.4 Measurement report triggering

### 5.5.4.1 General

If AS security has been activated successfully, the UE shall:

- 1> for each *measId* included in the *measIdList* within *VarMeasConfig*:
  - 2> if the corresponding *reportConfig* includes a *reportType* set to *eventTriggered* or *periodical*:
    - 3> if the corresponding *measObject* concerns NR:
      - 4> if the *eventA1* or *eventA2* is configured in the corresponding *reportConfig*:
        - 5> consider only the serving cell to be applicable;
      - 4> if the *eventA3* or *eventA5* is configured in the corresponding *reportConfig*:
        - 5> if a serving cell is associated with a *measObjectNR* and neighbours are associated with another *measObjectNR*, consider any serving cell associated with the other *measObjectNR* to be a neighbouring cell as well;
      - 4> if corresponding *reportConfig* includes *reportType* set to *periodical*; or
      - 4> for measurement events other than *eventA1* or *eventA2*:
        - 5> if *useWhiteCellList* is set to *true*:
          - 6> consider any neighbouring cell detected based on parameters in the associated *measObjectNR* to be applicable when the concerned cell is included in the *whiteCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;
        - 5> else:
          - 6> consider any neighbouring cell detected based on parameters in the associated *measObjectNR* to be applicable when the concerned cell is not included in the *blackCellsToAddModList* defined within the *VarMeasConfig* for this *measId*;
    - 3> else if the corresponding *measObject* concerns E-UTRA:
      - 4> if *eventB1* or *eventB2* is configured in the corresponding *reportConfig*:
        - 5> consider a serving cell, if any, on the associated E-UTRA frequency as neighbour cell;
      - 4> else:
        - 5> consider any neighbouring cell detected on the associated frequency to be applicable when the concerned cell is not included in the *blackCellsToAddModListEUTRAN* defined within the *VarMeasConfig* for this *measId*;



- 2> else if the corresponding *reportConfig* includes a *reportType* set to *reportCGI*:
  - 3> consider the cell detected on the associated *measObject* which has a physical cell identity matching the value of the *cellForWhichToReportCGI* included in the corresponding *reportConfig* within the *VarMeasConfig* to be applicable;
- 2> else if the corresponding *reportConfig* includes a *reportType* set to *reportSFTD*:
  - 3> if the corresponding *measObject* concerns NR:
    - 4> if the *reportSFTD-Meas* is set to *true*:
      - 5> consider the NR PSCell to be applicable;
  - 3> else if the corresponding *measObject* concerns E-UTRA:
    - 4> if the *reportSFTD-Meas* is set to *true*:
      - 5> consider the E-UTRA PSCell to be applicable;
- 2> if the *reportType* is set to *eventTriggered* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig*, while the *VarMeasReportList* does not include a measurement reporting entry for this *measId* (a first cell triggers the event):
  - 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
  - 3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
  - 3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;
  - 3> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> else if the *reportType* is set to *eventTriggered* and if the entry condition applicable for this event, i.e. the event corresponding with the *eventId* of the corresponding *reportConfig* within *VarMeasConfig*, is fulfilled for one or more applicable cells not included in the *cellsTriggeredList* for all measurements after layer 3 filtering taken during *timeToTrigger* defined for this event within the *VarMeasConfig* (a subsequent cell triggers the event):
  - 3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
  - 3> include the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;
  - 3> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> else if the *reportType* is set to *eventTriggered* and if the leaving condition applicable for this event is fulfilled for one or more of the cells included in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* for all measurements after layer 3 filtering taken during *timeToTrigger* defined within the *VarMeasConfig* for this event:
  - 3> remove the concerned cell(s) in the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId*;
  - 3> if *reportOnLeave* is set to *true* for the corresponding reporting configuration:
    - 4> initiate the measurement reporting procedure, as specified in 5.5.5;
  - 3> if the *cellsTriggeredList* defined within the *VarMeasReportList* for this *measId* is empty:
    - 4> remove the measurement reporting entry within the *VarMeasReportList* for this *measId*;
    - 4> stop the periodical reporting timer for this *measId*, if running;
- 2> if *reportType* is set to *periodical* and if a (first) measurement result is available:

- 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
- 3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
- 3> if the *reportAmount* exceeds 1:
  - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCell;
- 3> else (i.e. the *reportAmount* is equal to 1):
  - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the NR SpCell and for the strongest cell among the applicable cells;
- 2> upon expiry of the periodical reporting timer for this *measId*:
  - 3> initiate the measurement reporting procedure, as specified in 5.5.5.
- 2> if the corresponding *reportConfig* includes a *reportType* is set to *reportSFTD*:
  - 3> if the corresponding *measObject* concerns NR:
    - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the pair of PCell and NR PSCell or the maximal measurement reporting delay as specified in TS 38.133 [14];
  - 3> else if the corresponding *measObject* concerns E-UTRA:
    - 4> initiate the measurement reporting procedure, as specified in 5.5.5, immediately after the quantity to be reported becomes available for the pair of PCell and E-UTRA PSCell or the maximal measurement reporting delay as specified in TS 38.133 [14];
- 2> if *reportType* is set to *reportCGI*:
  - 3> if the UE acquired the *SIB1* or *SystemInformationBlockType1* for the requested cell; or
  - 3> if the UE detects that the requested NR cell is not transmitting *SIB1* (see TS 38.213 [13], clause 13):
    - 4> stop timer T321;
    - 4> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
    - 4> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
    - 4> initiate the measurement reporting procedure, as specified in 5.5.5;
- 2> upon the expiry of T321 for this *measId*:
  - 3> include a measurement reporting entry within the *VarMeasReportList* for this *measId*;
  - 3> set the *numberOfReportsSent* defined within the *VarMeasReportList* for this *measId* to 0;
  - 3> initiate the measurement reporting procedure, as specified in 5.5.5.

#### 5.5.4.2 Event A1 (Serving becomes better than threshold)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when condition A1-1, as specified below, is fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A1-2, as specified below, is fulfilled;
- 1> for this measurement, consider the NR serving cell corresponding to the associated *measObjectNR* associated with this event.

Inequality A1-1 (Entering condition)

$$Ms - Hys > Thresh$$

Inequality A1-2 (Leaving condition)

$$Ms + Hys < Thresh$$

The variables in the formula are defined as follows:

***Ms*** is the measurement result of the serving cell, not taking into account any offsets.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

***Thresh*** is the threshold parameter for this event (i.e. *a1-Threshold* as defined within *reportConfigNR* for this event).

***Ms*** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Hys*** is expressed in dB.

***Thresh*** is expressed in the same unit as ***Ms***.

#### 5.5.4.3 Event A2 (Serving becomes worse than threshold)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when condition A2-1, as specified below, is fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A2-2, as specified below, is fulfilled;
- 1> for this measurement, consider the serving cell indicated by the *measObjectNR* associated to this event.

Inequality A2-1 (Entering condition)

$$Ms + Hys < Thresh$$

Inequality A2-2 (Leaving condition)

$$Ms - Hys > Thresh$$

The variables in the formula are defined as follows:

***Ms*** is the measurement result of the serving cell, not taking into account any offsets.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

***Thresh*** is the threshold parameter for this event (i.e. *a2-Threshold* as defined within *reportConfigNR* for this event).

***Ms*** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Hys*** is expressed in dB.

***Thresh*** is expressed in the same unit as ***Ms***.

#### 5.5.4.4 Event A3 (Neighbour becomes offset better than SpCell)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when condition A3-1, as specified below, is fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A3-2, as specified below, is fulfilled;
- 1> use the SpCell for *Mp*, *Ofp* and *Ocp*.

NOTE The cell(s) that triggers the event has reference signals indicated in the *measObjectNR* associated to this event which may be different from the NR SpCell *measObjectNR*.

Inequality A3-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Mp + Ofp + Ocp + Off$$

Inequality A3-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Mp + Ofp + Ocp + Off$$

The variables in the formula are defined as follows:

**Mn** is the measurement result of the neighbouring cell, not taking into account any offsets.

**Ofn** is the measurement object specific offset of the reference signal of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

**Ocn** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the frequency of the neighbour cell), and set to zero if not configured for the neighbour cell.

**Mp** is the measurement result of the SpCell, not taking into account any offsets.

**Ofp** is the measurement object specific offset of the SpCell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the SpCell).

**Ocp** is the cell specific offset of the SpCell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the SpCell), and is set to zero if not configured for the SpCell.

**Hys** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

**Off** is the offset parameter for this event (i.e. *a3-Offset* as defined within *reportConfigNR* for this event).

**Mn, Mp** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

**Ofn, Ocn, Ofp, Ocp, Hys, Off** are expressed in dB.

#### 5.5.4.5 Event A4 (Neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition A4-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition A4-2, as specified below, is fulfilled.

Inequality A4-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Thresh$$

Inequality A4-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Thresh$$

The variables in the formula are defined as follows:

**Mn** is the measurement result of the neighbouring cell, not taking into account any offsets.

**Ofn** is the measurement object specific offset of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

**Ocn** is the measurement object specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the neighbour cell), and set to zero if not configured for the neighbour cell.

**Hys** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

**Thresh** is the threshold parameter for this event (i.e. *a4-Threshold* as defined within *reportConfigNR* for this event).

**Mn** is expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

**Ofn, Ocn, Hys** are expressed in dB.

**Thresh** is expressed in the same unit as **Mn**.

#### 5.5.4.6 Event A5 (SpCell becomes worse than threshold1 and neighbour becomes better than threshold2)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when both condition A5-1 and condition A5-2, as specified below, are fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A5-3 or condition A5-4, i.e. at least one of the two, as specified below, is fulfilled;
- 1> use the SpCell for *Mp*.

NOTE: The parameters of the reference signal(s) of the cell(s) that triggers the event are indicated in the *measObjectNR* associated to the event which may be different from the *measObjectNR* of the NR SpCell.

Inequality A5-1 (Entering condition 1)

$$M_p + H_{ys} < Thresh1$$

Inequality A5-2 (Entering condition 2)

$$M_n + Ofn + Ocn - H_{ys} > Thresh2$$

Inequality A5-3 (Leaving condition 1)

$$M_p - H_{ys} > Thresh1$$

Inequality A5-4 (Leaving condition 2)

$$M_n + Ofn + Ocn + H_{ys} < Thresh2$$

The variables in the formula are defined as follows:

***Mp*** is the measurement result of the NR SpCell, not taking into account any offsets.

***Mn*** is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ofn*** is the measurement object specific offset of the neighbour cell (i.e. *offsetMO* as defined within *measObjectNR* corresponding to the neighbour cell).

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within *measObjectNR* corresponding to the neighbour cell), and set to zero if not configured for the neighbour cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

***Thresh1*** is the threshold parameter for this event (i.e. *a5-Threshold1* as defined within *reportConfigNR* for this event).

***Thresh2*** is the threshold parameter for this event (i.e. *a5-Threshold2* as defined within *reportConfigNR* for this event).

***Mn*, *Mp*** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ofn*, *Ocn*, *Hys*** are expressed in dB.

***Thresh1*** is expressed in the same unit as ***Mp***.

***Thresh2*** is expressed in the same unit as ***Mn***.

#### 5.5.4.7 Event A6 (Neighbour becomes offset better than SCell)

The UE shall:

- 1> consider the entering condition for this event to be satisfied when condition A6-1, as specified below, is fulfilled;
- 1> consider the leaving condition for this event to be satisfied when condition A6-2, as specified below, is fulfilled;

1> for this measurement, consider the (secondary) cell corresponding to the *measObjectNR* associated to this event to be the serving cell.

NOTE: The reference signal(s) of the neighbour(s) and the reference signal(s) of the SCell are both indicated in the associated *measObjectNR*.

Inequality A6-1 (Entering condition)

$$Mn + Ocn - Hys > Ms + Ocs + Off$$

Inequality A6-2 (Leaving condition)

$$Mn + Ocn + Hys < Ms + Ocs + Off$$

The variables in the formula are defined as follows:

***Mn*** is the measurement result of the neighbouring cell, not taking into account any offsets.

***Ocn*** is the cell specific offset of the neighbour cell (i.e. *cellIndividualOffset* as defined within the associated *measObjectNR*), and set to zero if not configured for the neighbour cell.

***Ms*** is the measurement result of the serving cell, not taking into account any offsets.

***Ocs*** is the cell specific offset of the serving cell (i.e. *cellIndividualOffset* as defined within the associated *measObjectNR*), and is set to zero if not configured for the serving cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigNR* for this event).

***Off*** is the offset parameter for this event (i.e. *a6-Offset* as defined within *reportConfigNR* for this event).

***Mn, Ms*** are expressed in dBm in case of RSRP, or in dB in case of RSRQ and RS-SINR.

***Ocn, Ocs, Hys, Off*** are expressed in dB.

#### 5.5.4.8 Event B1 (Inter RAT neighbour becomes better than threshold)

The UE shall:

1> consider the entering condition for this event to be satisfied when condition B1-1, as specified below, is fulfilled;

1> consider the leaving condition for this event to be satisfied when condition B1-2, as specified below, is fulfilled.

Inequality B1-1 (Entering condition)

$$Mn + Ofn + Ocn - Hys > Thresh$$

Inequality B1-2 (Leaving condition)

$$Mn + Ofn + Ocn + Hys < Thresh$$

The variables in the formula are defined as follows:

***Mn*** is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets.

***Ofn*** is the measurement object specific offset of the frequency of the inter-RAT neighbour cell (i.e. *utra-Q-OffsetRange* as defined within the *measObjectEUTRA* corresponding to the frequency of the neighbour inter-RAT cell).

***Ocn*** is the cell specific offset of the inter-RAT neighbour cell (i.e. *cellIndividualOffset* as defined within the *measObjectEUTRA* corresponding to the neighbour inter-RAT cell), and set to zero if not configured for the neighbour cell.

***Hys*** is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigInterRAT* for this event).

***Thresh*** is the threshold parameter for this event (i.e. *b1-ThresholdEUTRA* as defined within *reportConfigInterRAT* for this event).

*Mn* is expressed in dBm or in dB, depending on the measurement quantity of the inter-RAT neighbour cell.

*Ofn, Ocn, Hys* are expressed in dB.

*Thresh* is expressed in the same unit as *Mn*.

#### 5.5.4.9 Event B2 (PCell becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2)

The UE shall:

1> consider the entering condition for this event to be satisfied when both condition B2-1 and condition B2-2, as specified below, are fulfilled;

1> consider the leaving condition for this event to be satisfied when condition B2-3 or condition B2-4, i.e. at least one of the two, as specified below, is fulfilled;

Inequality B2-1 (Entering condition 1)

$$Mp + Hys < Thresh1$$

Inequality B2-2 (Entering condition 2)

$$Mn + Ofn + Ocn - Hys > Thresh2$$

Inequality B2-3 (Leaving condition 1)

$$Mp - Hys > Thresh1$$

Inequality B2-4 (Leaving condition 2)

$$Mn + Ofn + Ocn + Hys < Thresh2$$

The variables in the formula are defined as follows:

*Mp* is the measurement result of the PCell, not taking into account any offsets.

*Mn* is the measurement result of the inter-RAT neighbour cell, not taking into account any offsets.

*Ofn* is the measurement object specific offset of the frequency of the inter-RAT neighbour cell (i.e. *extra-Q-OffsetRange* as defined within the *measObjectEUTRA* corresponding to the frequency of the inter-RAT neighbour cell).

*Ocn* is the cell specific offset of the inter-RAT neighbour cell (i.e. *cellIndividualOffset* as defined within the *measObjectEUTRA* corresponding to the neighbour inter-RAT cell), and set to zero if not configured for the neighbour cell.

*Hys* is the hysteresis parameter for this event (i.e. *hysteresis* as defined within *reportConfigInterRAT* for this event).

*Thresh1* is the threshold parameter for this event (i.e. *b2-Threshold1* as defined within *reportConfigInterRAT* for this event).

*Thresh2* is the threshold parameter for this event (i.e. *b2-Threshold2EUTRA* as defined within *reportConfigInterRAT* for this event).

*Mp* is expressed in dBm in case of RSRP, or in dB in case of RSRQ and SINR.

*Mn* is expressed in dBm or dB, depending on the measurement quantity of the inter-RAT neighbour cell.

*Ofn, Ocn, Hys* are expressed in dB.

*Thresh1* is expressed in the same unit as *Mp*.

*Thresh2* is expressed in the same unit as *Mn*.

## 5.5.5 Measurement reporting

### 5.5.5.1 General



**Figure 5.5.5.1-1: Measurement reporting**

The purpose of this procedure is to transfer measurement results from the UE to the network. The UE shall initiate this procedure only after successful AS security activation.

For the *measId* for which the measurement reporting procedure was triggered, the UE shall set the *measResults* within the *MeasurementReport* message as follows:

- 1> set the *measId* to the measurement identity that triggered the measurement reporting;
- 1> for each serving cell configured with *servicingCellMO*:
  - 2> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *rsType*:
    - 3> if the serving cell measurements based on the *rsType* included in the *reportConfig* that triggered the measurement report are available:
      - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on the *rsType* included in the *reportConfig* that triggered the measurement report;
    - 2> else:
      - 3> if SSB based serving cell measurements are available:
        - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on SSB;
      - 3> else if CSI-RS based serving cell measurements are available:
        - 4> set the *measResultServingCell* within *measResultServingMOList* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on CSI-RS;
  - 1> set the *servCellId* within *measResultServingMOList* to include each NR serving cell that is configured with *servicingCellMO*, if any;
  - 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
    - 2> for each serving cell configured with *servicingCellMO*, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;
  - 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
    - 2> for each *measObjectId* referenced in the *measIdList* which is also referenced with *servicingCellMO*, other than the *measObjectId* corresponding with the *measId* that triggered the measurement reporting:
      - 3> if the *measObjectNR* indicated by the *servicingCellMO* includes the RS resource configuration corresponding to the *rsType* indicated in the *reportConfig*:
        - 4> set the *measResultBestNeighCell* within *measResultServingMOList* to include the *physCellId* and the available measurement quantities based on the *reportQuantityCell* and *rsType* indicated in



*reportConfig* of the non-serving cell corresponding to the concerned *measObjectNR* with the highest measured RSRP if RSRP measurement results are available for cells corresponding to this *measObjectNR*, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells corresponding to this *measObjectNR*, otherwise with the highest measured SINR;

- 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
  - 5> for each best non-serving cell included in the measurement report:
    - 6> include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2;
- 1> if the *reportConfig* associated with the *measId* that triggered the measurement reporting is set to *eventTriggered* and *eventId* is set to *eventA3*, or *eventA4*, or *eventA5*, or *eventB1*, or *eventB2*:
  - 2> if the UE is in NE-DC and the measurement configuration that triggered this measurement report is associated with the MCG:
    - 3> set the *measResultServFreqListEUTRA-SCG* to include an entry for each E-UTRA SCG serving frequency with the following:
      - 4> include *carrierFreq* of the E-UTRA serving frequency;
      - 4> set the *measResultServingCell* to include the available measurement quantities that the UE is configured to measure by the measurement configuration associated with the SCG;
      - 4> if *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
        - 5> set the *measResultServFreqListEUTRA-SCG* to include within *measResultBestNeighCell* the quantities of the best non-serving cell, based on RSRP, on the concerned serving frequency;
  - 1> if *reportConfig* associated with the *measId* that triggered the measurement reporting is set to *eventTriggered* and *eventId* is set to *eventA3*, or *eventA4*, or *eventA5*:
    - 2> if the UE is in NR-DC and the measurement configuration that triggered this measurement report is associated with the MCG:
      - 3> set the *measResultServFreqListNR-SCG* to include for each NR SCG serving cell that is configured with *servingCellMO*, if any, the following:
        - 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *rsType*:
          - 5> if the serving cell measurements based on the *rsType* included in the *reportConfig* that triggered the measurement report are available according to the measurement configuration associated with the SCG:
            - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on the *rsType* included in the *reportConfig* that triggered the measurement report;
        - 4> else:
          - 5> if SSB based serving cell measurements are available according to the measurement configuration associated with the SCG:
            - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on SSB;
          - 5> else if CSI-RS based serving cell measurements are available according to the measurement configuration associated with the SCG:
            - 6> set the *measResultServingCell* within *measResultServFreqListNR-SCG* to include RSRP, RSRQ and the available SINR of the serving cell, derived based on CSI-RS;

- 4> if results for the serving cell derived based on SSB are included:
  - 5> include the *ssbFrequency* to the value indicated by *ssbFrequency* as included in the *MeasObjectNR* of the serving cell;
- 4> if results for the serving cell derived based on CSI-RS are included:
  - 5> include the *refFreqCSI-RS* to the value indicated by *refFreqCSI-RS* as included in the *MeasObjectNR* of the serving cell;
- 4> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
  - 5> for each serving cell configured with *servicingCellMO*, include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2, where availability is considered according to the measurement configuration associated with the SCG;
- 4> if *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportAddNeighMeas*:
  - 5> if the *measObjectNR* indicated by the *servicingCellMO* includes the RS resource configuration corresponding to the *rsType* indicated in the *reportConfig*:
    - 6> set the *measResultBestNeighCellListNR* within *measResultServFreqListNR-SCG* to include one entry with the *physCellId* and the available measurement quantities based on the *reportQuantityCell* and *rsType* indicated in *reportConfig* of the non-serving cell corresponding to the concerned *measObjectNR* with the highest measured RSRP if RSRP measurement results are available for cells corresponding to this *measObjectNR*, otherwise with the highest measured RSRQ if RSRQ measurement results are available for cells corresponding to this *measObjectNR*, otherwise with the highest measured SINR, where availability is considered according to the measurement configuration associated with the SCG;
    - 7> if the *reportConfig* associated with the *measId* that triggered the measurement reporting includes *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport*:
      - 8> for each best non-serving cell included in the measurement report:
        - 9> include beam measurement information according to the associated *reportConfig* as described in 5.5.5.2, where availability is considered according to the measurement configuration associated with the SCG;
- 1> if there is at least one applicable neighbouring cell to report:
  - 2> if the *reportType* is set to *eventTriggered* or *periodical*:
    - 3> set the *measResultNeighCells* to include the best neighbouring cells up to *maxReportCells* in accordance with the following:
      - 4> if the *reportType* is set to *eventTriggered*:
        - 5> include the cells included in the *cellsTriggeredList* as defined within the *VarMeasReportList* for this *measId*;
      - 4> else:
        - 5> include the applicable cells for which the new measurement results became available since the last periodical reporting or since the measurement was initiated or reset;
      - 4> for each cell that is included in the *measResultNeighCells*, include the *physCellId*;
      - 4> if the *reportType* is set to *eventTriggered* or *periodical*:
        - 5> for each included cell, include the layer 3 filtered measured results in accordance with the *reportConfig* for this *measId*, ordered as follows:
          - 6> if the *measObject* associated with this *measId* concerns NR:

- 7> if *rsType* in the associated *reportConfig* is set to *ssb*:
  - 8> set *resultsSSB-Cell* within the *measResult* to include the SS/PBCH block based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;
  - 8> if *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* are configured, include beam measurement information as described in 5.5.5.2;
- 7> else if *rsType* in the associated *reportConfig* is set to *csi-rs*:
  - 8> set *resultsCSI-RS-Cell* within the *measResult* to include the CSI-RS based quantity(ies) indicated in the *reportQuantityCell* within the concerned *reportConfig*, in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;
  - 8> if *reportQuantityRS-Indexes* and *maxNrofRS-IndexesToReport* are configured, include beam measurement information as described in 5.5.5.2;
- 6> if the *measObject* associated with this *measId* concerns E-UTRA:
  - 7> set the *measResult* to include the quantity(ies) indicated in the *reportQuantity* within the concerned *reportConfigInterRAT* in decreasing order of the sorting quantity, determined as specified in 5.5.5.3, i.e. the best cell is included first;
- 2> else:
  - 3> if the cell indicated by *cellForWhichToReportCGI* is an NR cell:
    - 4> if *plmn-IdentityInfoList* of the *cgi-Info* for the concerned cell has been obtained:
      - 5> include the *plmn-IdentityInfoList* including *plmn-IdentityList*, *trackingAreaCode* (if available), *ranac* (if available) and *cellIdentity* for each entry of the *plmn-IdentityInfoList*;
      - 5> include *frequencyBandList* if available;
    - 4> else if *MIB* indicates the *SIB1* is not broadcast:
      - 5> include the *noSIB1* including the *ssb-SubcarrierOffset* and *pdccch-ConfigSIB1* obtained from *MIB* of the concerned cell;
  - 3> if the cell indicated by *cellForWhichToReportCGI* is an E-UTRA cell:
    - 4> if all mandatory fields of the *cgi-Info-EPC* for the concerned cell have been obtained:
      - 5> include in the *cgi-Info-EPC* the fields broadcasted in E-UTRA *SystemInformationBlockType1* associated to EPC;
    - 4> if the UE is E-UTRA/5GC capable and all mandatory fields of the *cgi-Info-5GC* for the concerned cell have been obtained:
      - 5> include in the *cgi-Info-5GC* the fields broadcasted in E-UTRA *SystemInformationBlockType1* associated to 5GC;
    - 4> if the mandatory present fields of the *cgi-Info* for the cell indicated by the *cellForWhichToReportCGI* in the associated *measObject* have been obtained:
      - 5> include the *freqBandIndicator*;
      - 5> if the cell broadcasts the *multiBandInfoList*, include the *multiBandInfoList*;
      - 5> if the cell broadcasts the *freqBandIndicatorPriority*, include the *freqBandIndicatorPriority*;
  - 1> if the corresponding *measObject* concerns NR:
    - 2> if the *reportSFTD-Meas* is set to *true* within the corresponding *reportConfigNR* for this *measId*:

- 3> set the *measResultSFTD-NR* in accordance with the following:
  - 4> set *sfn-OffsetResult* and *frameBoundaryOffsetResult* to the measurement results provided by lower layers;
  - 4> if the *reportRSRP* is set to *true*;
    - 5> set *rsrp-Result* to the RSRP of the NR PSCell;
- 1> else if the corresponding *measObject* concerns E-UTRA:
  - 2> if the *reportSFTD-Meas* is set to *true* within the corresponding *reportConfigInterRAT* for this *measId*:
    - 3> set the *measResultSFTD-EUTRA* in accordance with the following:
      - 4> set *sfn-OffsetResult* and *frameBoundaryOffsetResult* to the measurement results provided by lower layers;
      - 4> if the *reportRSRP* is set to *true*;
        - 5> set *rsrpResult-EUTRA* to the RSRP of the EUTRA PSCell;
  - 1> increment the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* by 1;
  - 1> stop the periodical reporting timer, if running;
  - 1> if the *numberOfReportsSent* as defined within the *VarMeasReportList* for this *measId* is less than the *reportAmount* as defined within the corresponding *reportConfig* for this *measId*:
    - 2> start the periodical reporting timer with the value of *reportInterval* as defined within the corresponding *reportConfig* for this *measId*;
  - 1> else:
    - 2> if the *reportType* is set to *periodical*:
      - 3> remove the entry within the *VarMeasReportList* for this *measId*;
      - 3> remove this *measId* from the *measIdList* within *VarMeasConfig*;
  - 1> if the UE is in (NG)EN-DC:
    - 2> if SRB3 is configured:
      - 3> submit the *MeasurementReport* message via SRB3 to lower layers for transmission, upon which the procedure ends;
    - 2> else:
      - 3> submit the *MeasurementReport* message via the E-UTRA MCG embedded in E-UTRA RRC message *ULInformationTransferMRDC* as specified in TS 36.331 [10].
  - 1> else if the UE is in NR-DC:
    - 2> if the measurement configuration that triggered this measurement report is associated with the SCG:
      - 3> if SRB3 is configured:
        - 4> submit the *MeasurementReport* message via SRB3 to lower layers for transmission, upon which the procedure ends;
      - 3> else:
        - 4> submit the *MeasurementReport* message via the NR MCG embedded in NR RRC message *ULInformationTransferMRDC* as specified in 5.7.2a.3;
  - 1> else:

2> submit the *MeasurementReport* message to lower layers for transmission, upon which the procedure ends.

### 5.5.5.2 Reporting of beam measurement information

For beam measurement information to be included in a measurement report the UE shall:

1> if *reportType* is set to *eventTriggered*:

2> consider the trigger quantity as the sorting quantity if available, otherwise RSRP as sorting quantity if available, otherwise RSRQ as sorting quantity if available, otherwise SINR as sorting quantity;

1> if *reportType* is set to *periodical*:

2> if a single reporting quantity is set to *true* in *reportQuantityRS-Indexes*;

3> consider the configured single quantity as the sorting quantity;

2> else:

3> if *rsrp* is set to *true*;

4> consider RSRP as the sorting quantity;

3> else:

4> consider RSRQ as the sorting quantity;

1> set *rsIndexResults* to include up to *maxNrofRS-IndexesToReport* SS/PBCH block indexes or CSI-RS indexes in order of decreasing sorting quantity as follows:

2> if the measurement information to be included is based on SS/PBCH block:

3> include within *resultsSSB-Indexes* the index associated to the best beam for that SS/PBCH block sorting quantity and if *absThreshSS-BlocksConsolidation* is included in the *VarMeasConfig* for the *measObject* associated to the cell for which beams are to be reported, the remaining beams whose sorting quantity is above *absThreshSS-BlocksConsolidation*;

3> if *includeBeamMeasurements* is configured, include the SS/PBCH based measurement results for the quantities in *reportQuantityRS-Indexes* set to *true* for each SS/PBCH block index;

2> else if the beam measurement information to be included is based on CSI-RS:

3> include within *resultsCSI-RS-Indexes* the index associated to the best beam for that CSI-RS sorting quantity and, if *absThreshCSI-RS-Consolidation* is included in the *VarMeasConfig* for the *measObject* associated to the cell for which beams are to be reported, the remaining beams whose sorting quantity is above *absThreshCSI-RS-Consolidation*;

3> if *includeBeamMeasurements* is configured, include the CSI-RS based measurement results for the quantities in *reportQuantityRS-Indexes* set to *true* for each CSI-RS index.

### 5.5.5.3 Sorting of cell measurement results

The UE shall determine the sorting quantity according to parameters of the *reportConfig* associated with the *measId* that triggered the reporting:

1> if the *reportType* is set to *eventTriggered*:

2> for an NR cell, consider the quantity used in the in the *aN-Threshold* (for *eventA1*, *eventA2* and *eventA4*) or in the *a5-Threshold2* (for *eventA5*) or in the *aN-Offset* (for *eventA3* and *eventA6*) as the sorting quantity;

2> for an E-UTRA cell, consider the quantity used in the *bN-ThresholdEUTRA* as the sorting quantity;

1> if the *reportType* is set to *periodical*:

2> determine the sorting quantity according to *reportQuantityCell* for an NR cell, and according to *reportQuantity* for an E-UTRA cell, as below:

- 3> if a single quantity is set to *true*:
  - 4> consider this quantity as the sorting quantity;
- 3> else:
  - 4> if *rsrp* is set to *true*;
    - 5> consider RSRP as the sorting quantity;
  - 4> else:
    - 5> consider RSRQ as the sorting quantity.

## 5.5.6 Location measurement indication

### 5.5.6.1 General



**Figure 5.5.5.1-1: Location measurement indication**

The purpose of this procedure is to indicate to the network that the UE is going to start/stop location related measurements which require measurement gaps. UE shall initiate this procedure only after successful AS security activation.

NOTE: It is a network decision to configure the measurement gap.

### 5.5.6.2 Initiation

The UE shall:

- 1> if and only if upper layers indicate to start performing location measurements and the UE requires measurement gaps for these measurements while measurement gaps are either not configured or not sufficient:
  - 2> initiate the procedure to indicate start;

NOTE 1: The UE verifies the measurement gap situation only upon receiving the indication from upper layers. If at this point in time sufficient gaps are available, the UE does not initiate the procedure. Unless it receives a new indication from upper layers, the UE is only allowed to further repeat the procedure in the same PCell once per frequency of the target RAT if the provided measurement gaps are insufficient.

- 1> if and only if upper layers indicate to stop performing location measurements:
  - 2> initiate the procedure to indicate stop.

NOTE 2: The UE may initiate the procedure to indicate stop even if it did not previously initiate the procedure to indicate start.

### 5.5.6.3 Actions related to transmission of *LocationMeasurementIndication* message

The UE shall set the contents of *LocationMeasurementIndication* message as follows:

- 1> set the *measurementIndication* as follows:
  - 2> if the procedure is initiated to indicate start of location related measurements:

- 3> set the *measurementIndication* to setup *LocationMeasurementInfo*;
- 3> if the procedure is initiated for RSTD measurements towards E-UTRA:
  - 4> set the *locationMeasurementInfo* to the value *eutra-RSTD* according to the information received from upper layers;
- 2> else if the procedure is initiated for subframe and slot timing detection towards E-UTRA:
  - 3> set the *measurementIndication* to setup *LocationMeasurementInfo*;
  - 3> set the *locationMeasurementInfo* to the value *eutra-FineTimingDetection*;
- 2> else if the procedure is initiated to indicate stop of location related measurements:
  - 3> set the *measurementIndication* to *release*;
- 1> submit the *LocationMeasurementIndication* message to lower layers for transmission, upon which the procedure ends.

## 5.6 UE capabilities

### 5.6.1 UE capability transfer

#### 5.6.1.1 General

This clause describes how the UE compiles and transfers its UE capability information upon receiving a *UECapabilityEnquiry* from the network.

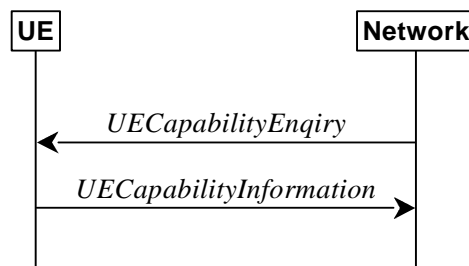


Figure 5.6.1.1-1: UE capability transfer

#### 5.6.1.2 Initiation

The network initiates the procedure to a UE in RRC\_CONNECTED when it needs (additional) UE radio access capability information.

#### 5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

The UE shall set the contents of *UECapabilityInformation* message as follows:

- 1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *nr*:
  - 2> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-NR-Capability* and with the *rat-Type* set to *nr*;
  - 2> include the *supportedBandCombinationList*, *featureSets* and *featureSetCombinations* as specified in clause 5.6.1.4;
- 1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr*:
  - 2> if the UE supports (NG)EN-DC or NE-DC:

- 3> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability* and with the *rat-Type* set to *eutra-nr*;
- 3> include the *supportedBandCombinationList* and *featureSetCombinations* as specified in clause 5.6.1.4;
- 1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra*:
  - 2> if the UE supports E-UTRA:
    - 3> include in the *ue-CapabilityRAT-ContainerList* a *ue-CapabilityRAT-Container* of the type *UE-EUTRA-Capability* and with the *rat-Type* set to *eutra* as specified in TS 36.331 [10], clause 5.6.3.3, according to the *capabilityRequestFilter*, if received;
- 1> submit the *UECapabilityInformation* message to lower layers for transmission, upon which the procedure ends.

#### 5.6.1.4 Setting band combinations, feature set combinations and feature sets supported by the UE

The UE invokes the procedures in this clause if the NR or E-UTRA network requests UE capabilities for *nr*, *eutra-nr* or *eutra*. This procedure is invoked once per requested *rat-Type* (see clause 5.6.1.3 for capability enquiry by the NR network; see TS 36.331 [10], clause 5.6.3.3 for capability enquiry by the E-UTRA network). The UE shall ensure that the feature set IDs are consistent across feature sets, feature set combinations and band combinations in all three UE capability containers that the network queries with the same fields with the same values, i.e. *UE-CapabilityRequestFilterNR* and fields in *UECapabilityEnquiry* message (i.e. *requestedFreqBandsNR-MRDC*, *requestedCapabilityNR* and *eutra-nr-only* flag) as defined in TS 36.331, where applicable.

NOTE 1: Capability enquiry without *frequencyBandListFilter* is not supported.

NOTE 2: In EN-DC, the gNB needs the capabilities for RAT types *nr* and *eutra-nr* and it uses the *featureSets* in the *UE-NR-Capabilities* together with the *featureSetCombinations* in the *UE-MRDC-Capabilities* to determine the NR UE capabilities for the supported MRDC band combinations. Similarly, the eNB needs the capabilities for RAT types *eutra* and *eutra-nr* and it uses the *featureSetsEUTRA-r15* in the *UE-EUTRA-Capabilities* together with the *featureSetCombinations* in the *UE-MRDC-Capabilities* to determine the E-UTRA UE capabilities for the supported MRDC band combinations. Hence, the IDs used in the *featureSets* must match the IDs referred to in *featureSetCombinations* across all three containers. The requirement on consistency implies that there are no undefined feature sets and feature set combinations.

NOTE 3: If the UE cannot include all feature sets and feature set combinations due to message size or list size constraints, it is up to UE implementation which feature sets and feature set combinations it prioritizes.

The UE shall:

- 1> compile a list of "candidate band combinations" only consisting of bands included in *frequencyBandListFilter*, and prioritized in the order of *frequencyBandListFilter* (i.e. first include band combinations containing the first-listed band, then include remaining band combinations containing the second-listed band, and so on), where for each band in the band combination, the parameters of the band do not exceed *maxBandwidthRequestedDL*, *maxBandwidthRequestedUL*, *maxCarriersRequestedDL*, *maxCarriersRequestedUL*, *ca-BandwidthClassDL-EUTRA* or *ca-BandwidthClassUL-EUTRA*, whichever are received;
- 1> for each band combination included in the list of "candidate band combinations":
  - 2> if the network (E-UTRA) included the *eutra-nr-only* field, or
  - 2> if the requested *rat-Type* is *eutra*:
    - 3> remove the NR-only band combination from the list of "candidate band combinations";

NOTE 4: The (E-UTRA) network may request capabilities for *nr* but indicate with the *eutra-nr-only* flag that the UE shall not include any NR band combinations in the *UE-NR-Capabilities*. In this case the procedural text above removes all NR-only band combinations from the candidate list and thereby also avoids inclusion of corresponding feature set combinations and feature sets below.

- 2> if it is regarded as a fallback band combination with the same capabilities of another band combination included in the list of "candidate band combinations":



3> remove the band combination from the list of "candidate band combinations";

1> if *capabilityRequestFilterCommon* is received:

2> remove band combinations from the list of "candidate band combinations" in accordance with the given filter criteria in *capabilityRequestFilterCommon*;

NOTE 5: Even if the network requests (only) capabilities for *nr*, it may include E-UTRA band numbers in the *frequencyBandListFilter* to ensure that the UE includes all necessary feature sets needed for subsequently requested *eutra-nr* capabilities. At this point of the procedure the list of "candidate band combinations" contains all NR- and/or E-UTRA-NR band combinations that match the filter (*frequencyBandListFilter*) provided by the NW and that match the *eutra-nr-only* flag (if RAT-Type *nr* is requested by E-UTRA). In the following, this candidate list is used to derive the band combinations, feature set combinations and feature sets to be reported in the requested capability container.

1> if the requested *rat-Type* is *nr*:

2> include into *supportedBandCombinationList* as many NR-only band combinations as possible from the list of "candidate band combinations", starting from the first entry;

3> if *srs-SwitchingTimeRequest* is received:

4> if SRS carrier switching is supported;

5> include *srs-SwitchingTimesListNR* for each band combination;

4> set *srs-SwitchingTimeRequested* to *true*;

2> include, into *featureSetCombinations*, the feature set combinations referenced from the supported band combinations as included in *supportedBandCombinationList* according to the previous;

2> compile a list of "candidate feature set combinations" referenced from the list of "candidate band combinations" excluding entries (rows in feature set combinations) for fallback band combinations with same or lower capabilities;

NOTE 6: This list of "candidate feature set combinations" contains the feature set combinations used for NR-only as well as E-UTRA-NR band combinations. It is used to derive a list of NR feature sets referred to from the feature set combinations in the UE-NR-Capabilities and from the feature set combinations in a UE-MRDC-Capabilities container.

2> include into *featureSets* the feature sets referenced from the "candidate feature set combinations" excluding entries (feature sets per CC) for fallback band combinations with same or lower capabilities and may exclude the feature sets with the parameters that exceed any of *maxBandwidthRequestedDL*, *maxBandwidthRequestedUL*, *maxCarriersRequestedDL* or *maxCarriersRequestedUL*, whichever are received;

1> else, if the requested *rat-Type* is *eutra-nr*:

2> include into *supportedBandCombinationList* as many E-UTRA-NR band combinations as possible from the list of "candidate band combinations", starting from the first entry;

3> if *srs-SwitchingTimeRequest* is received:

4> if SRS carrier switching is supported;

5> include *srs-SwitchingTimesListNR* and *srs-SwitchingTimesListEUTRA* for each band combination;

4> set *srs-SwitchingTimeRequested* to *true*;

2> include, into *featureSetCombinations*, the feature set combinations referenced from the supported band combinations as included in *supportedBandCombinationList* according to the previous;

1> else (if the requested *rat-Type* is *eutra*):

- 2> compile a list of "candidate feature set combinations" referenced from the list of "candidate band combinations" excluding entries (rows in feature set combinations) for fallback band combinations with same or lower capabilities;

NOTE 7: This list of "candidate feature set combinations" contains the feature set combinations used for E-UTRA-NR band combinations. It is used to derive a list of E-UTRA feature sets referred to from the feature set combinations in a UE-MRDC-Capabilities container.

- 2> include into *featureSetsEUTRA* the feature sets referenced from the "candidate feature set combinations" excluding entries (feature sets per CC) for fallback band combinations with same or lower capabilities and where the parameters do not exceed *ca-BandwidthClassDL-EUTRA* and *ca-BandwidthClassUL-EUTRA*, whichever are received;
- 1> include the received *frequencyBandListFilter* in the field *appliedFreqBandListFilter* of the requested UE capability, except if the requested *rat-Type* is *nr* and the network included the *eutra-nr-only* field;
- 1> if the network included *ue-CapabilityEnquiryExtension*:
  - 2> include the received *ue-CapabilityEnquiryExtension* in the field *receivedFilters*;

#### 5.6.1.5 Void

## 5.7 Other

### 5.7.1 DL information transfer

#### 5.7.1.1 General

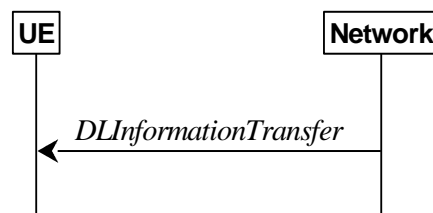


Figure 5.7.1.1-1: DL information transfer

The purpose of this procedure is to transfer NAS dedicated information from NG-RAN to a UE in RRC\_CONNECTED.

#### 5.7.1.2 Initiation

The network initiates the DL information transfer procedure whenever there is a need to transfer NAS dedicated information. The network initiates the DL information transfer procedure by sending the *DLInformationTransfer* message.

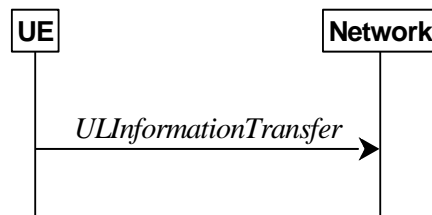
#### 5.7.1.3 Reception of the *DLInformationTransfer* by the UE

Upon receiving *DLInformationTransfer* message, the UE shall:

- 1> if *dedicatedNAS-Message* is included:
  - 2> forward *dedicatedNAS-Message* to upper layers.

## 5.7.2 UL information transfer

### 5.7.2.1 General



**Figure 5.7.2.1-1: UL information transfer**

The purpose of this procedure is to transfer NAS dedicated information from the UE to the network.

### 5.7.2.2 Initiation

A UE in RRC\_CONNECTED initiates the UL information transfer procedure whenever there is a need to transfer NAS dedicated information. The UE initiates the UL information transfer procedure by sending the *ULInformationTransfer* message.

### 5.7.2.3 Actions related to transmission of *ULInformationTransfer* message

The UE shall set the contents of the *ULInformationTransfer* message as follows:

- 1> if the upper layer provides NAS PDU:
  - 2> set the *dedicatedNAS-Message* to include the information received from upper layers
- 1> submit the *ULInformationTransfer* message to lower layers for transmission, upon which the procedure ends.

### 5.7.2.4 Failure to deliver *ULInformationTransfer* message

The UE shall:

- 1> if AS security is not started and radio link failure occurs before the successful delivery of *ULInformationTransfer* messages has been confirmed by lower layers; or
- 1> if PDCP re-establishment or release/addition (e.g due to key refresh upon PCell or PSCell change, or RRC connection re-establishment) occurs on an SRB on which *ULInformationTransfer* messages were submitted for transmission but successful delivery of these messages was not confirmed by lower layers:
  - 2> inform upper layers about the possible failure to deliver the information contained in the concerned *ULInformationTransfer* messages.

## 5.7.2a UL information transfer for MR-DC

### 5.7.2a.1 General



**Figure 5.7.2a.1-1: UL information transfer MR-DC**

The purpose of this procedure is to transfer MR-DC dedicated information from the UE to the network e.g. the NR or E-UTRA RRC *MeasurementReport* and *FailureInformation* message.

### 5.7.2a.2 Initiation

A UE in RRC\_CONNECTED initiates the UL information transfer for MR-DC procedure whenever there is a need to transfer MR-DC dedicated information. I.e. the procedure is not used during an RRC connection reconfiguration involving NR or E-UTRA connection reconfiguration, in which case the MR DC information is piggybacked to the *RRCReconfigurationComplete* message.

### 5.7.2a.3 Actions related to transmission of *ULInformationTransferMRDC* message

The UE shall set the contents of the *ULInformationTransferMRDC* message as follows:

- 1> if there is a need to transfer MR-DC dedicated information related to NR:
  - 2> set the *ul-DCCH-MessageNR* to include the NR MR-DC dedicated information to be transferred (e.g., NR RRC *MeasurementReport* and *FailureInformation* message);
- 1> else if there is a need to transfer MR-DC dedicated information related to E-UTRA:
  - 2> set the *ul-DCCH-MessageEUTRA* to include the E-UTRA MR-DC dedicated information to be transferred (e.g., E-UTRA RRC *MeasurementReport* and *FailureInformation* message);
- 1> submit the *ULInformationTransferMRDC* message to lower layers for transmission, upon which the procedure ends;

## 5.7.3 SCG failure information

### 5.7.3.1 General

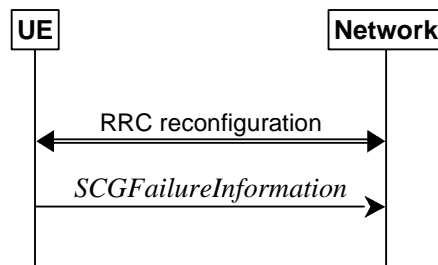


Figure 5.7.3.1-1: SCG failure information

The purpose of this procedure is to inform E-UTRAN or NR MN about an SCG failure the UE has experienced i.e. SCG radio link failure, failure of SCG reconfiguration with sync, SCG configuration failure for RRC message on SRB3 and SCG integrity check failure.

### 5.7.3.2 Initiation

A UE initiates the procedure to report SCG failures when SCG transmission is not suspended and when one of the following conditions is met:

- 1> upon detecting radio link failure for the SCG, in accordance with subclause 5.3.10.3;
- 1> upon reconfiguration with sync failure of the SCG, in accordance with subclause 5.3.5.8.3;
- 1> upon SCG configuration failure, in accordance with subclause 5.3.5.8.2;
- 1> upon integrity check failure indication from SCG lower layers concerning SRB3.

Upon initiating the procedure, the UE shall:

- 1> suspend SCG transmission for all SRBs and DRBs;
- 1> reset SCG MAC;
- 1> stop T304, if running;
- 1> if the UE is in (NG)EN-DC:
  - 2> initiate transmission of the *SCGFailureInformationNR* message as specified in TS 36.331 [10], clause 5.6.13a.
- 1> else:
  - 2> initiate transmission of the *SCGFailureInformation* message in accordance with 5.7.3.5.

### 5.7.3.3 Failure type determination for (NG)EN-DC

The UE shall set the SCG failure type as follows:

- 1> if the UE initiates transmission of the *SCGFailureInformationNR* message due to T310 expiry:
  - 2> set the *failureType* as *t310-Expiry*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide reconfiguration with sync failure information for an SCG:
  - 2> set the *failureType* as *synchReconfigFailure-SCG*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide random access problem indication from SCG MAC:
  - 2> set the *failureType* as *randomAccessProblem*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message to provide indication from SCG RLC that the maximum number of retransmissions has been reached:
  - 2> set the *failureType* as *rlc-MaxNumRetx*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message due to SRB3 integrity check failure:
  - 2> set the *failureType* as *srb3-IntegrityFailure*;
- 1> else if the UE initiates transmission of the *SCGFailureInformationNR* message due to Reconfiguration failure of NR RRC reconfiguration message:
  - 2> set the *failureType* as *scg-reconfigFailure*.

### 5.7.3.4 Setting the contents of *MeasResultSCG-Failure*

The UE shall set the contents of the *MeasResultSCG-Failure* as follows:

- 1> for each *MeasObjectNR* configured on NR SCG for which a *measId* is configured and measurement results are available:
  - 2> include an entry in *measResultsPerMOList*;
  - 2> if there is a *measId* configured with the *MeasObjectNR* and a *reportConfig* which has *rsType* set to *ssb*:
    - 3> set *ssbFrequency* to the value indicated by *ssbFrequency* as included in the *MeasObjectNR*;
  - 2> if there is a *measId* configured with the *MeasObjectNR* and a *reportConfig* which has *rsType* set to *csi-rs*:
    - 3> set *refFreqCSI-RS* to the value indicated by *refFreqCSI-RS* as included in the associated measurement object;

- 2> if a serving cell is associated with the *MeasObjectNR*:
  - 3> set *measResultServingCell* to include the available quantities of the concerned cell and in accordance with the performance requirements in TS 38.133 [14];
- 2> set the *measResultNeighCellList* to include the best measured cells, ordered such that the best cell is listed first, and based on measurements collected up to the moment the UE detected the failure, and set its fields as follows;
  - 3> ordering the cells with sorting as follows:
    - 4> based on SS/PBCH block if SS/PBCH block measurement results are available and otherwise based on CSI-RS;
    - 4> using RSRP if RSRP measurement results are available, otherwise using RSRQ if RSRQ measurement results are available, otherwise using SINR;
  - 3> for each neighbour cell included:
    - 4> include the optional fields that are available.

NOTE: The measured quantities are filtered by the L3 filter as configured in the mobility measurement configuration. The measurements are based on the time domain measurement resource restriction, if configured. Blacklisted cells are not required to be reported.

### 5.7.3.5 Actions related to transmission of *SCGFailureInformation* message

The UE shall set the contents of the *SCGFailureInformation* message as follows:

- 1> if the UE initiates transmission of the *SCGFailureInformation* message due to T310 expiry:
  - 2> set the *failureType* as *t310-Expiry*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide reconfiguration with sync failure information for an SCG:
  - 2> set the *failureType* as *synchReconfigFailure-SCG*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide random access problem indication from SCG MAC:
  - 2> set the *failureType* as *randomAccessProblem*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message to provide indication from SCG RLC that the maximum number of retransmissions has been reached:
  - 2> set the *failureType* as *rlc-MaxNumRetx*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message due to SRB3 IP check failure:
  - 2> set the *failureType* as *srb3-IntegrityFailure*;
- 1> else if the UE initiates transmission of the *SCGFailureInformation* message due to Reconfiguration failure of NR RRC reconfiguration message:
  - 2> set the *failureType* as *scg-reconfigFailure*.
- 1> include and set *MeasResultSCG-Failure* in accordance with 5.7.3.4;
- 1> for each NR frequency the UE is configured to measure by a *MeasConfig* associate with the MCG and for which measurement results are available:
  - 2> set the *measResultFreqList* to include the best measured cells, ordered such that the best cell is listed first using RSRP to order if RSRP measurement results are available for cells on this frequency, otherwise using RSRQ to order if RSRQ measurement results are available for cells on this frequency, otherwise using SINR

to order, and based on measurements collected up to the moment the UE detected the failure, and for each cell that is included, include the optional fields that are available;

NOTE: Field *measResultSCG-Failure* is used to report available results for NR frequencies the UE is configured to measure by SCG RRC signalling.

The UE shall submit the *SCGFailureInformation* message to lower layers for transmission.

## 5.7.3a EUTRA SCG failure information

### 5.7.3a.1 General

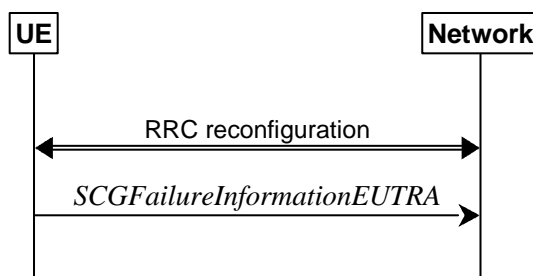


Figure 5.7.3a.1-1: EUTRA SCG failure information

The purpose of this procedure is to inform NR MN about an SCG failure on E-UTRA SN the UE has experienced (e.g. SCG radio link failure, SCG change failure), as specified in TS 36.331 [10] clause 5.6.13.2.

### 5.7.3a.2 Initiation

A UE initiates the procedure to report EUTRA SCG failures when EUTRA SCG transmission is not suspended and in accordance with TS 36.331 [10] clause 5.6.13.2. Actions the UE shall perform upon initiating the procedure, other than related to the transmission of the *SCGFailureInformationEUTRA* message are specified in TS 36.331 [10] clause 5.6.13.2.

### 5.7.3a.3 Actions related to transmission of *SCGFailureInformationEUTRA* message

The UE shall set the contents of the *SCGFailureInformationEUTRA* message as follows:

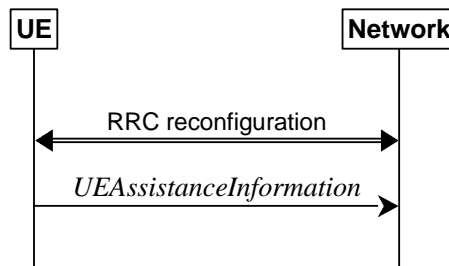
- 1> include *failureType* within *failureReportSCG-EUTRA* and set it to indicate the SCG failure in accordance with TS 36.331 [10] clause 5.6.13.3;
- 1> include and set *measResultSCG-FailureMRDC* in accordance with TS 36.331 [10] clause 5.6.13.5;
- 1> for each EUTRA frequency the UE is configured to measure by *measConfig* for which measurement results are available:
  - 2> set the *measResultFreqListMRDC* to include the best measured cells, ordered such that the best cell is listed first using RSRP to order if RSRP measurement results are available for cells on this frequency, otherwise using RSRQ to order if RSRQ measurement results are available for cells on this frequency, otherwise using SINR to order, and based on measurements collected up to the moment the UE detected the failure, and for each cell that is included, include the optional fields that are available;

NOTE: Field *measResultSCG-FailureMRDC* is used to report available results for E-UTRAN frequencies the UE is configured to measure by E-UTRA RRC signalling.

The UE shall submit the *SCGFailureInformationEUTRA* message to lower layers for transmission.

## 5.7.4 UE Assistance Information

### 5.7.4.1 General



**Figure 5.7.4.1-1: UE Assistance Information**

The purpose of this procedure is to inform the network of the UE's delay budget report carrying desired increment/decrement in the connected mode DRX cycle length, or overheating assistance information.

### 5.7.4.2 Initiation

A UE capable of providing delay budget report in RRC\_CONNECTED may initiate the procedure in several cases, including upon being configured to provide delay budget report and upon change of delay budget preference.

A UE capable of providing overheating assistance information in RRC\_CONNECTED may initiate the procedure if it was configured to do so, upon detecting internal overheating, or upon detecting that it is no longer experiencing an overheating condition.

Upon initiating the procedure, the UE shall:

- 1> if configured to provide delay budget report:
  - 2> if the UE did not transmit a *UEAssistanceInformation* message with *delayBudgetReport* since it was configured to provide delay budget report; or
  - 2> if the current delay budget is different from the one indicated in the last transmission of the *UEAssistanceInformation* message and timer T342 is not running;
  - 3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3;
- 1> if configured to provide overheating assistance information:
  - 2> if the overheating condition has been detected and T345 is not running; or
  - 2> if the current overheating assistance information is different from the one indicated in the last transmission of the *UEAssistanceInformation* message and timer T345 is not running;
  - 3> initiate transmission of the *UEAssistanceInformation* message in accordance with 5.7.4.3;

### 5.7.4.3 Actions related to transmission of *UEAssistanceInformation* message

The UE shall set the contents of the *UEAssistanceInformation* message for delay budget report as follows:

- 1> if configured to provide delay budget report:
  - 2> if the UE prefers an adjustment in the connected mode DRX cycle length:
    - 3> set *delayBudgetReport* to *type1* according to a desired value;
  - 2> start or restart timer T342 with the timer value set to the *delayBudgetReportingProhibitTimer*.

The UE shall set the contents of the *UEAssistanceInformation* message for overheating assistance indication:

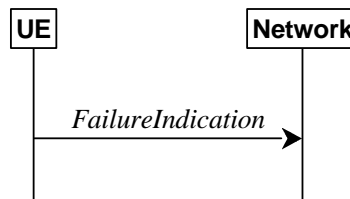
- 1> if the UE experiences internal overheating:



- 2> if the UE prefers to temporarily reduce the number of maximum secondary component carriers:
  - 3> include *reducedMaxCCs* in the *OverheatingAssistance* IE;
  - 3> set *reducedCCsDL* to the number of maximum SCells the UE prefers to be temporarily configured in downlink;
  - 3> set *reducedCCsUL* to the number of maximum SCells the UE prefers to be temporarily configured in uplink;
- 2> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR1:
  - 3> include *reducedMaxBW-FR1* in the *OverheatingAssistance* IE;
  - 3> set *reducedBW-FR1-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR1;
  - 3> set *reducedBW-FR1-UL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR1;
- 2> if the UE prefers to temporarily reduce maximum aggregated bandwidth of FR2:
  - 3> include *reducedMaxBW-FR2* in the *OverheatingAssistance* IE;
  - 3> set *reducedBW-FR2-DL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all downlink carriers of FR2;
  - 3> set *reducedBW-FR2-UL* to the maximum aggregated bandwidth the UE prefers to be temporarily configured across all uplink carriers of FR2;
- 2> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR1:
  - 3> include *reducedMaxMIMO-LayersFR1* in the *OverheatingAssistance* IE;
  - 3> set *reducedMIMO-LayersFR1-DL* to the number of maximum MIMO layers of each serving cell operating on FR1 the UE prefers to be temporarily configured in downlink;
  - 3> set *reducedMIMO-LayersFR1-UL* to the number of maximum MIMO layers of each serving cell operating on FR1 the UE prefers to be temporarily configured in uplink;
- 2> if the UE prefers to temporarily reduce the number of maximum MIMO layers of each serving cell operating on FR2:
  - 3> include *reducedMaxMIMO-LayersFR2* in the *OverheatingAssistance* IE;
  - 3> set *reducedMIMO-LayersFR2-DL* to the number of maximum MIMO layers of each serving cell operating on FR2 the UE prefers to be temporarily configured in downlink;
  - 3> set *reducedMIMO-LayersFR2-UL* to the number of maximum MIMO layers of each serving cell operating on FR2 the UE prefers to be temporarily configured in uplink;
- 2> start timer T345 with the timer value set to the *overheatingIndicationProhibitTimer*;
- 1> else (if the UE no longer experiences an overheating condition):
  - 2> do not include *reducedMaxCCs*, *reducedMaxBW-FR1*, *reducedMaxBW-FR2*, *reducedMaxMIMO-LayersFR1* and *reducedMaxMIMO-LayersFR2* in *OverheatingAssistance* IE;
  - 2> start timer T345 with the timer value set to the *overheatingIndicationProhibitTimer*.

## 5.7.5 Failure information

### 5.7.5.1 General



**Figure 5.7.5.1-1: Failure information**

The purpose of this procedure is to inform the network about a failure detected by the UE.

### 5.7.5.2 Initiation

A UE initiates the procedure when there is a need inform the network about a failure detected by the UE. In particular, the UE initiates the procedure when the following condition is met:

- 1> upon detecting failure for an RLC bearer, in accordance with 5.3.10.3;

Upon initiating the procedure, the UE shall:

- 1> initiate transmission of the *FailureInformation* message as specified in 5.7.5.3;

### 5.7.5.3 Actions related to transmission of *FailureInformation* message

The UE shall:

- 1> if initiated to provide RLC failure information:

- 2> set *logicalChannelIdentity* to the logical channel identity of the failing RLC bearer;
- 2> set *cellGroupId* to the cell group identity of the failing RLC bearer;
- 2> set *failureType* to the type of failure that was detected;

- 1> if used to inform the network about a failure for an MCG RLC bearer:

- 2> submit the *FailureInformation* message to lower layers for transmission via SRB1;

- 1> else if used to inform the network about a failure for an SCG RLC bearer:

- 2> if SRB3 is configured;

- 3> submit the *FailureInformation* message to lower layers for transmission via SRB3;

- 2> else;

- 3> if the UE is in (NG)EN-DC:

- 4> submit the *FailureInformation* message via the E-UTRA MCG embedded in E-UTRA RRC message *ULInformationTransferMRDC* as specified in TS 36.331 [10].

- 3> else if the UE is in NR-DC:

- 4> submit the *FailureInformation* message via the NR MCG embedded in NR RRC message *ULInformationTransferMRDC* as specified in section 5.7.2a.3.

---

## 6 Protocol data units, formats and parameters (ASN.1)

### 6.1 General

#### 6.1.1 Introduction

The contents of each RRC message is specified in sub-clause 6.2 using ASN.1 to specify the message syntax and using tables when needed to provide further detailed information about the fields specified in the message syntax. The syntax of the information elements that are defined as stand-alone abstract types is further specified in a similar manner in sub-clause 6.3.

Usage of the text "Network always configures the UE with a value for this field" in the field description indicates that the network has to provide a value for the field in this or in a previous message based on delta configuration (for an optional field with Need M). It does not imply a mandatory presence of the field.

#### 6.1.2 Need codes and conditions for optional downlink fields

The need for fields to be present in a message or an abstract type, i.e., the ASN.1 fields that are specified as OPTIONAL in the abstract notation (ASN.1), is specified by means of comment text tags attached to the OPTIONAL statement in the abstract syntax. All comment text tags are available for use in the downlink direction only. The meaning of each tag is specified in table 6.1.2-1.

If conditions are used, a conditional presence table is provided for the message or information element specifying the need of the field for each condition case. The table also specifies whether UE maintains or releases the value in case the field is absent. The conditions clarify what the UE may expect regarding the setting of the message by the network. Violation of conditions is regarded as invalid network behaviour, which the UE is not required to cope with. Hence the general error handling defined in 10.4 does not apply in case a field is absent although it is mandatory according to the CondC or CondM condition.

For guidelines on the use of need codes and conditions, see Annex A.6 and A.7.

**Table 6.1.2-1: Meaning of abbreviations used to specify the need for fields to be present**

| <b>Abbreviation</b> | <b>Meaning</b>  |
|---------------------|---|
| Cond conditionTag   | Conditionally present<br>Presence of the field is specified in a tabular form following the ASN.1 segment.  |
| CondC conditionTag  | Configuration condition<br>Presence of the field is conditional to other configuration settings.  |
| CondM conditionTag  | Message condition<br>Presence of the field is conditional to other fields included in the message.  |
| Need S              | <i>Specified</i><br>Used for (configuration) fields, whose field description or procedure <b>specifies</b> the UE behavior performed upon receiving a message with the field absent (and not if field description or procedure specifies the UE behavior when field is not configured). |
| Need M              | <i>Maintain</i><br>Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE maintains the current value.   |
| Need N              | <i>No action</i> (one-shot configuration that is not maintained)<br>Used for (configuration) fields that are not stored and whose presence causes a one-time action by the UE. Upon receiving message with the field absent, the UE takes no action.                                    |
| Need R              | <i>Release</i><br>Used for (configuration) fields that are stored by the UE i.e. not one-shot. Upon receiving a message with the field absent, the UE releases the current value.   |

NOTE: In this version of the specification, the condition tags CondC and CondM are not used.

Any field with Need M or Need N in system information shall be interpreted as Need R.

The need code used within a CondX definition only applies for the case (part of the condition) where it is defined: A condition may have different need codes for different parts of the condition. In particular, the CondX definition may contain the following "otherwise the field is absent" parts:

- "Otherwise, the field is absent": The field is not relevant or should not be configured when this part of the condition applies. In particular, the UE behaviour is not defined when the field is configured via another part of the condition and is reconfigured to this part of the condition. A need code is not provided when the transition from another part of the condition to this part of the condition is not supported, when the field clearly is a one-shot or there is no difference whether UE maintains or releases the value (e.g., in case the field is mandatory present according to the other part of the condition).
- "Otherwise, the field is absent, Need R": The field is released if absent when this part of the condition applies. This handles UE behaviour in case the field is configured via another part of the condition and this part of the condition applies (which means that network can assume UE releases the field if this part of the condition is valid).
- "Otherwise, the field is absent, Need M": The UE retains the field if it was already configured when this part of the condition applies. This means the network cannot release the field, but UE retains the previously configured value.

Use of different Need codes in different parts of a condition should be avoided.

For downlink messages, the need codes, conditions and ASN.1 defaults specified for a particular (child) field only apply in case the (parent) field including the particular field is present. Thus, if the parent is absent the UE shall not release the field unless the absence of the parent field implies that.

For (parent) fields without need codes in downlink messages, if the parent field is absent, UE shall follow the need codes of the child fields. Thus, if parent field is absent, the need code of each child field is followed (i.e. Need R child fields are released, Need M child fields are not modified and the actions for Need S child fields depend on the specified conditions of each field). Examples of (parent) fields in downlink messages without need codes where this rule applies are:

- *nonCriticalExtension* fields at the end of a message using empty SEQUENCE extension mechanism,
- groups of non-critical extensions using double brackets (referred to as extension groups), and
- non-critical extensions at the end of a message or at the end of a structure, contained in a BIT STRING or OCTET STRING (referred to as parent extension fields).

The handling of need codes as specified in the previous is illustrated by means of an example, as shown in the following ASN.1.

```
-- /example/ ASN1START

RRCMessage-IEs ::=          SEQUENCE {
    field1                  InformationElement1      OPTIONAL, -- Need M
    field2                  InformationElement2      OPTIONAL, -- Need R
    nonCriticalExtension    RRCMessage-v1570-IEs    OPTIONAL
}

RRCMessage-1570-IEs ::=    SEQUENCE {
    field3                  InformationElement3      OPTIONAL, -- Need M
    nonCriticalExtension    RRCMessage-v1640-IEs    OPTIONAL
}

RRCMessage-v1640-IEs ::=   SEQUENCE {
    field4                  InformationElement4      OPTIONAL, -- Need R
    nonCriticalExtension    SEQUENCE {}             OPTIONAL
}

InformationElement1 ::=    SEQUENCE {
    field11                 InformationElement11     OPTIONAL, -- Need M
    field12                 InformationElement12     OPTIONAL, -- Need R
    ...,
    [[
    field13                 InformationElement13     OPTIONAL, -- Need R
    field14                 InformationElement14     OPTIONAL, -- Need M
    ]]
}

InformationElement2 ::=    SEQUENCE {
    field21                 InformationElement11     OPTIONAL, -- Need M
    ...
}

-- ASN1STOP
```

The handling of need codes as specified in the previous implies that:

- if *field1* in *RRCMessage-IEs* is absent, UE does not modify any child fields configured within *field1* (regardless of their need codes);

- if *field2* in *RRCMessage-IEs* is absent, UE releases the *field2* (and also its child field *field21*);
- if *field1* or *field2* in *RRCMessage-IEs* is present, UE retains or releases their child fields according to the child field presence conditions;
- if *field1* in *RRCMessage-IEs* is present but the extension group containing *field13* and *field14* is absent, the UE releases *field13* but does not modify *field14*;
- if *nonCriticalExtension* defined by IE *RRCMessage-v1570-IEs* is absent, the UE does not modify *field3* but releases *field4*;

### 6.1.3 General rules

In the ASN.1 of this specification, the first bit of a bit string refers to the leftmost bit, unless stated otherwise.

## 6.2 RRC messages

### 6.2.1 General message structure

#### – *NR-RRC-Definitions*

This ASN.1 segment is the start of the NR RRC PDU definitions.

```
-- ASN1START
-- TAG-NR-RRC-DEFINITIONS-START

NR-RRC-Definitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

-- TAG-NR-RRC-DEFINITIONS-STOP
-- ASN1STOP
```

#### – *BCCH-BCH-Message*

The *BCCH-BCH-Message* class is the set of RRC messages that may be sent from the network to the UE via BCH on the BCCH logical channel.

```
-- ASN1START
-- TAG-BCCH-BCH-MESSAGE-START

BCCH-BCH-Message ::= SEQUENCE {
    message BCCH-BCH-MessageType
}

BCCH-BCH-MessageType ::= CHOICE {
    mib MIB,
    messageClassExtension SEQUENCE {}
}
```

```

}
-- TAG-BCCH-BCH-MESSAGE-STOP
-- ASN1STOP

```

### — *BCCH-DL-SCH-Message*

The *BCCH-DL-SCH-Message* class is the set of RRC messages that may be sent from the network to the UE via DL-SCH on the BCCH logical channel.

```

-- ASN1START
-- TAG-BCCH-DL-SCH-MESSAGE-START

BCCH-DL-SCH-Message ::= SEQUENCE {
    message BCCH-DL-SCH-MessageType
}

BCCH-DL-SCH-MessageType ::= CHOICE {
    c1 CHOICE {
        systemInformation SystemInformation,
        systemInformationBlockType1 SIB1
    },
    messageClassExtension SEQUENCE {}
}

-- TAG-BCCH-DL-SCH-MESSAGE-STOP
-- ASN1STOP

```

### — *DL-CCCH-Message*

The *DL-CCCH-Message* class is the set of RRC messages that may be sent from the Network to the UE on the downlink CCCH logical channel.

```

-- ASN1START
-- TAG-DL-CCCH-MESSAGE-START

DL-CCCH-Message ::= SEQUENCE {
    message DL-CCCH-MessageType
}

DL-CCCH-MessageType ::= CHOICE {
    c1 CHOICE {
        rrcReject RRCReject,
        rrcSetup RRCSetup,
        spare2 NULL,
        spare1 NULL
    },
    messageClassExtension SEQUENCE {}
}

```

```
-- TAG-DL-CCCH-MESSAGE-STOP
-- ASN1STOP
```

## — *DL-DCCH-Message*

The *DL-DCCH-Message* class is the set of RRC messages that may be sent from the network to the UE on the downlink DCCH logical channel.

```
-- ASN1START
-- TAG-DL-DCCH-MESSAGE-START

DL-DCCH-Message ::=
  message
  SEQUENCE {
    DL-DCCH-MessageType
  }

DL-DCCH-MessageType ::=
  CHOICE {
    c1
      CHOICE {
        rrcReconfiguration          RRCReconfiguration,
        rrcResume                   RRCResume,
        rrcRelease                   RRCRelease,
        rrcReestablishment          RRCReestablishment,
        securityModeCommand         SecurityModeCommand,
        dlInformationTransfer        DLInformationTransfer,
        ueCapabilityEnquiry         UECapabilityEnquiry,
        counterCheck                 CounterCheck,
        mobilityFromNRCommand        MobilityFromNRCommand,
        spare7 NULL,
        spare6 NULL, spare5 NULL, spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL
      },
    messageClassExtension SEQUENCE {}
  }

-- TAG-DL-DCCH-MESSAGE-STOP
-- ASN1STOP
```

## — *PCCH-Message*

The *PCCH-Message* class is the set of RRC messages that may be sent from the Network to the UE on the PCCH logical channel.

```
-- ASN1START
-- TAG-PCCH-PCH-MESSAGE-START

PCCH-Message ::=
  message
  SEQUENCE {
    PCCH-MessageType
  }

PCCH-MessageType ::=
  CHOICE {
    c1
      CHOICE {
        paging
      }
  }
```



```

        spare1 NULL
    },
    messageClassExtension      SEQUENCE {}
}

-- TAG-PCCH-PCH-MESSAGE-STOP
-- ASN1STOP

```

### – *UL-CCCH-Message*

The *UL-CCCH-Message* class is the set of 48-bits RRC messages that may be sent from the UE to the Network on the uplink CCCH logical channel.

```

-- ASN1START
-- TAG-UL-CCCH-MESSAGE-START

UL-CCCH-Message ::=
    SEQUENCE {
        message      UL-CCCH-MessageType
    }

UL-CCCH-MessageType ::=
    CHOICE {
        c1           CHOICE {
            rrcSetupRequest          RRCSetupRequest,
            rrcResumeRequest         RRCResumeRequest,
            rrcReestablishmentRequest RRCReestablishmentRequest,
            rrcSystemInfoRequest     RRCSystemInfoRequest
        },
        messageClassExtension      SEQUENCE {}
    }

-- TAG-UL-CCCH-MESSAGE-STOP
-- ASN1STOP

```

### – *UL-CCCH1-Message*

The *UL-CCCH1-Message* class is the set of 64-bits RRC messages that may be sent from the UE to the Network on the uplink CCCH1 logical channel.

```

-- ASN1START
-- TAG-UL-CCCH1-MESSAGE-START

UL-CCCH1-Message ::=
    SEQUENCE {
        message      UL-CCCH1-MessageType
    }

UL-CCCH1-MessageType ::=
    CHOICE {
        c1           CHOICE {
            rrcResumeRequest1      RRCResumeRequest1,
            spare3 NULL,
        }
    }

```

```

        spare2 NULL,
        spare1 NULL
    },
    messageClassExtension SEQUENCE {}
}

-- TAG-UL-CCCH1-MESSAGE-STOP
-- ASN1STOP

```

## – *UL-DCCH-Message*

The *UL-DCCH-Message* class is the set of RRC messages that may be sent from the UE to the network on the uplink DCCH logical channel.

```

-- ASN1START
-- TAG-UL-DCCH-MESSAGE-START

UL-DCCH-Message ::=          SEQUENCE {
    message                  UL-DCCH-MessageType
}

UL-DCCH-MessageType ::=     CHOICE {
    c1                       CHOICE {
        measurementReport      MeasurementReport,
        rrcReconfigurationComplete RRCReconfigurationComplete,
        rrcSetupComplete       RRCSetupComplete,
        rrcReestablishmentComplete RRCReestablishmentComplete,
        rrcResumeComplete      RRCResumeComplete,
        securityModeComplete   SecurityModeComplete,
        securityModeFailure    SecurityModeFailure,
        ulInformationTransfer   ULInformationTransfer,
        locationMeasurementIndication LocationMeasurementIndication,
        ueCapabilityInformation UECapabilityInformation,
        counterCheckResponse   CounterCheckResponse,
        ueAssistanceInformation UEAssistanceInformation,
        failureInformation     FailureInformation,
        ulInformationTransferMRDC ULInformationTransferMRDC,
        scgFailureInformation   SCGFailureInformation,
        scgFailureInformationEUTRA SCGFailureInformationEUTRA
    },
    messageClassExtension     SEQUENCE {}
}

-- TAG-UL-DCCH-MESSAGE-STOP
-- ASN1STOP

```

## 6.2.2 Message definitions

### – CounterCheck

The *CounterCheck* message is used by the network to indicate the current COUNT MSB values associated to each DRB and to request the UE to compare these to its COUNT MSB values and to report the comparison results to the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

### **CounterCheck message**

```
-- ASN1START
-- TAG-COUNTERCHECK-START

CounterCheck ::=
    SEQUENCE {
        rrc-TransactionIdentifier    RRC-TransactionIdentifier,
        criticalExtensions            CHOICE {
            counterCheck              CounterCheck-IEs,
            criticalExtensionsFuture   SEQUENCE {}
        }
    }

CounterCheck-IEs ::=
    SEQUENCE {
        drb-CountMSB-InfoList        DRB-CountMSB-InfoList,
        lateNonCriticalExtension      OCTET STRING                OPTIONAL,
        nonCriticalExtension          SEQUENCE {}                    OPTIONAL
    }

DRB-CountMSB-InfoList ::=
    SEQUENCE (SIZE (1..maxDRB)) OF DRB-CountMSB-Info

DRB-CountMSB-Info ::=
    SEQUENCE {
        drb-Identity                 DRB-Identity,
        countMSB-Uplink               INTEGER(0..33554431),
        countMSB-Downlink             INTEGER(0..33554431)
    }

-- TAG-COUNTERCHECK-STOP
-- ASN1STOP
```

| <i>CounterCheck-IEs field descriptions</i>   |
|--|
| <b><i>drb-CountMSB-InfoList</i></b><br>Indicates the MSBs of the COUNT values of the DRBs. |

| <i>DRB-CountMSB-Info field descriptions</i>   |
|---|
| <b><i>countMSB-Downlink</i></b><br>Indicates the value of 25 MSBs from RX_NEXT – 1 (specified in TS 38.323 [5]) associated to this DRB. |
| <b><i>countMSB-Uplink</i></b><br>Indicates the value of 25 MSBs from TX_NEXT – 1 (specified in TS 38.323 [5]) associated to this DRB.   |

## – *CounterCheckResponse*

The *CounterCheckResponse* message is used by the UE to respond to a *CounterCheck* message.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***CounterCheckResponse message***

```
-- ASN1START
-- TAG-COUNTERCHECKRESPONSE-START

CounterCheckResponse ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        counterCheckResponse CounterCheckResponse-IEs,
        criticalExtensionsFuture SEQUENCE {}
    }
}

CounterCheckResponse-IEs ::= SEQUENCE {
    drb-CountInfoList DRB-CountInfoList,
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension SEQUENCE {} OPTIONAL
}

DRB-CountInfoList ::= SEQUENCE (SIZE (0..maxDRB)) OF DRB-CountInfo

DRB-CountInfo ::= SEQUENCE {
    drb-Identity DRB-Identity,
    count-Uplink INTEGER(0..4294967295),
```

```

    count-Downlink          INTEGER(0..4294967295)
  }
-- TAG-COUNTERCHECKRESPONSE-STOP
-- ASN1STOP

```

| <b>CounterCheckResponse-IEs field descriptions</b>                  |
|---|
| <b>drb-CountInfoList</b><br>Indicates the COUNT values of the DRBs. |

| <b>DRB-CountInfo field descriptions</b>  |
|--|
| <b>count-Downlink</b><br>Indicates the value of RX_NEXT – 1 (specified in TS 38.323 [5]) associated to this DRB. |
| <b>count-Uplink</b><br>Indicates the value of TX_NEXT – 1 (specified in TS 38.323 [5]) associated to this DRB.   |

## – *DLInformationTransfer*

The *DLInformationTransfer* message is used for the downlink transfer of NAS dedicated information.

Signalling radio bearer: SRB2 or SRB1 (only if SRB2 not established yet. If SRB2 is suspended, the network does not send this message until SRB2 is resumed.)

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

### ***DLInformationTransfer* message**

```

-- ASN1START
-- TAG-DLINFORMATIONTRANSFER-START

DLInformationTransfer ::= SEQUENCE {
    rrc-TransactionIdentifier    RRC-TransactionIdentifier,
    criticalExtensions           CHOICE {
        dlInformationTransfer    DLInformationTransfer-IEs,
        criticalExtensionsFuture SEQUENCE {}
    }
}

DLInformationTransfer-IEs ::= SEQUENCE {
    dedicatedNAS-Message    DedicatedNAS-Message           OPTIONAL, -- Need N
    lateNonCriticalExtension OCTET STRING                 OPTIONAL,
    nonCriticalExtension     SEQUENCE {} OPTIONAL
}

```

```
-- TAG-DLINFORMATIONTRANSFER-STOP
-- ASN1STOP
```

## – *FailureInformation*

The *FailureInformation* message is used to inform the network about a failure detected by the UE.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to network

### ***FailureInformation message***

```
-- ASN1START
-- TAG-FAILUREINFORMATION-START

FailureInformation ::= SEQUENCE {
    criticalExtensions CHOICE {
        failureInformation FailureInformation-IEs,
        criticalExtensionsFuture SEQUENCE {}
    }
}

FailureInformation-IEs ::= SEQUENCE {
    failureInfoRLC-Bearer FailureInfoRLC-Bearer OPTIONAL,
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension SEQUENCE {} OPTIONAL
}

FailureInfoRLC-Bearer ::= SEQUENCE {
    cellGroupId CellGroupId,
    logicalChannelIdentity LogicalChannelIdentity,
    failureType ENUMERATED {duplication, spare3, spare2, spare1}
}

-- TAG-FAILUREINFORMATION-STOP
-- ASN1STOP
```

## – *LocationMeasurementIndication*

The *LocationMeasurementIndication* message is used to indicate that the UE is going to either start or stop location related measurement which requires measurement gaps.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***LocationMeasurementIndication message***

```
-- ASN1START
-- TAG-LOCATIONMEASUREMENTINDICATION-START

LocationMeasurementIndication ::= SEQUENCE {
    criticalExtensions          CHOICE {
        locationMeasurementIndication  LocationMeasurementIndication-IEs,
        criticalExtensionsFuture        SEQUENCE {}
    }
}

LocationMeasurementIndication-IEs ::= SEQUENCE {
    measurementIndication      SetupRelease {LocationMeasurementInfo},

    lateNonCriticalExtension   OCTET STRING                               OPTIONAL,
    nonCriticalExtension       SEQUENCE{}                               OPTIONAL
}

-- TAG-LOCATIONMEASUREMENTINDICATION-STOP
-- ASN1STOP
```

### – ***MeasurementReport***

The *MeasurementReport* message is used for the indication of measurement results.

Signalling radio bearer: SRB1, SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***MeasurementReport message***

```
-- ASN1START
-- TAG-MEASUREMENTREPORT-START

MeasurementReport ::= SEQUENCE {
```

```

    criticalExtensions          CHOICE {
      measurementReport        MeasurementReport-IEs,
      criticalExtensionsFuture SEQUENCE {}
    }
}

MeasurementReport-IEs ::=
  measResults

  lateNonCriticalExtension    OCTET STRING
  nonCriticalExtension        SEQUENCE{}

}

-- TAG-MEASUREMENTREPORT-STOP
-- ASN1STOP

```

OPTIONAL,  
OPTIONAL

## – MIB

The *MIB* includes the system information transmitted on BCH.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: BCCH

Direction: Network to UE

## MIB

```

-- ASN1START
-- TAG-MIB-START

MIB ::=
  systemFrameNumber          BIT STRING (SIZE (6)),
  subCarrierSpacingCommon    ENUMERATED {scs15or60, scs30or120},
  ssb-SubcarrierOffset       INTEGER (0..15),
  dmrs-TypeA-Position        ENUMERATED {pos2, pos3},
  pdcch-ConfigSIB1          PDCCH-ConfigSIB1,
  cellBarred                 ENUMERATED {barred, notBarred},
  intraFreqReselection       ENUMERATED {allowed, notAllowed},
  spare                      BIT STRING (SIZE (1))
}

-- TAG-MIB-STOP
-- ASN1STOP

```



| <b>MIB field descriptions</b>  |
|--|
| <p><b>cellBarred</b><br/>Value <i>barred</i> means that the cell is barred, as defined in TS 38.304 [20].</p>  |
| <p><b>dmrs-TypeA-Position</b><br/>Position of (first) DM-RS for downlink (see TS 38.211 [16], clause 7.4.1.1.2) and uplink (see TS 38.211 [16], clause 6.4.1.1.3).</p>   |
| <p><b>intraFreqReselection</b><br/>Controls cell selection/reselection to intra-frequency cells when the highest ranked cell is barred, or treated as barred by the UE, as specified in TS 38.304 [20].</p>  |
| <p><b>pdccch-ConfigSIB1</b><br/>Determines a common <i>ControlResourceSet</i> (CORESET), a common search space and necessary PDCCH parameters. If the field <i>ssb-SubcarrierOffset</i> indicates that <i>SIB1</i> is absent, the field <i>pdccch-ConfigSIB1</i> indicates the frequency positions where the UE may find SS/PBCH block with <i>SIB1</i> or the frequency range where the network does not provide SS/PBCH block with <i>SIB1</i> (see TS 38.213 [13], clause 13).</p>  |
| <p><b>ssb-SubcarrierOffset</b><br/>Corresponds to <math>k_{SSB}</math> (see TS 38.213 [13]), which is the frequency domain offset between SSB and the overall resource block grid in number of subcarriers. (See TS 38.211 [16], clause 7.4.3.1).<br/>The value range of this field may be extended by an additional most significant bit encoded within PBCH as specified in TS 38.213 [13].<br/>This field may indicate that this cell does not provide <i>SIB1</i> and that there is hence no CORESET#0 configured in <i>MIB</i> (see TS 38.213 [13], clause 13). In this case, the field <i>pdccch-ConfigSIB1</i> may indicate the frequency positions where the UE may (not) find a SS/PBCH with a control resource set and search space for <i>SIB1</i> (see TS 38.213 [13], clause 13).</p> |
| <p><b>subCarrierSpacingCommon</b><br/>Subcarrier spacing for <i>SIB1</i>, Msg.2/4 for initial access, paging and broadcast SI-messages. If the UE acquires this <i>MIB</i> on an FR1 carrier frequency, the value <i>scs15or60</i> corresponds to 15 kHz and the value <i>scs30or120</i> corresponds to 30 kHz. If the UE acquires this <i>MIB</i> on an FR2 carrier frequency, the value <i>scs15or60</i> corresponds to 60 kHz and the value <i>scs30or120</i> corresponds to 120 kHz.</p>   |
| <p><b>systemFrameNumber</b><br/>The 6 most significant bits (MSB) of the 10-bit System Frame Number (SFN). The 4 LSB of the SFN are conveyed in the PBCH transport block as part of channel coding (i.e. outside the <i>MIB</i> encoding), as defined in clause 7.1 in TS 38.212 [17].</p>   |

## – *MobilityFromNRCommand*

The *MobilityFromNRCommand* message is used to command handover from NR to E-UTRA (connected to EPC or 5GC).

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

### ***MobilityFromNRCommand* message**

```
-- ASN1START
-- TAG-MOBILITYFROMNRCOMMAND-START

MobilityFromNRCommand ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
```

```

        mobilityFromNRCommand          MobilityFromNRCommand-IEs,
        criticalExtensionsFuture        SEQUENCE {}
    }
}

MobilityFromNRCommand-IEs ::= SEQUENCE {
    targetRAT-Type                     ENUMERATED { eutra, spare3, spare2, spare1, ...},
    targetRAT-MessageContainer          OCTET STRING,
    nas-SecurityParamFromNR            OCTET STRING                      OPTIONAL,  -- Cond HO-ToEPC
    lateNonCriticalExtension           OCTET STRING                      OPTIONAL,
    nonCriticalExtension                SEQUENCE {}                          OPTIONAL
}

-- TAG-MOBILITYFROMNRCOMMAND-STOP
-- ASN1STOP

```

#### **MobilityFromNRCommand-IEs field descriptions**

##### **nas-SecurityParamFromNR**

This field is used to deliver the key synchronisation and Key freshness for the NR to LTE/EPC handovers and a part of the downlink NAS COUNT as specified in TS 33.501 [11].

##### **targetRAT-MessageContainer**

The field contains a message specified in another standard, as indicated by the *targetRAT-Type*, and carries information about the target cell identifier(s) and radio parameters relevant for the target radio access technology. A complete message is included, as specified in the other standard. See NOTE 1

##### **targetRAT-Type**

Indicates the target RAT type.

NOTE 1: The correspondence between the value of the *targetRAT-Type*, the standard to apply, and the message contained within the *targetRAT-MessageContainer* is shown in the table below:

| <b>targetRAT-Type</b> | <b>Standard to apply</b>      | <b>targetRAT-MessageContainer</b>                                       |
|-----------------------|-------------------------------|---|
| <i>eutra</i>          | TS 36.331 [10] (clause 5.4.2) | <i>DL-DCCH-Message</i> including the <i>RRConnectionReconfiguration</i> |

| <b>Conditional Presence</b> | <b>Explanation</b>  |
|-----------------------------|---|
| <i>HO-ToEPC</i>             | This field is mandatory present in case of inter system handover. Otherwise it is absent. |

## – Paging

The *Paging* message is used for the notification of one or more UEs.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channel: PCCH

Direction: Network to UE

### ***Paging message***

```

-- ASN1START
-- TAG-PAGING-START

Paging ::=
    pagingRecordList          SEQUENCE {
        pagingRecordList      PagingRecordList          OPTIONAL, -- Need N
        lateNonCriticalExtension OCTET STRING          OPTIONAL,
        nonCriticalExtension   SEQUENCE{ }              OPTIONAL
    }

PagingRecordList ::=
    SEQUENCE (SIZE(1..maxNrofPageRec)) OF PagingRecord

PagingRecord ::=
    SEQUENCE {
        ue-Identity            PagingUE-Identity,
        accessType              ENUMERATED {non3GPP}     OPTIONAL, -- Need N
        ...
    }

PagingUE-Identity ::=
    CHOICE {
        ng-5G-S-TMSI           NG-5G-S-TMSI,
        fullI-RNTI              I-RNTI-Value,
        ...
    }

-- TAG-PAGING-STOP
-- ASN1STOP

```

#### ***PagingRecord*** field descriptions

##### ***accessType***

Indicates whether the *Paging* message is originated due to the PDU sessions from the non-3GPP access.

### – ***RRCReestablishment***

The *RRCReestablishment* message is used to re-establish SRB1.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

***RRCReestablishment*** message

```

-- ASN1START
-- TAG-RRCREESTABLISHMENT-START

RRCReestablishment ::=
    rrc-TransactionIdentifier      SEQUENCE {
        RRC-TransactionIdentifier,
        criticalExtensions         CHOICE {
            rrcReestablishment     RRCReestablishment-IEs,
            criticalExtensionsFuture SEQUENCE {}
        }
    }

RRCReestablishment-IEs ::=
    nextHopChainingCount          NextHopChainingCount,
    lateNonCriticalExtension      OCTET STRING                OPTIONAL,
    nonCriticalExtension          SEQUENCE {}                  OPTIONAL
}

-- TAG-RRCREESTABLISHMENT-STOP
-- ASN1STOP

```

– ***RRCReestablishmentComplete***

The *RRCReestablishmentComplete* message is used to confirm the successful completion of an RRC connection re-establishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

***RRCReestablishmentComplete*** message

```

-- ASN1START
-- TAG-RRCREESTABLISHMENTCOMPLETE-START

RRCReestablishmentComplete ::=
    rrc-TransactionIdentifier      SEQUENCE {
        RRC-TransactionIdentifier,
        criticalExtensions         CHOICE {
            rrcReestablishmentComplete RRCReestablishmentComplete-IEs,
            criticalExtensionsFuture    SEQUENCE {}
        }
    }

RRCReestablishmentComplete-IEs ::= SEQUENCE {
    lateNonCriticalExtension      OCTET STRING                OPTIONAL,
    nonCriticalExtension          SEQUENCE {}                  OPTIONAL
}

```

```

}
-- TAG-RRCREESTABLISHMENTCOMPLETE-STOP
-- ASN1STOP

```

### – *RRCReestablishmentRequest*

The *RRCReestablishmentRequest* message is used to request the reestablishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

### *RRCReestablishmentRequest* message

```

-- ASN1START
-- TAG-RRCREESTABLISHMENTREQUEST-START

RRCReestablishmentRequest ::= SEQUENCE {
    rrcReestablishmentRequest    RRCReestablishmentRequest-IEs
}

RRCReestablishmentRequest-IEs ::= SEQUENCE {
    ue-Identity                  ReestabUE-Identity,
    reestablishmentCause         ReestablishmentCause,
    spare                        BIT STRING (SIZE (1))
}

ReestabUE-Identity ::= SEQUENCE {
    c-RNTI                       RNTI-Value,
    physCellId                   PhysCellId,
    shortMAC-I                   ShortMAC-I
}

ReestablishmentCause ::= ENUMERATED {reconfigurationFailure, handoverFailure, otherFailure, spare1}

-- TAG-RRCREESTABLISHMENTREQUEST-STOP
-- ASN1STOP

```

#### *ReestabUE-Identity* field descriptions

##### ***physCellId***

The Physical Cell Identity of the PCell the UE was connected to prior to the failure.

**RRCReestablishmentRequest-IEs field descriptions****reestablishmentCause**

Indicates the failure cause that triggered the re-establishment procedure. gNB is not expected to reject a *RRCReestablishmentRequest* due to unknown cause value being used by the UE.

**ue-Identity**

UE identity included to retrieve UE context and to facilitate contention resolution by lower layers.

– **RRCReconfiguration**

The *RRCReconfiguration* message is the command to modify an RRC connection. It may convey information for measurement configuration, mobility control, radio resource configuration (including RBs, MAC main configuration and physical channel configuration) and AS security configuration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

**RRCReconfiguration message**

```
-- ASN1START
-- TAG-RRCRECONFIGURATION-START

RRCReconfiguration ::=
    SEQUENCE {
        rrc-TransactionIdentifier    RRC-TransactionIdentifier,
        criticalExtensions           CHOICE {
            rrcReconfiguration      RRCReconfiguration-IEs,
            criticalExtensionsFuture SEQUENCE {}
        }
    }

RRCReconfiguration-IEs ::=
    SEQUENCE {
        radioBearerConfig           RadioBearerConfig           OPTIONAL, -- Need M
        secondaryCellGroup          OCTET STRING (CONTAINING CellGroupConfig)  OPTIONAL, -- Need M
        measConfig                  MeasConfig                 OPTIONAL, -- Need M
        lateNonCriticalExtension     OCTET STRING           OPTIONAL,
        nonCriticalExtension         RRCReconfiguration-v1530-IEs  OPTIONAL
    }

RRCReconfiguration-v1530-IEs ::=
    SEQUENCE {
        masterCellGroup             OCTET STRING (CONTAINING CellGroupConfig)  OPTIONAL, -- Need M
        fullConfig                  ENUMERATED {true}          OPTIONAL, -- Cond FullConfig
        dedicatedNAS-MessageList    SEQUENCE (SIZE(1..maxDRB)) OF DedicatedNAS-Message  OPTIONAL, -- Cond nonHO
        masterKeyUpdate             MasterKeyUpdate           OPTIONAL, -- Cond
    }

MasterKeyChange
    dedicatedSIB1-Delivery         OCTET STRING (CONTAINING SIB1)          OPTIONAL, -- Need N
    dedicatedSystemInformationDelivery  OCTET STRING (CONTAINING SystemInformation)  OPTIONAL, -- Need N
```

```

    otherConfig          OtherConfig          OPTIONAL, -- Need M
    nonCriticalExtension RRCReconfiguration-v1540-IEs OPTIONAL
}

RRCReconfiguration-v1540-IEs ::=
    otherConfig-v1540          OPTIONAL, -- Need M
    nonCriticalExtension      OPTIONAL
}

RRCReconfiguration-v1560-IEs ::=
    mrdc-SecondaryCellGroupConfig  SetupRelease { MRDC-SecondaryCellGroupConfig } OPTIONAL, -- Need M
    radioBearerConfig2             OCTET STRING (CONTAINING RadioBearerConfig)  OPTIONAL, -- Need M
    sk-Counter                     SK-Counter                               OPTIONAL, -- Need N
    nonCriticalExtension           SEQUENCE {}                               OPTIONAL
}

MRDC-SecondaryCellGroupConfig ::=
    mrdc-ReleaseAndAdd
    mrdc-SecondaryCellGroup
        nr-SCG
        eutra-SCG
    }
}

MasterKeyUpdate ::=
    keySetChangeIndicator  BOOLEAN,
    nextHopChainingCount   NextHopChainingCount,
    nas-Container          OCTET STRING
    ...
}

-- TAG-RRCRECONFIGURATION-STOP
-- ASN1STOP

```

| <b><i>RRCReconfiguration-IEs field descriptions</i></b>   |
|---|
| <p><b><i>dedicatedNAS-MessageList</i></b><br/>This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for each PDU in the list.</p>   |
| <p><b><i>dedicatedSIB1-Delivery</i></b><br/>This field is used to transfer <i>SIB1</i> to the UE. The field has the same values as the corresponding configuration in <i>-servingCellConfigCommon</i>.</p>  |
| <p><b><i>dedicatedSystemInformationDelivery</i></b><br/>This field is used to transfer <i>SIB6</i>, <i>SIB7</i>, <i>SIB8</i> to the UE.</p>   |
| <p><b><i>fullConfig</i></b><br/>Indicates that the full configuration option is applicable for the <i>RRCReconfiguration</i> message for intra-system intra-RAT HO. For inter-RAT HO from E-UTRA to NR, <i>fullConfig</i> indicates whether or not delta signalling of SDAP/PDCP from source RAT is applicable.</p>   |
| <p><b><i>keySetChangeIndicator</i></b><br/>Indicates whether UE shall derive a new <math>K_{gNB}</math>. If <i>reconfigurationWithSync</i> is included, value <i>true</i> indicates that a <math>K_{gNB}</math> key is derived from a <math>K_{AMF}</math> key taken into use through the latest successful NAS SMC procedure, or N2 handover procedure with <math>K_{AMF}</math> change, as described in TS 33.501 [11] for <math>K_{gNB}</math> re-keying. Value <i>false</i> indicates that the new <math>K_{gNB}</math> key is obtained from the current <math>K_{gNB}</math> key or from the NH as described in TS 33.501 [11].</p>                              |
| <p><b><i>masterCellGroup</i></b><br/>Configuration of master cell group.</p>  |
| <p><b><i>mrhc-ReleaseAndAdd</i></b><br/>This field indicates that the current SCG configuration is released and a new SCG is added at the same time.</p>  |
| <p><b><i>mrhc-SecondaryCellGroup</i></b><br/>Includes an RRC message for SCG configuration in NR-DC or NE-DC.<br/>For NR-DC (nr-SCG), <i>mrhc-SecondaryCellGroup</i> contains the <i>RRCReconfiguration</i> message as generated (entirely) by SN gNB. In this version of the specification, the RRC message can only include fields <i>secondaryCellGroup</i> and <i>measConfig</i>.<br/>For NE-DC (eutra-SCG), <i>mrhc-SecondaryCellGroup</i> includes the E-UTRA <i>RRCConnectionReconfiguration</i> message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field <i>scg-Configuration</i>.</p> |
| <p><b><i>nas-Container</i></b><br/>This field is used to transfer UE specific NAS layer information between the network and the UE. The RRC layer is transparent for this field, although it affects activation of AS security after inter-system handover to NR. The content is defined in TS 24.501 [23].</p>   |
| <p><b><i>nextHopChainingCount</i></b><br/>Parameter NCC: See TS 33.501 [11]</p>   |
| <p><b><i>otherConfig</i></b><br/>Contains configuration related to other configurations.</p>  |
| <p><b><i>radioBearerConfig</i></b><br/>Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. In EN-DC this field may only be present if the <i>RRCReconfiguration</i> is transmitted over SRB3.</p>  |
| <p><b><i>radioBearerConfig2</i></b><br/>Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. This field can only be used if the UE supports NR-DC or NE-DC.</p>   |
| <p><b><i>secondaryCellGroup</i></b><br/>Configuration of secondary cell group ((NG)EN-DC or NR-DC). This field is absent when the <i>RRCReconfiguration</i> message is directly transmitted via MCG SRB1 and not within <i>mrhc-secondaryCellGroup</i>.</p>   |
| <p><b><i>sk-Counter</i></b><br/>A counter used upon initial configuration of S-<math>K_{gNB}</math> or S-<math>K_{eNB}</math>, as well as upon refresh of S-<math>K_{gNB}</math> or S-<math>K_{eNB}</math>. This field is always included upon initial configuration of an NR SCG or upon configuration of the first RB with <i>keyToUse</i> set to <i>secondary</i>. This field is absent if there is neither any NR SCG nor any RB with <i>keyToUse</i> set to <i>secondary</i>.</p>  |



| Conditional Presence   | Explanation  |
|------------------------|--|
| <i>nonHO</i>           | The field is absent in case of reconfiguration with sync within NR or to NR; otherwise it is optionally present, need N.   |
| <i>securityNASC</i>    | This field is mandatory present in case of inter system handover. Otherwise the field is optionally present, need N.   |
| <i>MasterKeyChange</i> | This field is mandatory present in case <i>masterCellGroup</i> includes <i>ReconfigurationWithSync</i> and <i>RadioBearerConfig</i> includes <i>SecurityConfig</i> with <i>SecurityAlgorithmConfig</i> , indicating a change of the AS security algorithms associated to the master key. If <i>ReconfigurationWithSync</i> is included for other cases, this field is optionally present, need N. Otherwise the field is absent. |
| <i>FullConfig</i>      | The field is mandatory present in case of inter-system handover from E-UTRA/EPC to NR. It is optionally present, Need N, during reconfiguration with sync and also in first reconfiguration after reestablishment; or for intra-system handover from E-UTRA/5GC to NR. It is absent otherwise.   |

## – *RRCReconfigurationComplete*

The *RRCReconfigurationComplete* message is used to confirm the successful completion of an RRC connection reconfiguration.

Signalling radio bearer: SRB1 or SRB3

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### *RRCReconfigurationComplete* message

```
-- ASN1START
-- TAG-RRCRECONFIGURATIONCOMPLETE-START
```

```
RRCReconfigurationComplete ::=
  rrc-TransactionIdentifier
  criticalExtensions
    rrcReconfigurationComplete
    criticalExtensionsFuture
  }
}

RRCReconfigurationComplete-IEs ::=
  lateNonCriticalExtension
  nonCriticalExtension
}

RRCReconfigurationComplete-v1530-IEs ::=
  uplinkTxDirectCurrentList
  nonCriticalExtension
}

RRCReconfigurationComplete-v1560-IEs ::=
  scg-Response
  nr-SCG-Response
}

SEQUENCE {
  RRC-TransactionIdentifier,
  CHOICE {
    RRCReconfigurationComplete-IEs,
    SEQUENCE {}
  }
}

SEQUENCE {
  OCTET STRING
  RRCReconfigurationComplete-v1530-IEs
}

SEQUENCE {
  UplinkTxDirectCurrentList
  RRCReconfigurationComplete-v1560-IEs
}

SEQUENCE {
  CHOICE {
    OCTET STRING,
```

```

        eutra-SCG-Response          OCTET STRING
    }
    nonCriticalExtension            SEQUENCE {}
}

-- TAG-RRCRECONFIGURATIONCOMPLETE-STOP
-- ASN1STOP

```

| <b><i>RRCREconfigurationComplete-IEs</i> field descriptions</b>  |
|--|
| <p><b><i>scg-Response</i></b><br/>                     In case of NR-DC (<i>nr-SCG-Response</i>), this field includes the <i>RRCREconfigurationComplete</i> message. In case of NE-DC (<i>eutra-SCG-Response</i>), this field includes the E-UTRA <i>RRConnectionReconfigurationComplete</i> message as specified in TS 36.331 [10].</p> |
| <p><b><i>uplinkTxDirectCurrentList</i></b><br/>                     The Tx Direct Current locations for the configured serving cells and BWPs if requested by the NW (see <i>reportUplinkTxDirectCurrent</i> in <i>CellGroupConfig</i>).</p>   |

## – *RRCREject*

The *RRCREject* message is used to reject an RRC connection establishment or an RRC connection resumption.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: Network to UE

### ***RRCREject* message**

```

-- ASN1START
-- TAG-RRCREJECT-START

RRCREject ::=
    criticalExtensions
        rrcReject
        criticalExtensionsFuture
    }
    SEQUENCE {
        CHOICE {
            RRCReject-IEs,
            SEQUENCE {}
        }
    }

RRCREject-IEs ::=
    waitTime
    lateNonCriticalExtension
    nonCriticalExtension
    SEQUENCE {
        RejectWaitTime
        OCTET STRING
        SEQUENCE{}
    }
    OPTIONAL, -- Need N
    OPTIONAL,
    OPTIONAL

-- TAG-RRCREJECT-STOP
-- ASN1STOP

```

**RRCReject-IEs field descriptions****waitTime**

Wait time value in seconds. The field is always included.

– **RRCRelease**The *RRCRelease* message is used to command the release of an RRC connection or the suspension of the RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

**RRCRelease message**

```

-- ASN1START
-- TAG-RRCRELEASE-START

RRCRelease ::=
    rrc-TransactionIdentifier          SEQUENCE {
    criticalExtensions                  CHOICE {
        rrcRelease                     RRCRelease-IEs,
        criticalExtensionsFuture        SEQUENCE {}
    }
}

RRCRelease-IEs ::=
    redirectedCarrierInfo              OPTIONAL, -- Need N
    cellReselectionPriorities          OPTIONAL, -- Need R
    suspendConfig                      OPTIONAL, -- Need R
    deprioritisationReq                SEQUENCE {
        deprioritisationType           ENUMERATED {frequency, nr},
        deprioritisationTimer          ENUMERATED {min5, min10, min15, min30}
    }
    lateNonCriticalExtension           OPTIONAL, -- Need N
    nonCriticalExtension               OPTIONAL,
                                        OPTIONAL
}

RRCRelease-v1540-IEs ::=
    waitTime                           OPTIONAL, -- Need N
    nonCriticalExtension               SEQUENCE {}
                                        OPTIONAL

RedirectedCarrierInfo ::=
    CHOICE {

```

```

    nr          CarrierInfoNR,
    eutra       RedirectedCarrierInfo-EUTRA,
    ...
}

RedirectedCarrierInfo-EUTRA ::= SEQUENCE {
    eutraFrequency      ARFCN-ValueEUTRA,
    cnType              ENUMERATED {epc,fiveGC}
}
OPTIONAL -- Need N

CarrierInfoNR ::= SEQUENCE {
    carrierFreq        ARFCN-ValueNR,
    ssbSubcarrierSpacing SubcarrierSpacing,
    smtc              SSB-MTC
    ...
}
OPTIONAL, -- Need S

SuspendConfig ::= SEQUENCE {
    fullI-RNTI        I-RNTI-Value,
    shortI-RNTI       ShortI-RNTI-Value,
    ran-PagingCycle   PagingCycle,
    ran-NotificationAreaInfo RAN-NotificationAreaInfo
    t380              PeriodicRNAU-TimerValue
    nextHopChainingCount NextHopChainingCount,
    ...
}
OPTIONAL, -- Need M
OPTIONAL, -- Need R

PeriodicRNAU-TimerValue ::= ENUMERATED { min5, min10, min20, min30, min60, min120, min360, min720}

CellReselectionPriorities ::= SEQUENCE {
    freqPriorityListEUTRA FreqPriorityListEUTRA
    freqPriorityListNR   FreqPriorityListNR
    t320                ENUMERATED {min5, min10, min20, min30, min60, min120, min180, spare1}
    ...
}
OPTIONAL, -- Need M
OPTIONAL, -- Need M
OPTIONAL, -- Need R

PagingCycle ::= ENUMERATED {rf32, rf64, rf128, rf256}

FreqPriorityListEUTRA ::= SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityEUTRA

FreqPriorityListNR ::= SEQUENCE (SIZE (1..maxFreq)) OF FreqPriorityNR

FreqPriorityEUTRA ::= SEQUENCE {
    carrierFreq        ARFCN-ValueEUTRA,
    cellReselectionPriority CellReselectionPriority,
    cellReselectionSubPriority CellReselectionSubPriority
}
OPTIONAL -- Need R

FreqPriorityNR ::= SEQUENCE {
    carrierFreq        ARFCN-ValueNR,
    cellReselectionPriority CellReselectionPriority,
    cellReselectionSubPriority CellReselectionSubPriority
}
OPTIONAL -- Need R

```

```

}
RAN-NotificationAreaInfo ::= CHOICE {
    cellList          PLMN-RAN-AreaCellList,
    ran-AreaConfigList
    ...
}
PLMN-RAN-AreaCellList ::= SEQUENCE (SIZE (1.. maxPLMNIdentities)) OF PLMN-RAN-AreaCell
PLMN-RAN-AreaCell ::= SEQUENCE {
    plmn-Identity          PLMN-Identity          OPTIONAL, -- Need S
    ran-AreaCells          SEQUENCE (SIZE (1..32)) OF CellIdentity
}
PLMN-RAN-AreaConfigList ::= SEQUENCE (SIZE (1..maxPLMNIdentities)) OF PLMN-RAN-AreaConfig
PLMN-RAN-AreaConfig ::= SEQUENCE {
    plmn-Identity          PLMN-Identity          OPTIONAL, -- Need S
    ran-Area              SEQUENCE (SIZE (1..16)) OF RAN-AreaConfig
}
RAN-AreaConfig ::= SEQUENCE {
    trackingAreaCode      TrackingAreaCode,
    ran-AreaCodeList      SEQUENCE (SIZE (1..32)) OF RAN-AreaCode    OPTIONAL -- Need R
}
-- TAG-RRCRELEASE-STOP
-- ASN1STOP

```

| <b>RRCRelease-IEs field descriptions</b>  |
|---|
| <b>cnType</b><br>Indicate that the UE is redirected to EPC or 5GC.  |
| <b>deprioritisationReq</b><br>Indicates whether the current frequency or RAT is to be de-prioritised.   |
| <b>deprioritisationTimer</b><br>Indicates the period for which either the current carrier frequency or NR is deprioritised. Value <i>minN</i> corresponds to N minutes.   |
| <b>suspendConfig</b><br>Indicates configuration for the RRC_INACTIVE state. The network does not configure <i>suspendConfig</i> when the network redirect the UE to an inter-RAT carrier frequency.   |
| <b>redirectedCarrierInfo</b><br>Indicates a carrier frequency (downlink for FDD) and is used to redirect the UE to an NR or an inter-RAT carrier frequency, by means of cell selection at transition to RRC_IDLE or RRC_INACTIVE as specified in TS 38.304 [20] |

| <b>CarrierInfoNR field descriptions</b>   |
|---|
| <b>carrierFreq</b><br>Indicates the redirected NR frequency.  |
| <b>ssbSubcarrierSpacing</b><br>Subcarrier spacing of SSB in the redirected SSB frequency. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.  |
| <b>smtc</b><br>The SSB periodicity/offset/duration configuration for the redirected SSB frequency. It is based on timing reference of PCell. If the field is absent, the UE uses the SMTTC configured in the measObjectNR having the same SSB frequency and subcarrier spacing. |

| <b>RAN-NotificationAreaInfo field descriptions</b>                               |
|--|
| <b>cellList</b><br>A list of cells configured as RAN area.                       |
| <b>ran-AreaConfigList</b><br>A list of RAN area codes or RA code(s) as RAN area. |

| <b>PLMN-RAN-AreaConfig field descriptions</b>   |
|---|
| <b>plmn-Identity</b><br>PLMN Identity to which the cells in <i>ran-Area</i> belong. If the field is absent the UE uses the ID of the registered PLMN.   |
| <b>ran-AreaCodeList</b><br>The total number of RAN-AreaCodes of all PLMNs does not exceed 32.   |
| <b>ran-Area</b><br>Indicates whether TA code(s) or RAN area code(s) are used for the RAN notification area. The network uses only TA code(s) or RAN area code(s) to configure a UE. The total number of TACs across all PLMNs does not exceed 16. |

| <b>PLMN-RAN-AreaCell field descriptions</b>  |
|--|
| <b>plmn-Identity</b><br>PLMN Identity to which the cells in <i>ran-AreaCells</i> belong. If the field is absent the UE uses the ID of the registered PLMN. |
| <b>ran-AreaCells</b><br>The total number of cells of all PLMNs does not exceed 32.   |

| <b>SuspendConfig field descriptions</b>   |
|---|
| <b>ran-NotificationAreaInfo</b><br>Network ensures that the UE in RRC_INACTIVE always has a valid <i>ran-NotificationAreaInfo</i> .   |
| <b>ran-PagingCycle</b><br>Refers to the UE specific cycle for RAN-initiated paging. Value <i>rf32</i> corresponds to 32 radio frames, value <i>rf64</i> corresponds to 64 radio frames and so on. |
| <b>t380</b><br>Refers to the timer that triggers the periodic RNAU procedure in UE. Value <i>min5</i> corresponds to 5 minutes, value <i>min10</i> corresponds to 10 minutes and so on.           |

– **RRCResume**

The *RRCResume* message is used to resume the suspended RRC connection.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

### ***RRCResume message***

```

-- ASN1START
-- TAG-RRCRESUME-START

RRCResume ::=
  rrc-TransactionIdentifier
  criticalExtensions
    rrcResume
    criticalExtensionsFuture
  }
}

RRCResume-IEs ::=
  radioBearerConfig
  masterCellGroup
  measConfig
  fullConfig

  lateNonCriticalExtension
  nonCriticalExtension
}

RRCResume-v1560-IEs ::=
  radioBearerConfig2
  sk-Counter
  nonCriticalExtension
}

-- TAG-RRCRESUME-STOP
-- ASN1STOP

```

|                           |   |  |                     |
|---------------------------|---|--|---------------------|
|                           | SEQUENCE {                                  |  |                     |
| rrc-TransactionIdentifier | RRC-TransactionIdentifier,                  |  |                     |
| criticalExtensions        | CHOICE {                                    |  |                     |
| rrcResume                 | RRCResume-IEs,                              |  |                     |
| criticalExtensionsFuture  | SEQUENCE {}                                 |  |                     |
|                           | }   |  |                     |
|                           | }   |  |                     |
| radioBearerConfig         | RadioBearerConfig                           |  | OPTIONAL, -- Need M |
| masterCellGroup           | OCTET STRING (CONTAINING CellGroupConfig)   |  | OPTIONAL, -- Need M |
| measConfig                | MeasConfig                                  |  | OPTIONAL, -- Need M |
| fullConfig                | ENUMERATED {true}                           |  | OPTIONAL, -- Need N |
| lateNonCriticalExtension  | OCTET STRING                                |  | OPTIONAL,           |
| nonCriticalExtension      | RRCResume-v1560-IEs                         |  | OPTIONAL            |
|                           | }   |  |                     |
|                           | }   |  |                     |
| radioBearerConfig2        | OCTET STRING (CONTAINING RadioBearerConfig) |  | OPTIONAL, -- Need M |
| sk-Counter                | SK-Counter                                  |  | OPTIONAL,           |
| nonCriticalExtension      | SEQUENCE {}                                 |  | OPTIONAL            |
|                           | }   |  |                     |
|                           | }   |  |                     |

| <i>RRCResume-IEs</i> field descriptions   |
|---|
| <b><i>masterCellGroup</i></b><br>Configuration of the master cell group.  |
| <b><i>radioBearerConfig</i></b><br>Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP.   |
| <b><i>radioBearerConfig2</i></b><br>Configuration of Radio Bearers (DRBs, SRBs) including SDAP/PDCP. This field can only be used if the UE supports NR-DC or NE-DC.   |
| <b><i>sk-Counter</i></b><br>A counter used to derive S-K <sub>qNB</sub> or S-K <sub>eNB</sub> based on the newly derived K <sub>qNB</sub> during RRC Resume. The field is only included with there is one or more RB with <i>keyToUse</i> set to <i>secondary</i> . |

– *RRCResumeComplete*

The *RRCResumeComplete* message is used to confirm the successful completion of an RRC connection resumption.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

***RRCResumeComplete* message**

```

-- ASN1START
-- TAG-RRCRESUMECOMplete-START

RRCResumeComplete ::=
    rrc-TransactionIdentifier          SEQUENCE {
    criticalExtensions                 RRC-TransactionIdentifier,
    rrcResumeComplete                 CHOICE {
    criticalExtensionsFuture           RRCResumeComplete-IEs,
                                     SEQUENCE {}
    }
}

RRCResumeComplete-IEs ::=
    dedicatedNAS-Message              OPTIONAL,
    selectedPLMN-Identity              INTEGER (1..maxPLMN)          OPTIONAL,
    uplinkTxDirectCurrentList          UplinkTxDirectCurrentList    OPTIONAL,
    lateNonCriticalExtension           OCTET STRING                OPTIONAL,
    nonCriticalExtension               SEQUENCE{}                  OPTIONAL
}

-- TAG-RRCRESUMECOMplete-STOP
-- ASN1STOP

```



| <i>RRCResumeComplete-IEs</i> field descriptions  |
|--|
| <b><i>selectedPLMN-Identity</i></b><br>Index of the PLMN selected by the UE from the <i>plmn-IdentityList</i> fields included in <i>SIB1</i> .   |
| <b><i>uplinkTxDirectCurrentList</i></b><br>The Tx Direct Current locations for the configured serving cells and BWPs if requested by the NW (see <i>reportUplinkTxDirectCurrent</i> in <i>CellGroupConfig</i> ). |

## – *RRCResumeRequest*

The *RRCResumeRequest* message is used to request the resumption of a suspended RRC connection or perform an RNA update.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

### *RRCResumeRequest* message

```
-- ASN1START
-- TAG-RRCRESUMEREQUEST-START

RRCResumeRequest ::=
    SEQUENCE {
        rrcResumeRequest    RRCResumeRequest-IEs
    }

RRCResumeRequest-IEs ::=
    SEQUENCE {
        resumeIdentity      ShortI-RNTI-Value,
        resumeMAC-I         BIT STRING (SIZE (16)),
        resumeCause         ResumeCause,
        spare                BIT STRING (SIZE (1))
    }

-- TAG-RRCRESUMEREQUEST-STOP
-- ASN1STOP
```

| <i>RRCResumeRequest-IEs</i> field descriptions   |
|--|
| <b><i>resumeCause</i></b><br>Provides the resume cause for the RRC connection resume request as provided by the upper layers or RRC. The network is not expected to reject an <i>RRCResumeRequest</i> due to unknown cause value being used by the UE. |
| <b><i>resumeIdentity</i></b><br>UE identity to facilitate UE context retrieval at gNB.   |
| <b><i>resumeMAC-I</i></b><br>Authentication token to facilitate UE authentication at gNB. The 16 least significant bits of the MAC-I calculated using the AS security configuration as specified in 5.3.13.3.  |

– *RRCResumeRequest1*

The *RRCResumeRequest1* message is used to request the resumption of a suspended RRC connection or perform an RNA update.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH1

Direction: UE to Network

***RRCResumeRequest1* message**

```
-- ASN1START
-- TAG-RRCRESUMEREQUEST1-START

RRCResumeRequest1 ::= SEQUENCE {
    rrcResumeRequest1      RRCResumeRequest1-IEs
}

RRCResumeRequest1-IEs ::= SEQUENCE {
    resumeIdentity          I-RNTI-Value,
    resumeMAC-I             BIT STRING (SIZE (16)),
    resumeCause             ResumeCause,
    spare                   BIT STRING (SIZE (1))
}

-- TAG-RRCRESUMEREQUEST1-STOP
-- ASN1STOP
```

***RRCResumeRequest1-IEs* field descriptions**

***resumeCause***

Provides the resume cause for the *RRCResumeRequest1* as provided by the upper layers or RRC. A gNB is not expected to reject an *RRCResumeRequest1* due to unknown cause value being used by the UE.

***resumeIdentity***

UE identity to facilitate UE context retrieval at gNB.

***resumeMAC-I***

Authentication token to facilitate UE authentication at gNB. The 16 least significant bits of the MAC-I calculated using the AS security configuration as specified in 5.3.13.3.

– *RRCSetup*

The *RRCSetup* message is used to establish SRB1.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: Network to UE

### ***RRCSetup* message**

```

-- ASN1START
-- TAG-RRCSETUP-START

RRCSetup ::=
    rrc-TransactionIdentifier      SEQUENCE {
    criticalExtensions              CHOICE {
        rrcSetup                   RRCSetup-IEs,
        criticalExtensionsFuture    SEQUENCE {}
    }
}

RRCSetup-IEs ::=
    radioBearerConfig              SEQUENCE {
    masterCellGroup                 OCTET STRING (CONTAINING CellGroupConfig),

    lateNonCriticalExtension        OCTET STRING                      OPTIONAL,
    nonCriticalExtension             SEQUENCE{}                       OPTIONAL
}

-- TAG-RRCSETUP-STOP
-- ASN1STOP

```

#### ***RRCSetup-IEs* field descriptions**

##### ***masterCellGroup***

The network configures only the RLC bearer for the SRB1, *mac-CellGroupConfig*, *physicalCellGroupConfig* and *spCellConfig*.

##### ***radioBearerConfig***

Only SRB1 can be configured in RRC setup.

### – ***RRCSetupComplete***

The *RRCSetupComplete* message is used to confirm the successful completion of an RRC connection establishment.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

**RRCSetupComplete message**

```

-- ASN1START
-- TAG-RRCSETUPCOMPLETE-START

RRCSetupComplete ::=
    rrc-TransactionIdentifier
    criticalExtensions
        rrcSetupComplete
        criticalExtensionsFuture
    }
}

RRCSetupComplete-IEs ::=
    selectedPLMN-Identity
    registeredAMF
    guami-Type
    s-NSSAI-List
    dedicatedNAS-Message
    ng-5G-S-TMSI-Value
        ng-5G-S-TMSI
        ng-5G-S-TMSI-Part2
    }
    lateNonCriticalExtension
    nonCriticalExtension
}

RegisteredAMF ::=
    plmn-Identity
    amf-Identifier
}

-- TAG-RRCSETUPCOMPLETE-STOP
-- ASN1STOP

```

**RRCSetupComplete-IEs field descriptions****guami-Type**

This field is used to indicate whether the GUAMI included is native (derived from native 5G-GUTI) or mapped (from EPS, derived from EPS GUTI) as specified in TS 24.501 [23].

**ng-5G-S-TMSI-Part2**

The leftmost 9 bits of 5G-S-TMSI.

**registeredAMF**

This field is used to transfer the GUAMI of the AMF where the UE is registered, as provided by upper layers, see TS 23.003 [21].

**selectedPLMN-Identity**

Index of the PLMN selected by the UE from the *plmn-IdentityList* fields included in SIB1.

– *RRCSetupRequest*

The *RRCSetupRequest* message is used to request the establishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

***RRCSetupRequest message***

```
-- ASN1START
-- TAG-RRCSETUPREQUEST-START

RRCSetupRequest ::=
    SEQUENCE {
        rrcSetupRequest
    }

RRCSetupRequest-IEs ::=
    SEQUENCE {
        ue-Identity
        establishmentCause
        spare
    }

InitialUE-Identity ::=
    CHOICE {
        ng-5G-S-TMSI-Part1
        randomValue
    }

EstablishmentCause ::=
    ENUMERATED {
        emergency, highPriorityAccess, mt-Access, mo-Signalling,
        mo-Data, mo-VoiceCall, mo-VideoCall, mo-SMS, mps-PriorityAccess, mcs-PriorityAccess,
        spare6, spare5, spare4, spare3, spare2, spare1}

-- TAG-RRCSETUPREQUEST-STOP
-- ASN1STOP
```

***RRCSetupRequest-IEs field descriptions***

***establishmentCause***

Provides the establishment cause for the *RRCSetupRequest* in accordance with the information received from upper layers. gNB is not expected to reject an *RRCSetupRequest* due to unknown cause value being used by the UE.

***ue-Identity***

UE identity included to facilitate contention resolution by lower layers.

| <i>InitialUE-Identity</i> field descriptions                         |
|--|
| <b>ng-5G-S-TMSI-Part1</b><br>The rightmost 39 bits of 5G-S-TMSI.     |
| <b>randomValue</b><br>Integer value in the range 0 to $2^{39} - 1$ . |

## – *RRCSystemInfoRequest*

The *RRCSystemInfoRequest* message is used to request SI message(s) required by the UE as specified in section 5.2.2.3.3.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to Network

### *RRCSystemInfoRequest* message

```
-- ASN1START
-- TAG-RRCSYSTEMINFOREQUEST-START

RRCSystemInfoRequest ::=          SEQUENCE {
    criticalExtensions              CHOICE {
        rrcSystemInfoRequest-r15  RRCSystemInfoRequest-r15-IEs,
        criticalExtensionsFuture  SEQUENCE {}
    }
}

RRCSystemInfoRequest-r15-IEs ::= SEQUENCE {
    requested-SI-List              BIT STRING (SIZE (maxSI-Message)), --32bits
    spare                          BIT STRING (SIZE (12))
}

-- TAG-RRCSYSTEMINFOREQUEST-STOP
-- ASN1STOP
```

| <i>RRCSystemInfoRequest-r15-IEs</i> field descriptions  |
|---|
| <b>requested-SI-List</b><br>Contains a list of requested SI messages. According to the order of entry in the list of SI messages configured by <i>schedulingInfoList</i> in <i>si-SchedulingInfo</i> in <i>SIB1</i> , first bit corresponds to first/leftmost listed SI message, second bit corresponds to second listed SI message, and so on. |

– *SCGFailureInformation*

The *SCGFailureInformation* message is used to provide information regarding NR SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

***SCGFailureInformation* message**

```
-- ASN1START
-- TAG-SCGFAILUREINFORMATION-START

SCGFailureInformation ::=
    criticalExtensions
        scgFailureInformation
        criticalExtensionsFuture
    }
}

SCGFailureInformation-IEs ::=
    failureReportSCG
    nonCriticalExtension
}

FailureReportSCG ::=
    failureType
    measResultFreqList
    measResultSCG-Failure
    ...
}

MeasResultFreqList ::=
    SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

-- TAG-SCGFAILUREINFORMATION-STOP
-- ASN1STOP
```

```
SEQUENCE {
    CHOICE {
        SCGFailureInformation-IEs,
        SEQUENCE {}
    }
}

SEQUENCE {
    FailureReportSCG
    SEQUENCE {}
}

SEQUENCE {
    ENUMERATED {
        t310-Expiry, randomAccessProblem,
        rlc-MaxNumRetx,
        synchReconfigFailureSCG, scg-ReconfigFailure,
        srb3-IntegrityFailure, spare2, spare1},
    MeasResultFreqList
    OCTET STRING (CONTAINING MeasResultSCG-Failure)
}

OPTIONAL,
OPTIONAL
```

| <i>SCGFailureInformation field descriptions</i>  |
|--|
| <p><b>measResultFreqList</b><br/>The field contains available results of measurements on NR frequencies the UE is configured to measure by <i>measConfig</i>.</p>  |
| <p><b>measResultSCG-Failure</b><br/>The field contains the <i>MeasResultSCG-Failure</i> IE which includes available results of measurements on NR frequencies the UE is configured to measure by the NR SCG <i>RRCReconfiguration</i> message.</p> |

## – *SCGFailureInformationEUTRA*

The *SCGFailureInformationEUTRA* message is used to provide information regarding E-UTRA SCG failures detected by the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***SCGFailureInformationEUTRA* message**

```

-- ASN1START
-- TAG-SCGFAILUREINFORMATIONEUTRA-START

SCGFailureInformationEUTRA ::=
    criticalExtensions
        scgFailureInformationEUTRA
        criticalExtensionsFuture
    }
}

SCGFailureInformationEUTRA-IEs ::=
    failureReportSCG-EUTRA
    nonCriticalExtension
}

FailureReportSCG-EUTRA ::=
    failureType
    measResultFreqListMRDC
    measResultSCG-FailureMRDC
    ...
}

MeasResultFreqListFailMRDC ::= SEQUENCE (SIZE (1.. maxFreq)) OF MeasResult2EUTRA

-- TAG-SCGFAILUREINFORMATIONEUTRA-STOP

```



-- ASN1STOP

### **SCGFailureInformationEUTRA field descriptions**

#### **measResultFreqListMRDC**

The field contains available results of measurements on E-UTRA frequencies the UE is configured to measure by *measConfig*.

#### **measResultSCG-FailureMRDC**

Includes the E-UTRA *MeasResultSCG-FailureMRDC* IE as specified in TS 36.331 [10]. The field contains available results of measurements on E-UTRA frequencies the UE is configured to measure by the E-UTRA *RRCConnectionReconfiguration* message.

## – *SecurityModeCommand*

The *SecurityModeCommand* message is used to command the activation of AS security.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

### **SecurityModeCommand message**

```
-- ASN1START
-- TAG-SECURITYMODECOMMAND-START

SecurityModeCommand ::=
  rrc-TransactionIdentifier      SEQUENCE {
    criticalExtensions            CHOICE {
      securityModeCommand        SecurityModeCommand-IEs,
      criticalExtensionsFuture    SEQUENCE {}
    }
  }

SecurityModeCommand-IEs ::=
  securityConfigSMC              SEQUENCE {
    lateNonCriticalExtension      OCTET STRING                OPTIONAL,
    nonCriticalExtension          SEQUENCE{}                  OPTIONAL
  }

SecurityConfigSMC ::=
  securityAlgorithmConfig        SEQUENCE {
    ...
  }

-- TAG-SECURITYMODECOMMAND-STOP
-- ASN1STOP
```

## – *SecurityModeComplete*

The *SecurityModeComplete* message is used to confirm the successful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***SecurityModeComplete* message**

```
-- ASN1START
-- TAG-SECURITYMODECOMPLETE-START

SecurityModeComplete ::=          SEQUENCE {
    rrc-TransactionIdentifier      RRC-TransactionIdentifier,
    criticalExtensions             CHOICE {
        securityModeComplete      SecurityModeComplete-IEs,
        criticalExtensionsFuture  SEQUENCE {}
    }
}

SecurityModeComplete-IEs ::=     SEQUENCE {
    lateNonCriticalExtension       OCTET STRING                               OPTIONAL,
    nonCriticalExtension           SEQUENCE {}                               OPTIONAL
}

-- TAG-SECURITYMODECOMPLETE-STOP
-- ASN1STOP
```

## – *SecurityModeFailure*

The *SecurityModeFailure* message is used to indicate an unsuccessful completion of a security mode command.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

**SecurityModeFailure message**

```

-- ASN1START
-- TAG-SECURITYMODEFAILURE-START

SecurityModeFailure ::=
  rrc-TransactionIdentifier      SEQUENCE {
    criticalExtensions           RRC-TransactionIdentifier,
    securityModeFailure         CHOICE {
    criticalExtensionsFuture     SecurityModeFailure-IEs,
                               SEQUENCE {}
    }
  }

SecurityModeFailure-IEs ::=
  lateNonCriticalExtension      OCTET STRING                OPTIONAL,
  nonCriticalExtension          SEQUENCE {}                  OPTIONAL
}

-- TAG-SECURITYMODEFAILURE-STOP
-- ASN1STOP

```

**– SIB1**

*SIB1* contains information relevant when evaluating if a UE is allowed to access a cell and defines the scheduling of other system information. It also contains radio resource configuration information that is common for all UEs and barring information applied to the unified access control.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH

Direction: Network to UE

**SIB1 message**

```

-- ASN1START
-- TAG-SIB1-START

SIB1 ::= SEQUENCE {
  cellSelectionInfo           SEQUENCE {
    q-RxLevMin                Q-RxLevMin,
    q-RxLevMinOffset          INTEGER (1..8)                OPTIONAL, -- Need S
    q-RxLevMinSUL             Q-RxLevMin                OPTIONAL, -- Need R
    q-QualMin                 Q-QualMin                    OPTIONAL, -- Need S
    q-QualMinOffset           INTEGER (1..8)                OPTIONAL, -- Need S
  }
  cellAccessRelatedInfo      CellAccessRelatedInfo,
  connEstFailureControl      ConnEstFailureControl          OPTIONAL, -- Need R
}

```

```

si-SchedulingInfo                SI-SchedulingInfo                OPTIONAL, -- Need R
servingCellConfigCommon          ServingCellConfigCommonSIB        OPTIONAL, -- Need R
ims-EmergencySupport             ENUMERATED {true}                OPTIONAL, -- Need R
eCallOverIMS-Support            ENUMERATED {true}                OPTIONAL, -- Cond Absent
ue-TimersAndConstants           UE-TimersAndConstants            OPTIONAL, -- Need R

uac-BarringInfo                 SEQUENCE {
  uac-BarringForCommon           UAC-BarringPerCatList            OPTIONAL, -- Need S
  uac-BarringPerPLMN-List       UAC-BarringPerPLMN-List         OPTIONAL, -- Need S
  uac-BarringInfoSetList        UAC-BarringInfoSetList,
  uac-AccessCategory1-SelectionAssistanceInfo CHOICE {
    plmnCommon                   UAC-AccessCategory1-SelectionAssistanceInfo,
    individualPLMNList           SEQUENCE (SIZE (2..maxPLMN)) OF UAC-AccessCategory1-SelectionAssistanceInfo
  }
}
}
}

useFullResumeID                 ENUMERATED {true}                OPTIONAL, -- Need N

lateNonCriticalExtension         OCTET STRING                      OPTIONAL,
nonCriticalExtension             SEQUENCE{}                       OPTIONAL
}

UAC-AccessCategory1-SelectionAssistanceInfo ::= ENUMERATED {a, b, c}

-- TAG-SIB1-STOP
-- ASN1STOP

```

| <b>SIB1 field descriptions</b>   |  |
|--|--|
| <b>cellSelectionInfo</b><br>Parameters for cell selection related to the serving cell.   |  |
| <b>ims-EmergencySupport</b><br>Indicates whether the cell supports IMS emergency bearer services for UEs in limited service mode. If absent, IMS emergency call is not supported by the network in the cell for UEs in limited service mode.   |  |
| <b>q-QualMin</b><br>Parameter "Q <sub>qualmin</sub> " in TS 38.304 [20], applicable for serving cell. If the field is absent, the UE applies the (default) value of negative infinity for Q <sub>qualmin</sub> .   |  |
| <b>q-QualMinOffset</b><br>Parameter "Q <sub>qualminoffset</sub> " in TS 38.304 [20]. Actual value Q <sub>qualminoffset</sub> = field value [dB]. If the field is absent, the UE applies the (default) value of 0 dB for Q <sub>qualminoffset</sub> . Affects the minimum required quality level in the cell.   |  |
| <b>q-RxLevMin</b><br>Parameter "Q <sub>rxlevmin</sub> " in TS 38.304 [20], applicable for serving cell.  |  |
| <b>q-RxLevMinOffset</b><br>Parameter "Q <sub>rxlevminoffset</sub> " in TS 38.304 [20]. Actual value Q <sub>rxlevminoffset</sub> = field value * 2 [dB]. If absent, the UE applies the (default) value of 0 dB for Q <sub>rxlevminoffset</sub> . Affects the minimum required Rx level in the cell.   |  |
| <b>q-RxLevMinSUL</b><br>Parameter "Q <sub>rxlevmin</sub> " in TS 38.304 [20], applicable for serving cell.   |  |
| <b>servingCellConfigCommon</b><br>Configuration of the serving cell.   |  |
| <b>uac-AccessCategory1-SelectionAssistanceInfo</b><br>Information used to determine whether Access Category 1 applies to the UE, as defined in TS 22.261 [25].   |  |
| <b>uac-BarringForCommon</b><br>Common access control parameters for each access category. Common values are used for all PLMNs, unless overwritten by the PLMN specific configuration provided in <i>uac-BarringPerPLMN-List</i> . The parameters are specified by providing an index to the set of configurations ( <i>uac-BarringInfoSetList</i> ). UE behaviour upon absence of this field is specified in clause 5.3.14.2. |  |
| <b>ue-TimersAndConstants</b><br>Timer and constant values to be used by the UE.  |  |
| <b>useFullResumeID</b><br>Indicates which resume identifier and Resume request message should be used. UE uses <i>fullI-RNTI</i> and <i>RRCResumeRequest1</i> if the field is present, or <i>shortI-RNTI</i> and <i>RRCResumeRequest</i> if the field is absent.   |  |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>Absent</i>        | The field is not used in this version of the specification, if received the UE shall ignore.         |
| <i>Standalone</i>    | The field is mandatory present in a cell that supports standalone operation, otherwise it is absent. |

## – SystemInformation

The *SystemInformation* message is used to convey one or more System Information Blocks. All the SIBs included are transmitted with the same periodicity.

Signalling radio bearer: N/A

RLC-SAP: TM

Logical channels: BCCH

Direction: Network to UE

### ***SystemInformation message***

```

-- ASN1START
-- TAG-SYSTEMINFORMATION-START

SystemInformation ::=
    criticalExtensions
        systemInformation
        criticalExtensionsFuture
    }
}

SystemInformation-IEs ::=
    sib-TypeAndInfo
        sib2
        sib3
        sib4
        sib5
        sib6
        sib7
        sib8
        sib9
        ...
    },
    lateNonCriticalExtension
    nonCriticalExtension
}

SEQUENCE {
    CHOICE {
        SystemInformation-IEs,
        SEQUENCE {}
    }
}

SEQUENCE {
    SEQUENCE (SIZE (1..maxSIB)) OF CHOICE {
        SIB2,
        SIB3,
        SIB4,
        SIB5,
        SIB6,
        SIB7,
        SIB8,
        SIB9,
        ...
    },
    OCTET STRING OPTIONAL,
    SEQUENCE {} OPTIONAL
}

-- TAG-SYSTEMINFORMATION-STOP
-- ASN1STOP

```

### – ***UEAssistanceInformation***

The *UEAssistanceInformation* message is used for the indication of UE assistance information to the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

**UEAssistanceInformation message**

```
-- ASN1START
-- TAG-UEASSISTANCEINFORMATION-START
```

```
UEAssistanceInformation ::= SEQUENCE {
    criticalExtensions          CHOICE {
        ueAssistanceInformation    UEAssistanceInformation-IEs,
        criticalExtensionsFuture    SEQUENCE {}
    }
}

UEAssistanceInformation-IEs ::= SEQUENCE {
    delayBudgetReport          DelayBudgetReport          OPTIONAL,
    lateNonCriticalExtension    OCTET STRING          OPTIONAL,
    nonCriticalExtension        UEAssistanceInformation-v1540-IEs OPTIONAL
}

DelayBudgetReport ::= CHOICE {
    type1          ENUMERATED {
        msMinus1280, msMinus640, msMinus320, msMinus160, msMinus80, msMinus60, msMinus40,
        msMinus20, ms0, ms20, ms40, ms60, ms80, ms160, ms320, ms640, ms1280},
    ...
}

UEAssistanceInformation-v1540-IEs ::= SEQUENCE {
    overheatingAssistance    OverheatingAssistance          OPTIONAL,
    nonCriticalExtension      SEQUENCE {}                    OPTIONAL
}

OverheatingAssistance ::= SEQUENCE {
    reducedMaxCCs          SEQUENCE {
        reducedCCsDL        INTEGER (0..31),
        reducedCCsUL        INTEGER (0..31)
    } OPTIONAL,
    reducedMaxBW-FR1       SEQUENCE {
        reducedBW-FR1-DL    ReducedAggregatedBandwidth,
        reducedBW-FR1-UL    ReducedAggregatedBandwidth
    } OPTIONAL,
    reducedMaxBW-FR2       SEQUENCE {
        reducedBW-FR2-DL    ReducedAggregatedBandwidth,
        reducedBW-FR2-UL    ReducedAggregatedBandwidth
    } OPTIONAL,
    reducedMaxMIMO-LayersFR1 SEQUENCE {
        reducedMIMO-LayersFR1-DL MIMO-LayersDL,
        reducedMIMO-LayersFR1-UL MIMO-LayersUL
    } OPTIONAL,
    reducedMaxMIMO-LayersFR2 SEQUENCE {
        reducedMIMO-LayersFR2-DL MIMO-LayersDL,
        reducedMIMO-LayersFR2-UL MIMO-LayersUL
    } OPTIONAL
}

ReducedAggregatedBandwidth ::= ENUMERATED {mhz0, mhz10, mhz20, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100, mhz200, mhz300, mhz400}
```

-- TAG-UEASSISTANCEINFORMATION-STOP  
 -- ASN1STOP

| <b>UEAssistanceInformation field descriptions</b>   |
|---|
| <p><b>delayBudgetReport</b><br/>           Indicates the UE-preferred adjustment to connected mode DRX.</p>   |
| <p><b>reducedBW-FR1-DL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all downlink carriers of FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1. This maximum aggregated bandwidth includes downlink carriers of FR1 of both the MCG and the SCG.</p>  |
| <p><b>reducedBW-FR1-UL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all uplink carriers of FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1. This maximum aggregated bandwidth includes uplink carriers of FR1 of both the MCG and the SCG.</p>  |
| <p><b>reducedBW-FR2-DL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all downlink carriers of FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2. Value <i>mhz0</i> is only applicable for FR2. This maximum aggregated bandwidth includes downlink carriers of FR2 of both the MCG and the NR SCG.</p> |
| <p><b>reducedBW-FR2-UL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum aggregated bandwidth across all uplink carriers of FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2. Value <i>mhz0</i> is only applicable for FR2. This maximum aggregated bandwidth includes uplink carriers of FR2 of both the MCG and the NR SCG.</p>     |
| <p><b>reducedCCsDL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink SCells indicated by the field, to address overheating. This maximum number includes both SCells of the MCG and PSCell/SCells of the SCG.</p>   |
| <p><b>reducedCCsUL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink SCells indicated by the field, to address overheating. This maximum number includes both SCells of the MCG and PSCell/SCells of the SCG.</p>   |
| <p><b>reducedMIMO-LayersFR1-DL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink MIMO layers of each serving cell operating on FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1.</p>   |
| <p><b>reducedMIMO-LayersFR1-UL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink MIMO layers of each serving cell operating on FR1 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR1.</p>   |
| <p><b>reducedMIMO-LayersFR2-DL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of downlink MIMO layers of each serving cell operating on FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2.</p>   |
| <p><b>reducedMIMO-LayersFR2-UL</b><br/>           Indicates the UE's preference on reduced configuration corresponding to the maximum number of uplink MIMO layers of each serving cell operating on FR2 indicated by the field, to address overheating. This field is allowed to be reported only when UE is configured with serving cells operating on FR2.</p>   |
| <p><b>type1</b><br/>           Indicates the preferred amount of increment/decrement to the long DRX cycle length with respect to the current configuration. Value in number of milliseconds. Value <i>ms40</i> corresponds to 40 milliseconds, <i>msMinus40</i> corresponds to -40 milliseconds and so on.</p>   |



– *UECapabilityEnquiry*

The *UECapabilityEnquiry* message is used to request UE radio access capabilities for NR as well as for other RATs.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

***UECapabilityEnquiry* information element**

```
-- ASN1START
-- TAG-UECAPABILITYENQUIRY-START

UECapabilityEnquiry ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        ueCapabilityEnquiry UECapabilityEnquiry-IEs,
        criticalExtensionsFuture SEQUENCE {}
    }
}

UECapabilityEnquiry-IEs ::= SEQUENCE {
    ue-CapabilityRAT-RequestList UE-CapabilityRAT-RequestList,
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    ue-CapabilityEnquiryExt OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs) OPTIONAL
}

UECapabilityEnquiry-v1560-IEs ::= SEQUENCE {
    capabilityRequestFilterCommon UE-CapabilityRequestFilterCommon OPTIONAL, -- Need N
    nonCriticalExtension SEQUENCE{} OPTIONAL
}

-- TAG-UECAPABILITYENQUIRY-STOP
-- ASN1STOP
```

– *UECapabilityInformation*

The IE *UECapabilityInformation* message is used to transfer UE radio access capabilities requested by the network.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### ***UECapabilityInformation* information element**

```
-- ASN1START
-- TAG-UECAPABILITYINFORMATION-START

UECapabilityInformation ::=          SEQUENCE {
    rrc-TransactionIdentifier         RRC-TransactionIdentifier,
    criticalExtensions                 CHOICE {
        ueCapabilityInformation      UECapabilityInformation-IEs,
        criticalExtensionsFuture     SEQUENCE {}
    }
}

UECapabilityInformation-IEs ::=      SEQUENCE {
    ue-CapabilityRAT-ContainerList    UE-CapabilityRAT-ContainerList           OPTIONAL,

    lateNonCriticalExtension          OCTET STRING                           OPTIONAL,
    nonCriticalExtension               SEQUENCE {}                             OPTIONAL
}

-- TAG-UECAPABILITYINFORMATION-STOP
-- ASN1STOP
```

### ***ULInformationTransfer***

The *ULInformationTransfer* message is used for the uplink transfer of NAS or non-3GPP dedicated information.

Signalling radio bearer: SRB2 or SRB1 (only if SRB2 not established yet). If SRB2 is suspended, the UE does not send this message until SRB2 is resumed

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to network

### ***ULInformationTransfer* message**

```
-- ASN1START
-- TAG-ULINFORMATIONTRANSFER-START

ULInformationTransfer ::=          SEQUENCE {
    criticalExtensions                 CHOICE {
        ulInformationTransfer         ULInformationTransfer-IEs,
        criticalExtensionsFuture     SEQUENCE {}
    }
}

-- TAG-ULINFORMATIONTRANSFER-STOP
-- ASN1STOP
```

```

ULInformationTransfer-IEs ::= SEQUENCE {
    dedicatedNAS-Message          DedicatedNAS-Message          OPTIONAL,
    lateNonCriticalExtension      OCTET STRING              OPTIONAL,
    nonCriticalExtension          SEQUENCE {}                  OPTIONAL
}

-- TAG-ULINFORMATIONTRANSFER-STOP
-- ASN1STOP

```

## – *ULInformationTransferMRDC*

The *ULInformationTransferMRDC* message is used for the uplink transfer of MR-DC dedicated information (e.g. for transferring the NR or E-UTRA RRC *MeasurementReport* message or the *FailureInformation* message).

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to Network

### *ULInformationTransferMRDC message*

```

-- ASN1START
-- TAG-ULINFORMATIONTRANSFERMRDC-START

ULInformationTransferMRDC ::= SEQUENCE {
    criticalExtensions          CHOICE {
        c1                     CHOICE {
            ulInformationTransferMRDC
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

ULInformationTransferMRDC-IEs ::= SEQUENCE {
    ul-DCCH-MessageNR          OCTET STRING          OPTIONAL,
    ul-DCCH-MessageEUTRA      OCTET STRING          OPTIONAL,
    lateNonCriticalExtension   OCTET STRING          OPTIONAL,
    nonCriticalExtension       SEQUENCE {}            OPTIONAL
}

-- TAG-ULINFORMATIONTRANSFERMRDC-STOP
-- ASN1STOP

```

| <i>ULInformationTransferMRDC</i> field descriptions  |
|--|
| <b><i>ul-DCCH-MessageNR</i></b><br>Includes the <i>UL-DCCH-Message</i> . In this version of the specification, the field is only used to transfer the NR RRC <i>MeasurementReport</i> and <i>FailureInformation</i> messages.        |
| <b><i>ul-DCCH-MessageEUTRA</i></b><br>Includes the <i>UL-DCCH-Message</i> . In this version of the specification, the field is only used to transfer the E-UTRA RRC <i>MeasurementReport</i> and <i>FailureInformation</i> messages. |

## 6.3 RRC information elements

### 6.3.0 Parameterized types

#### – *SetupRelease*

*SetupRelease* allows the *ElementTypeParam* to be used as the referenced data type for the setup and release entries. See A.3.8 for guidelines.

```
-- ASN1START
-- TAG-SETUPRELEASE-START

SetupRelease { ElementTypeParam } ::= CHOICE {
    release      NULL,
    setup       ElementTypeParam
}

-- TAG-SETUPRELEASE-STOP
-- ASN1STOP
```

### 6.3.1 System information blocks

#### – *SIB2*

*SIB2* contains cell re-selection information common for intra-frequency, inter-frequency and/or inter-RAT cell re-selection (i.e. applicable for more than one type of cell re-selection but not necessarily all) as well as intra-frequency cell re-selection information other than neighbouring cell related.

#### ***SIB2* information element**

```
-- ASN1START
-- TAG-SIB2-START

SIB2 ::=
    cellReselectionInfoCommon          SEQUENCE {
        nrofSS-BlocksToAverage          INTEGER (2..maxNrofSS-BlocksToAverage)    OPTIONAL,    -- Need S
        absThreshSS-BlocksConsolidation ThresholdNR                               OPTIONAL,    -- Need S
        rangeToBestCell                 RangeToBestCell                               OPTIONAL,    -- Need R
    }

-- TAG-SIB2-STOP
```

```

    q-Hyst          ENUMERATED {
                    dB0, dB1, dB2, dB3, dB4, dB5, dB6, dB8, dB10,
                    dB12, dB14, dB16, dB18, dB20, dB22, dB24},
    speedStateReselectionPars SEQUENCE {
        mobilityStateParameters
        q-HystSF
            sf-Medium
            sf-High
        }
    }
    ...
},
cellReselectionServingFreqInfo SEQUENCE {
    s-NonIntraSearchP ReselectionThreshold OPTIONAL, -- Need S
    s-NonIntraSearchQ ReselectionThresholdQ  OPTIONAL, -- Need S
    threshServingLowP ReselectionThreshold,
    threshServingLowQ ReselectionThresholdQ  OPTIONAL, -- Need R
    cellReselectionPriority CellReselectionPriority,
    cellReselectionSubPriority CellReselectionSubPriority OPTIONAL, -- Need R
    ...
},
intraFreqCellReselectionInfo SEQUENCE {
    q-RxLevMin          Q-RxLevMin,
    q-RxLevMinSUL       Q-RxLevMin          OPTIONAL, -- Need R
    q-QualMin           Q-QualMin           OPTIONAL, -- Need S
    s-IntraSearchP     ReselectionThreshold,
    s-IntraSearchQ     ReselectionThresholdQ OPTIONAL, -- Need S
    t-ReselectionNR    T-Reselection,
    frequencyBandList  MultiFrequencyBandListNR-SIB OPTIONAL, -- Need S
    frequencyBandListSUL MultiFrequencyBandListNR-SIB OPTIONAL, -- Need R
    p-Max              P-Max              OPTIONAL, -- Need R
    smtc               SSB-MTC            OPTIONAL, -- Need R
    ss-RSSI-Measurement SS-RSSI-Measurement OPTIONAL, -- Need R
    ssb-ToMeasure      SSB-ToMeasure      OPTIONAL, -- Need R
    deriveSSB-IndexFromCell BOOLEAN,
    ...
    [[
    t-ReselectionNR-SF SpeedStateScaleFactors OPTIONAL -- Need N
    ]]
},
...
}

RangeToBestCell ::= Q-OffsetRange

-- TAG-SIB2-STOP
-- ASN1STOP

```

| <b>SIB2 field descriptions</b>  |
|---|
| <p><b><i>absThreshSS-BlocksConsolidation</i></b><br/>Threshold for consolidation of L1 measurements per RS index. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].</p>  |
| <p><b><i>cellReselectionInfoCommon</i></b><br/>Cell re-selection information common for intra-frequency, inter-frequency and/ or inter-RAT cell re-selection. The fields <i>absThreshSS-BlocksConsolidation</i> and <i>nrofSS-BlocksToAverage</i> are only applied to intra-frequency cell reselection.</p>   |
| <p><b><i>cellReselectionServingFreqInfo</i></b><br/>Information common for non-intra-frequency cell re-selection i.e. cell re-selection to inter-frequency and inter-RAT cells.</p>   |
| <p><b><i>deriveSSB-IndexFromCell</i></b><br/>This field indicates whether the UE can utilize serving cell timing to derive the index of SS block transmitted by neighbour cell. If this field is set to <i>true</i>, the UE assumes SFN and frame boundary alignment across cells on the serving frequency as specified in TS 38.133 [14].</p>  |
| <p><b><i>frequencyBandList</i></b><br/>Indicates the list of frequency bands for which the NR cell reselection parameters apply. The UE behaviour in case the field is absent is described in subclause 5.2.2.4.3.</p>  |
| <p><b><i>intraFreqCellReselectionInfo</i></b><br/>Cell re-selection information common for intra-frequency cells.</p>   |
| <p><b><i>nrofSS-BlocksToAverage</i></b><br/>Number of SS blocks to average for cell measurement derivation. If the field is absent the UE uses the measurement quantity as specified in TS 38.304 [20].</p>   |
| <p><b><i>p-Max</i></b><br/>Value in dBm applicable for the intra-frequency neighbouring NR cells. If absent the UE applies the maximum power according to TS 38.101-1 [15].</p>   |
| <p><b><i>q-Hyst</i></b><br/>Parameter "<i>Q<sub>hyst</sub></i>" in TS 38.304 [20], Value in dB. Value <i>dB1</i> corresponds to 1 dB, <i>dB2</i> corresponds to 2 dB and so on.</p>   |
| <p><b><i>q-HystSF</i></b><br/>Parameter "Speed dependent ScalingFactor for Q<sub>hyst</sub>" in TS 38.304 [20]. The <i>sf-Medium</i> and <i>sf-High</i> concern the additional hysteresis to be applied, in Medium and High Mobility state respectively, to Q<sub>hyst</sub> as defined in TS 38.304 [20]. In dB. Value <i>dB-6</i> corresponds to -6dB, <i>dB-4</i> corresponds to -4dB and so on.</p> |
| <p><b><i>q-QualMin</i></b><br/>Parameter "<i>Q<sub>qualmin</sub></i>" in TS 38.304 [20], applicable for intra-frequency neighbour cells. If the field is absent, the UE applies the (default) value of negative infinity for <i>Q<sub>qualmin</sub></i>.</p>  |
| <p><b><i>q-RxLevMin</i></b><br/>Parameter "<i>Q<sub>rxlevmin</sub></i>" in TS 38.304 [20], applicable for intra-frequency neighbour cells.</p>  |
| <p><b><i>q-RxLevMinSUL</i></b><br/>Parameter "<i>Q<sub>rxlevmin</sub></i>" in TS 38.304 [20], applicable for intra-frequency neighbour cells.</p>   |
| <p><b><i>rangeToBestCell</i></b><br/>Parameter "rangeToBestCell" in TS 38.304 [20]. The network configures only non-negative (in dB) values.</p>  |
| <p><b><i>s-IntraSearchP</i></b><br/>Parameter "<i>S<sub>IntraSearchP</sub></i>" in TS 38.304 [20].</p>  |
| <p><b><i>s-IntraSearchQ</i></b><br/>Parameter "<i>S<sub>IntraSearchQ2</sub></i>" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of 0 dB for <i>S<sub>IntraSearchQ</sub></i>.</p>   |
| <p><b><i>s-NonIntraSearchP</i></b><br/>Parameter "<i>S<sub>nonIntraSearchP</sub></i>" in TS 38.304 [20]. If this field is absent, the UE applies the (default) value of infinity for <i>S<sub>nonIntraSearchP</sub></i>.</p>  |
| <p><b><i>s-NonIntraSearchQ</i></b><br/>Parameter "<i>S<sub>nonIntraSearchQ</sub></i>" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of 0 dB for <i>S<sub>nonIntraSearchQ</sub></i>.</p>   |
| <p><b><i>smtc</i></b><br/>Measurement timing configuration for intra-frequency measurement. If this field is absent, the UE assumes that SSB periodicity is 5 ms for the intra-frequency cells.</p>   |
| <p><b><i>ssb-ToMeasure</i></b><br/>The set of SS blocks to be measured within the SMTc measurement duration (see TS 38.215 [9]). When the field is absent the UE measures on all SS-blocks.</p>   |
| <p><b><i>t-ReselectionNR</i></b><br/>Parameter "T<sub>reselctionNR</sub>" in TS 38.304 [20].</p>  |

| <b>SIB2 field descriptions</b>  |
|---|
| <b><i>t-ReselectionNR-SF</i></b><br>Parameter "Speed dependent ScalingFactor for Treselection <sub>NR</sub> " in TS 38.304 [20]. If the field is absent, the UE behaviour is specified in TS 38.304 [20]. |
| <b><i>threshServingLowP</i></b><br>Parameter "Thresh <sub>Serving, LowP</sub> " in TS 38.304 [20].  |
| <b><i>threshServingLowQ</i></b><br>Parameter "Thresh <sub>Serving, LowQ</sub> " in TS 38.304 [20].  |

## – SIB3

SIB3 contains neighbouring cell related information relevant only for intra-frequency cell re-selection. The IE includes cells with specific re-selection parameters as well as blacklisted cells.

### SIB3 information element

```

-- ASN1START
-- TAG-SIB3-START

SIB3 ::=
    SEQUENCE {
        intraFreqNeighCellList      IntraFreqNeighCellList      OPTIONAL, -- Need R
        intraFreqBlackCellList      IntraFreqBlackCellList    OPTIONAL, -- Need R
        lateNonCriticalExtension     OCTET STRING              OPTIONAL,
        ...
    }

IntraFreqNeighCellList ::=
    SEQUENCE (SIZE (1..maxCellIntra)) OF IntraFreqNeighCellInfo

IntraFreqNeighCellInfo ::=
    SEQUENCE {
        physCellId                  PhysCellId,
        q-OffsetCell                 Q-OffsetRange,
        q-RxLevMinOffsetCell         INTEGER (1..8)           OPTIONAL, -- Need R
        q-RxLevMinOffsetCellSUL     INTEGER (1..8)           OPTIONAL, -- Need R
        q-QualMinOffsetCell         INTEGER (1..8)           OPTIONAL, -- Need R
        ...
    }

IntraFreqBlackCellList ::=
    SEQUENCE (SIZE (1..maxCellBlack)) OF PCI-Range

-- TAG-SIB3-STOP
-- ASN1STOP

```

| <b>SIB3 field descriptions</b>   |
|--|
| <b><i>intraFreqBlackCellList</i></b><br>List of blacklisted intra-frequency neighbouring cells.  |
| <b><i>intraFreqNeighCellList</i></b><br>List of intra-frequency neighbouring cells with specific cell re-selection parameters.   |
| <b><i>q-OffsetCell</i></b><br>Parameter "Qoffset <sub>s,n</sub> " in TS 38.304 [20].   |
| <b><i>q-QualMinOffsetCell</i></b><br>Parameter "Qqualminoffsetcell" in TS 38.304 [20]. Actual value Q <sub>qualminoffsetcell</sub> = field value [dB].                 |
| <b><i>q-RxLevMinOffsetCell</i></b><br>Parameter "Qrxlevminoffsetcell" in TS 38.304 [20]. Actual value Q <sub>rxlevminoffsetcell</sub> = field value * 2 [dB].          |
| <b><i>q-RxLevMinOffsetCellSUL</i></b><br>Parameter "QrxlevminoffsetcellSUL" in TS 38.304 [20]. Actual value Q <sub>rxlevminoffsetcellSUL</sub> = field value * 2 [dB]. |

## – SIB4

*SIB4* contains information relevant only for inter-frequency cell re-selection i.e. information about other NR frequencies and inter-frequency neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency as well as cell specific re-selection parameters.

### **SIB4 information element**

```

-- ASN1START
-- TAG-SIB4-START

SIB4 ::= SEQUENCE {
    interFreqCarrierFreqList      InterFreqCarrierFreqList,
    lateNonCriticalExtension      OCTET STRING                               OPTIONAL,
    ...
}

InterFreqCarrierFreqList ::= SEQUENCE (SIZE (1..maxFreq)) OF InterFreqCarrierFreqInfo

InterFreqCarrierFreqInfo ::= SEQUENCE {
    dl-CarrierFreq                ARFCN-ValueNR,
    frequencyBandList             MultiFrequencyBandListNR-SIB          OPTIONAL,    -- Cond Mandatory
    frequencyBandListSUL         MultiFrequencyBandListNR-SIB          OPTIONAL,    -- Need R
    nrofSS-BlocksToAverage        INTEGER (2..maxNrofSS-BlocksToAverage)  OPTIONAL,    -- Need R
    absThreshSS-BlocksConsolidation ThresholdNR                       OPTIONAL,    -- Need R
    smtc                          SSB-MTC                               OPTIONAL,    -- Need R
    ssbSubcarrierSpacing          SubcarrierSpacing,
    ssb-ToMeasure                 SSB-ToMeasure                               OPTIONAL,    -- Need R
    deriveSSB-IndexFromCell       BOOLEAN,
    ss-RSSI-Measurement           SS-RSSI-Measurement                               OPTIONAL,
    q-RxLevMin                    Q-RxLevMin,
    q-RxLevMinSUL                 Q-RxLevMin                               OPTIONAL,    -- Need R
    q-QualMin                      Q-QualMin                               OPTIONAL,    -- Need S,
    p-Max                          P-Max                                       OPTIONAL,    -- Need R
    t-ReselectionNR               T-Reselection,

```



```

t-ReselectionNR-SF          SpeedStateScaleFactors          OPTIONAL,    -- Need S
threshX-HighP               ReselectionThreshold,
threshX-LowP                ReselectionThreshold,
threshX-Q                   SEQUENCE {
    threshX-HighQ            ReselectionThresholdQ,
    threshX-LowQ            ReselectionThresholdQ
}
cellReselectionPriority     CellReselectionPriority          OPTIONAL,    -- Cond RSRQ
cellReselectionSubPriority  CellReselectionSubPriority      OPTIONAL,    -- Need R
q-OffsetFreq               Q-OffsetRange                  DEFAULT dB0,
interFreqNeighCellList     InterFreqNeighCellList         OPTIONAL,    -- Need R
interFreqBlackCellList     InterFreqBlackCellList        OPTIONAL,    -- Need R
...
}

InterFreqNeighCellList ::= SEQUENCE (SIZE (1..maxCellInter)) OF InterFreqNeighCellInfo

InterFreqNeighCellInfo ::= SEQUENCE {
    physCellId              PhysCellId,
    q-OffsetCell            Q-OffsetRange,
    q-RxLevMinOffsetCell    INTEGER (1..8)                OPTIONAL,    -- Need R
    q-RxLevMinOffsetCellSUL INTEGER (1..8)                OPTIONAL,    -- Need R
    q-QualMinOffsetCell     INTEGER (1..8)                OPTIONAL,    -- Need R
    ...
}

InterFreqBlackCellList ::= SEQUENCE (SIZE (1..maxCellBlack)) OF PCI-Range

-- TAG-SIB4-STOP
-- ASN1STOP

```

| <b>SIB4 field descriptions</b>  |
|---|
| <p><b>absThreshSS-BlocksConsolidation</b><br/>Threshold for consolidation of L1 measurements per RS index. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].</p>   |
| <p><b>deriveSSB-IndexFromCell</b><br/>This field indicates whether the UE may use the timing of any detected cell on that frequency to derive the SSB index of all neighbour cells on that frequency. If this field is set to <i>true</i>, the UE assumes SFN and frame boundary alignment across cells on the neighbor frequency as specified in TS 38.133 [14].</p> |
| <p><b>dl-CarrierFreq</b><br/>This field indicates center frequency of the SS block of the neighbour cells, where the frequency corresponds to a GSCN value as specified in TS 38.101-1 [15].</p>  |
| <p><b>frequencyBandList</b><br/>Indicates the list of frequency bands for which the NR cell reselection parameters apply.</p>   |
| <p><b>interFreqBlackCellList</b><br/>List of blacklisted inter-frequency neighbouring cells.</p>  |
| <p><b>interFreqCarrierFreqList</b><br/>List of neighbouring carrier frequencies and frequency specific cell re-selection information.</p>   |
| <p><b>interFreqNeighCellList</b><br/>List of inter-frequency neighbouring cells with specific cell re-selection parameters.</p>   |
| <p><b>nrofSS-BlocksToAverage</b><br/>Number of SS blocks to average for cell measurement derivation. If the field is absent, the UE uses the measurement quantity as specified in TS 38.304 [20].</p>   |
| <p><b>p-Max</b><br/>Value in dBm applicable for the neighbouring NR cells on this carrier frequency. If absent the UE applies the maximum power according to TS 38.101-1 [15].</p>  |
| <p><b>q-OffsetCell</b><br/>Parameter "Qoffset<sub>s,n</sub>" in TS 38.304 [20].</p>   |
| <p><b>q-OffsetFreq</b><br/>Parameter "Qoffset<sub>frequency</sub>" in TS 38.304 [20].</p>   |
| <p><b>q-QualMin</b><br/>Parameter "Q<sub>qualmin</sub>" in TS 38.304 [20]. If the field is absent, the UE applies the (default) value of negative infinity for Q<sub>qualmin</sub>.</p>   |
| <p><b>q-QualMinOffsetCell</b><br/>Parameter "Q<sub>qualminoffsetcell</sub>" in TS 38.304 [20]. Actual value Q<sub>qualminoffsetcell</sub> = field value [dB].</p>   |
| <p><b>q-RxLevMin</b><br/>Parameter "Q<sub>rxlevmin</sub>" in TS 38.304 [20].</p>  |
| <p><b>q-RxLevMinOffsetCell</b><br/>Parameter "Q<sub>rxlevminoffsetcell</sub>" in TS 38.304 [20]. Actual value Q<sub>rxlevminoffsetcell</sub> = field value * 2 [dB].</p>  |
| <p><b>q-RxLevMinOffsetCellSUL</b><br/>Parameter "Q<sub>rxlevminoffsetcellSUL</sub>" in TS 38.304 [20]. Actual value Q<sub>rxlevminoffsetcellSUL</sub> = field value * 2 [dB].</p>   |
| <p><b>q-RxLevMinSUL</b><br/>Parameter "Q<sub>rxlevmin</sub>" in TS 38.304 [20].</p>   |
| <p><b>smtc</b><br/>Measurement timing configuration for inter-frequency measurement. If this field is absent, the UE assumes that SSB periodicity is 5 ms in this frequency.</p>  |
| <p><b>ssb-ToMeasure</b><br/>The set of SS blocks to be measured within the SMTTC measurement duration (see TS 38.215 [9]). When the field is absent the UE measures on all SS-blocks.</p>   |
| <p><b>ssbSubcarrierSpacing</b><br/>Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.</p>  |
| <p><b>threshX-HighP</b><br/>Parameter "Thresh<sub>X, HighP</sub>" in TS 38.304 [20].</p>  |
| <p><b>threshX-HighQ</b><br/>Parameter "Thresh<sub>X, HighQ</sub>" in TS 38.304 [20].</p>  |

| <b>SIB4 field descriptions</b>   |
|--|
| <b>threshX-LowP</b><br>Parameter "Thresh <sub>X, LowP</sub> " in TS 38.304 [20].   |
| <b>threshX-LowQ</b><br>Parameter "Thresh <sub>X, LowQ</sub> " in TS 38.304 [20].   |
| <b>t-ReselectionNR</b><br>Parameter "Treseselection <sub>NR</sub> " in TS 38.304 [20].   |
| <b>t-ReselectionNR-SF</b><br>Parameter "Speed dependent ScalingFactor for Treseselection <sub>NR</sub> " in TS 38.304 [20]. If the field is absent, the UE behaviour is specified in TS 38.304 [20]. |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>Mandatory</i>            | The field is mandatory present in SIB4.  |
| <i>RSRQ</i>                 | The field is mandatory present if <i>threshServingLowQ</i> is present in SIB2; otherwise it is absent. |

## – SIB5

SIB5 contains information relevant only for inter-RAT cell re-selection i.e. information about E-UTRA frequencies and E-UTRAs neighbouring cells relevant for cell re-selection. The IE includes cell re-selection parameters common for a frequency.

### SIB5 information element

```
-- ASN1START
-- TAG-SIB5-START

SIB5 ::=
    SEQUENCE {
        carrierFreqListEUTRA          CarrierFreqListEUTRA          OPTIONAL,      -- Need R
        t-ReselectionEUTRA            T-Reselection,
        t-ReselectionEUTRA-SF        SpeedStateScaleFactors    OPTIONAL,      -- Need S
        lateNonCriticalExtension      OCTET STRING                OPTIONAL,
        ...
    }

CarrierFreqListEUTRA ::=
    SEQUENCE (SIZE (1..maxEUTRA-Carrier)) OF CarrierFreqEUTRA

CarrierFreqEUTRA ::=
    SEQUENCE {
        carrierFreq                  ARFCN-ValueEUTRA,
        eutra-multiBandInfoList      EUTRA-MultiBandInfoList    OPTIONAL,      -- Need R
        eutra-FreqNeighCellList      EUTRA-FreqNeighCellList    OPTIONAL,      -- Need R
        eutra-BlackCellList          EUTRA-FreqBlackCellList    OPTIONAL,      -- Need R
        allowedMeasBandwidth         EUTRA-AllowedMeasBandwidth,
        presenceAntennaPort1         EUTRA-PresenceAntennaPort1,
        cellReselectionPriority        CellReselectionPriority      OPTIONAL,      -- Need R
        cellReselectionSubPriority     CellReselectionSubPriority   OPTIONAL,      -- Need R
        threshX-High                 ReselectionThreshold,
        threshX-Low                 ReselectionThreshold,
        q-RxLevMin                   INTEGER (-70..-22),
        q-QualMin                     INTEGER (-34..-3),
    }
```

```

    p-MaxEUTRA                INTEGER (-30..33),
    threshX-Q                  SEQUENCE {
        threshX-HighQ          ReselectionThresholdQ,
        threshX-LowQ           ReselectionThresholdQ
    }
}
OPTIONAL                      -- Cond RSRQ

EUTRA-FreqBlackCellList ::= SEQUENCE (SIZE (1..maxEUTRA-CellBlack)) OF EUTRA-PhysCellIdRange

EUTRA-FreqNeighCellList ::= SEQUENCE (SIZE (1..maxCelleEUTRA)) OF EUTRA-FreqNeighCellInfo

EUTRA-FreqNeighCellInfo ::= SEQUENCE {
    physCellId                EUTRA-PhysCellId,
    dummy                      EUTRA-Q-OffsetRange,
    q-RxLevMinOffsetCell      INTEGER (1..8)                OPTIONAL,    -- Need R
    q-QualMinOffsetCell       INTEGER (1..8)                OPTIONAL    -- Need R
}

-- TAG-SIB5-STOP
-- ASN1STOP

```

| <b>SIB5 field descriptions</b> |  |
|--------------------------------|--|
| <b>carrierFreqListEUTRA</b>    | List of carrier frequencies of E-UTRA.   |
| <b>dummy</b>                   | This field is not used in the specification. If received it shall be ignored by the UE.  |
| <b>eutra-BlackCellList</b>     | List of blacklisted E-UTRA neighbouring cells.   |
| <b>eutra-multiBandInfoList</b> | Indicates the list of frequency bands in addition to the band represented by <i>carrierFreq</i> for which cell reselection parameters are common, and a list of <i>additionalPmax</i> and <i>additionalSpectrumEmission</i> values, as defined in TS 36.101 [22], table 6.2.4-1, for the frequency bands in <i>eutra-multiBandInfoList</i> |
| <b>p-MaxEUTRA</b>              | The maximum allowed transmission power in dBm on the (uplink) carrier frequency, see TS 36.304 [27]. In dBm  |
| <b>q-QualMin</b>               | Parameter "Q <sub>qualmin</sub> " in TS 36.304 [27]. Actual value Q <sub>qualmin</sub> = field value [dB].   |
| <b>q-QualMinOffsetCell</b>     | Parameter "Q <sub>qualminoffsetcell</sub> " in TS 38.304 [20]. Actual value Q <sub>qualminoffsetcell</sub> = field value [dB].   |
| <b>q-RxLevMin</b>              | Parameter "Q <sub>rxlevmin</sub> " in TS 36.304 [27]. Actual value Q <sub>rxlevmin</sub> = field value * 2 [dBm].  |
| <b>q-RxLevMinOffsetCell</b>    | Parameter "Q <sub>rxlevminoffsetcell</sub> " in TS 38.304 [20]. Actual value Q <sub>rxlevminoffsetcell</sub> = field value * 2 [dB].   |
| <b>t-ReselectionEUTRA</b>      | Parameter "TreselctionEUTRA" in TS 38.304 [20].  |
| <b>threshX-High</b>            | Parameter "Thresh <sub>X, HighP</sub> " in TS 38.304 [20].   |
| <b>threshX-HighQ</b>           | Parameter "Thresh <sub>X, HighQ</sub> " in TS 38.304 [20].   |
| <b>threshX-Low</b>             | Parameter "Thresh <sub>X, LowP</sub> " in TS 38.304 [20].  |
| <b>threshX-LowQ</b>            | Parameter "Thresh <sub>X, LowQ</sub> " in TS 38.304 [20].  |
| <b>t-ReselectionEUTRA-SF</b>   | Parameter "Speed dependent ScalingFactor for TreselctionEUTRA" in TS 38.304 [20]. If the field is absent, the UE behaviour is specified in TS 38.304 [20].   |

| Conditional Presence | Explanation  |
|----------------------|--|
| RSRQ                 | The field is mandatory present if the <i>threshServingLowQ</i> is present in <i>SIB2</i> ; otherwise it is absent. |

– **SIB6**

*SIB6* contains an ETWS primary notification.

**SIB6 information element**

```
-- ASN1START
-- TAG-SIB6-START
```

```

SIB6 ::=
  messageIdentifier      SEQUENCE {
    serialNumber         BIT STRING (SIZE (16)),
    warningType          BIT STRING (SIZE (16)),
    lateNonCriticalExtension OCTET STRING (SIZE (2)),
    ...
  }
  OPTIONAL,
-- TAG-SIB6-STOP
-- ASN1STOP

```

#### **SIB6 field descriptions**

**messageIdentifier**

Identifies the source and type of ETWS notification.

**serialNumber**

Identifies variations of an ETWS notification.

**warningType**

Identifies the warning type of the ETWS primary notification and provides information on emergency user alert and UE popup.

## — SIB7

SIB7 contains an ETWS secondary notification.

#### **SIB7 information element**

```

-- ASN1START
-- TAG-SIB7-START

SIB7 ::=
  messageIdentifier      SEQUENCE {
    serialNumber         BIT STRING (SIZE (16)),
    warningMessageSegmentType ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegmentNumber INTEGER (0..63),
    warningMessageSegment OCTET STRING,
    dataCodingScheme     OCTET STRING (SIZE (1))
    lateNonCriticalExtension OCTET STRING
    ...
  }
  OPTIONAL, -- Cond Segment1
-- TAG-SIB7-STOP
-- ASN1STOP

```

| <b>SIB7 field descriptions</b>  |
|---|
| <b>dataCodingScheme</b><br>Identifies the alphabet/coding and the language applied variations of an ETWS notification.  |
| <b>messageIdentifier</b><br>Identifies the source and type of ETWS notification.  |
| <b>serialNumber</b><br>Identifies variations of an ETWS notification.   |
| <b>warningMessageSegment</b><br>Carries a segment of the Warning Message Contents IE.   |
| <b>warningMessageSegmentNumber</b><br>Segment number of the ETWS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, A segment number of one corresponds to the second segment, and so on. |
| <b>warningMessageSegmentType</b><br>Indicates whether the included ETWS warning message segment is the last segment or not.   |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>Segment1</i>             | The field is mandatory present in the first segment of <i>SIB7</i> , otherwise it is absent. |

## – SIB8

*SIB8* contains a CMAS notification.

### **SIB8 information element**

```

-- ASN1START
-- TAG-SIB8-START

SIB8 ::= SEQUENCE {
    messageIdentifier      BIT STRING (SIZE (16)),
    serialNumber           BIT STRING (SIZE (16)),
    warningMessageSegmentType  ENUMERATED {notLastSegment, lastSegment},
    warningMessageSegmentNumber  INTEGER (0..63),
    warningMessageSegment  OCTET STRING,
    dataCodingScheme       OCTET STRING (SIZE (1))
    warningAreaCoordinatesSegment  OCTET STRING
    lateNonCriticalExtension  OCTET STRING
    ...
}

-- TAG-SIB8-STOP
-- ASN1STOP

```

| <b>SIB8 field descriptions</b>   |
|--|
| <b>dataCodingScheme</b><br>Identifies the alphabet/coding and the language applied variations of a CMAS notification.  |
| <b>messageIdentifier</b><br>Identifies the source and type of CMAS notification.   |
| <b>serialNumber</b><br>Identifies variations of a CMAS notification.   |
| <b>warningAreaCoordinatesSegment</b><br>Carries a segment of the geographical area where the CMAS warning message is valid as defined in [28]. The first octet of the first <i>warningAreaCoordinatesSegment</i> is equivalent to the first octet of Warning Area Coordinates IE defined in and encoded according to TS 23.041 [29] and so on. |
| <b>warningMessageSegment</b><br>Carries a segment of the Warning Message Contents IE.  |
| <b>warningMessageSegmentNumber</b><br>Segment number of the CMAS warning message segment contained in the SIB. A segment number of zero corresponds to the first segment, one corresponds to the second segment, and so on.  |
| <b>warningMessageSegmentType</b><br>Indicates whether the included CMAS warning message segment is the last segment or not.  |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>Segment1</i>             | The field is mandatory present in the first segment of <i>SIB8</i> , otherwise it is absent. |

## – SIB9

*SIB9* contains information related to GPS time and Coordinated Universal Time (UTC). The UE may use the parameters provided in this system information block to obtain the UTC, the GPS and the local time.

NOTE: The UE may use the time information for numerous purposes, possibly involving upper layers e.g. to assist GPS initialisation, to synchronise the UE clock.

### **SIB9 information element**

```

-- ASN1START
-- TAG-SIB9-START

SIB9 ::=
    SEQUENCE {
        timeInfo
            SEQUENCE {
                timeInfoUTC
                    INTEGER (0..549755813887),
                dayLightSavingTime
                    BIT STRING (SIZE (2))
                    OPTIONAL, -- Need R
                leapSeconds
                    INTEGER (-127..128)
                    OPTIONAL, -- Need R
                localTimeOffset
                    INTEGER (-63..64)
                    OPTIONAL, -- Need R
            }
            OPTIONAL, -- Need R
        lateNonCriticalExtension
            OCTET STRING
            OPTIONAL,
        ...
    }

-- TAG-SIB9-STOP
-- ASN1STOP

```



| <b>SIB9 field descriptions</b>  |
|---|
| <p><b>dayLightSavingTime</b><br/>Indicates if and how daylight-saving time (DST) is applied to obtain the local time. The semantics are the same as the semantics of the <i>Daylight Saving Time</i> IE in TS 24.501 [23] and TS 24.008 [38]. The first/leftmost bit of the bit string contains the b2 of octet 3 and the second bit of the bit string contains b1 of octet 3 in the value part of the <i>Daylight Saving Time</i> IE in TS 24.008 [38].</p>  |
| <p><b>leapSeconds</b><br/>Number of leap seconds offset between GPS Time and UTC. UTC and GPS time are related i.e. GPS time -leapSeconds = UTC time.</p>   |
| <p><b>localTimeOffset</b><br/>Offset between UTC and local time in units of 15 minutes. Actual value = field value * 15 minutes. Local time of the day is calculated as UTC time + localTimeOffset.</p>   |
| <p><b>timeInfoUTC</b><br/>Coordinated Universal Time corresponding to the SFN boundary at or immediately after the ending boundary of the SI-window in which SIB9 is transmitted. The field counts the number of UTC seconds in 10 ms units since 00:00:00 on Gregorian calendar date 1 January, 1900 (midnight between Sunday, December 31, 1899 and Monday, January 1, 1900). See NOTE 1. This field is excluded when determining changes in system information, i.e. changes of <i>timeInfoUTC</i> should neither result in system information change notifications nor in a modification of <i>valueTag</i> in <i>SIB1</i>.</p> |

NOTE 1: The UE may use this field together with the *leapSeconds* field to obtain GPS time as follows: GPS Time (in seconds) = timeInfoUTC (in seconds) - 2,524,953,600 (seconds) + leapSeconds, where 2,524,953,600 is the number of seconds between 00:00:00 on Gregorian calendar date 1 January, 1900 and 00:00:00 on Gregorian calendar date 6 January, 1980 (start of GPS time).

## 6.3.2 Radio resource control information elements

### – *AdditionalSpectrumEmission*

The IE *AdditionalSpectrumEmission* is used to indicate emission requirements to be fulfilled by the UE (see TS 38.101-1 [15], clause 6.2.3, and TS 38.101-2 [39], clause 6.2.3).

#### ***AdditionalSpectrumEmission* information element**

```
-- ASN1START
-- TAG-ADDITIONALSPECTRUMEMISSION-START
```

```
AdditionalSpectrumEmission ::= INTEGER (0..7)
```

```
-- TAG-ADDITIONALSPECTRUMEMISSION-STOP
-- ASN1STOP
```

### – *Alpha*

The IE *Alpha* defines possible values of a the pathloss compensation coefficient for uplink power control. Value *alpha0* corresponds to the value 0, Value *alpha04* corresponds to the value 0.4, Value *alpha05* corresponds to the value 0.5 and so on. Value *alpha1* corresponds to value 1. See also clause 7.1 of TS 38.213 [13].

```
-- ASN1START
-- TAG-ALPHA-START

Alpha ::=
    ENUMERATED {alpha0, alpha04, alpha05, alpha06, alpha07, alpha08, alpha09, alpha1}

-- TAG-ALPHA-STOP
-- ASN1STOP
```

### – *AMF-Identifier*

The IE *AMF-Identifier* (AMFI) comprises of an AMF Region ID, an AMF Set ID and an AMF Pointer as specified in TS 23.003 [21], clause 2.10.1.

#### ***AMF-Identifier* information element**

```
-- ASN1START
-- TAG-AMF-IDENTIFIER-START

AMF-Identifier ::=
    BIT STRING (SIZE (24))

-- TAG-AMF-IDENTIFIER-STOP
-- ASN1STOP
```

### – *ARFCN-ValueEUTRA*

The IE *ARFCN-ValueEUTRA* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) E-UTRA carrier frequency, as defined in TS 36.101 [22].

#### ***ARFCN-ValueEUTRA* information element**

```
-- ASN1START
-- TAG-ARFCN-VALUEEUTRA-START

ARFCN-ValueEUTRA ::=
    INTEGER (0..maxEARFCN)

-- TAG-ARFCN-VALUEEUTRA-STOP
-- ASN1STOP
```

### – *ARFCN-ValueNR*

The IE *ARFCN-ValueNR* is used to indicate the ARFCN applicable for a downlink, uplink or bi-directional (TDD) NR global frequency raster, as defined in TS 38.101-1 [15] and TS 38.101-2 [39], clause 5.4.2.

```
-- ASN1START
-- TAG-ARFCN-VALUENR-START
```

```
ARFCN-ValueNR ::= INTEGER (0..maxNARFCN)
```

```
-- TAG-ARFCN-VALUENR-STOP
-- ASN1STOP
```

## – *BeamFailureRecoveryConfig*

The IE *BeamFailureRecoveryConfig* is used to configure the UE with RACH resources and candidate beams for beam failure recovery in case of beam failure detection. See also TS 38.321 [3], clause 5.1.1.

### *BeamFailureRecoveryConfig* information element

```
-- ASN1START
-- TAG-BEAMFAILURERECOVERYCONFIG-START
```

```
BeamFailureRecoveryConfig ::= SEQUENCE {
  rootSequenceIndex-BFR          INTEGER (0..137)                OPTIONAL, -- Need M
  rach-ConfigBFR                 RACH-ConfigGeneric              OPTIONAL, -- Need M
  rsrp-ThresholdSSB              RSRP-Range                     OPTIONAL, -- Need M
  candidateBeamRSList            SEQUENCE (SIZE(1..maxNrofCandidateBeams)) OF PRACH-ResourceDedicatedBFR OPTIONAL, -- Need M
  ssb-perRACH-Occasion           ENUMERATED {oneEighth, oneFourth, oneHalf, one, two,
                                             four, eight, sixteen}    OPTIONAL, -- Need M
  ra-ssb-OccasionMaskIndex       INTEGER (0..15)                 OPTIONAL, -- Need M
  recoverySearchSpaceId         SearchSpaceId                  OPTIONAL, -- Need R
  ra-Prioritization              RA-Prioritization              OPTIONAL, -- Need R
  beamFailureRecoveryTimer       ENUMERATED {ms10, ms20, ms40, ms60, ms80, ms100, ms150, ms200} OPTIONAL, -- Need M
  ...
  [[
  msg1-SubcarrierSpacing-v1530   SubcarrierSpacing              OPTIONAL -- Need M
  ]]
}

PRACH-ResourceDedicatedBFR ::= CHOICE {
  ssb          BFR-SSB-Resource,
  csi-RS       BFR-CSIRS-Resource
}

BFR-SSB-Resource ::= SEQUENCE {
  ssb          SSB-Index,
  ra-PreambleIndex  INTEGER (0..63),
  ...
}

BFR-CSIRS-Resource ::= SEQUENCE {
  csi-RS       NZP-CSI-RS-ResourceId,
  ra-OccasionList  SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1)  OPTIONAL, -- Need R
  ra-PreambleIndex  INTEGER (0..63)                                OPTIONAL, -- Need R
  ...
}
```

-- TAG-BEAMFAILURERECOVERYCONFIG-STOP  
 -- ASN1STOP

| <b><i>BeamFailureRecoveryConfig</i> field descriptions</b>  |
|---|
| <p><b><i>beamFailureRecoveryTimer</i></b><br/>           Timer for beam failure recovery timer. Upon expiration of the timer the UE does not use CFRA for BFR. Value in ms. Value <i>ms10</i> corresponds to 10 ms, value <i>ms20</i> corresponds to 20 ms, and so on.</p>  |
| <p><b><i>candidateBeamRSList</i></b><br/>           A list of reference signals (CSI-RS and/or SSB) identifying the candidate beams for recovery and the associated RA parameters. The network configures these reference signals to be within the linked DL BWP (i.e., within the DL BWP with the same <i>bwp-Id</i>) of the UL BWP in which the <i>BeamFailureRecoveryConfig</i> is provided.</p>   |
| <p><b><i>msg1-SubcarrierSpacing</i></b><br/>           Subcarrier spacing for contention free beam failure recovery. Only the values 15 kHz or 30 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable. See TS 38.211 [16], clause 5.3.2.</p>  |
| <p><b><i>rsrp-ThresholdSSB</i></b><br/>           L1-RSRP threshold used for determining whether a candidate beam may be used by the UE to attempt contention free random access to recover from beam failure (see TS 38.213 [13], clause 6).</p>   |
| <p><b><i>ra-prioritization</i></b><br/>           Parameters which apply for prioritized random access procedure for BFR (see TS 38.321 [3], clause 5.1.1).</p>   |
| <p><b><i>ra-ssb-OccasionMaskIndex</i></b><br/>           Explicitly signalled PRACH Mask Index for RA Resource selection in TS 38.321 [3]. The mask is valid for all SSB resources.</p>   |
| <p><b><i>rach-ConfigBFR</i></b><br/>           Configuration of contention free random access occasions for BFR.</p>  |
| <p><b><i>recoverySearchSpaceId</i></b><br/>           Search space to use for BFR RAR. The network configures this search space to be within the linked DL BWP (i.e., within the DL BWP with the same <i>bwp-Id</i>) of the UL BWP in which the <i>BeamFailureRecoveryConfig</i> is provided. The CORESET associated with the recovery search space cannot be associated with another search space. Network always configures the UE with a value for this field when contention free random access resources for BFR are configured.</p> |
| <p><b><i>ssb-perRACH-Occasion</i></b><br/>           Number of SSBs per RACH occasion for CF-BFR, see TS 38.213 [13], clause 8.1.</p>   |

| <b><i>BFR-CSIRS-Resource</i> field descriptions</b>  |
|--|
| <p><b><i>csi-RS</i></b><br/>           The ID of a <i>NZP-CSI-RS-Resource</i> configured in the <i>CSI-MeasConfig</i> of this serving cell. This reference signal determines a candidate beam for beam failure recovery (BFR).</p>   |
| <p><b><i>ra-OccasionList</i></b><br/>           RA occasions that the UE shall use when performing BFR upon selecting the candidate beam identified by this CSI-RS. The network ensures that the RA occasion indexes provided herein are also configured by <i>prach-ConfigurationIndex</i> and <i>msg1-FDM</i>. Each RACH occasion is sequentially numbered, first, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions; second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot and Third, in increasing order of indexes for PRACH slots.<br/>           If the field is absent the UE uses the RA occasion associated with the SSB that is QCLed with this CSI-RS.</p> |
| <p><b><i>ra-PreambleIndex</i></b><br/>           The RA preamble index to use in the RA occasions associated with this CSI-RS. If the field is absent, the UE uses the preamble index associated with the SSB that is QCLed with this CSI-RS.</p>  |

| <b>BFR-SSB-Resource field descriptions</b>   |
|--|
| <b>ra-PreambleIndex</b><br>The preamble index that the UE shall use when performing BFR upon selecting the candidate beams identified by this SSB. |
| <b>ssb</b><br>The ID of an SSB transmitted by this serving cell. It determines a candidate beam for beam failure recovery (BFR).                   |

## – **BSR-Config**

The IE *BSR-Config* is used to configure buffer status reporting.

### **BSR-Config information element**

```
-- ASN1START
-- TAG-BSR-CONFIG-START

BSR-Config ::=
    SEQUENCE {
        periodicBSR-Timer          ENUMERATED { sf1, sf5, sf10, sf16, sf20, sf32, sf40, sf64,
                                                sf80, sf128, sf160, sf320, sf640, sf1280, sf2560, infinity },
        retxBSR-Timer             ENUMERATED { sf10, sf20, sf40, sf80, sf160, sf320, sf640, sf1280, sf2560,
                                                sf5120, sf10240, spare5, spare4, spare3, spare2, spare1},
        logicalChannelSR-DelayTimer  ENUMERATED { sf20, sf40, sf64, sf128, sf512, sf1024, sf2560, spare1} OPTIONAL, -- Need R
        ...
    }

-- TAG-BSR-CONFIG-STOP
-- ASN1STOP
```

| <b>BSR-Config field descriptions</b>   |
|--|
| <b>logicalChannelSR-DelayTimer</b><br>Value in number of subframes. Value <i>sf20</i> corresponds to 20 subframes, <i>sf40</i> corresponds to 40 subframes, and so on. |
| <b>periodicBSR-Timer</b><br>Value in number of subframes. Value <i>sf1</i> corresponds to 1 subframe, value <i>sf5</i> corresponds to 5 subframes and so on.           |
| <b>retxBSR-Timer</b><br>Value in number of subframes. Value <i>sf10</i> corresponds to 10 subframes, value <i>sf20</i> corresponds to 20 subframes and so on.          |

## – **BWP**

The IE *BWP* is used to configure generic parameters of a bandwidth part as defined in TS 38.211 [16], clause 4.5, and TS 38.213 [13], clause 12.

For each serving cell the network configures at least an initial downlink bandwidth part and one (if the serving cell is configured with an uplink) or two (if using supplementary uplink (SUL)) initial uplink bandwidth parts. Furthermore, the network may configure additional uplink and downlink bandwidth parts for a serving cell.

The uplink and downlink bandwidth part configurations are divided into common and dedicated parameters.

**BWP information element**

```

-- ASN1START
-- TAG-BWP-START

BWP ::=
    locationAndBandwidth          SEQUENCE {
        INTEGER (0..37949),
        subcarrierSpacing         SubcarrierSpacing,
        cyclicPrefix               ENUMERATED { extended }
    }
    OPTIONAL                      -- Need R

-- TAG-BWP-STOP
-- ASN1STOP

```

**BWP field descriptions****cyclicPrefix**

Indicates whether to use the extended cyclic prefix for this bandwidth part. If not set, the UE uses the normal cyclic prefix. Normal CP is supported for all subcarrier spacings and slot formats. Extended CP is supported only for 60 kHz subcarrier spacing. (see TS 38.211 [16], clause 4.2)

**locationAndBandwidth**

Frequency domain location and bandwidth of this bandwidth part. The value of the field shall be interpreted as resource indicator value (RIV) as defined TS 38.214 [19] with assumptions as described in TS 38.213 [13], clause 12, i.e. setting  $N_{\text{BWP}}^{\text{size}}=275$ . The first PRB is a PRB determined by *subcarrierSpacing* of this BWP and *offsetToCarrier* (configured in *SCS-SpecificCarrier* contained within *FrequencyInfoDL / FrequencyInfoUL / FrequencyInfoUL-SIB / FrequencyInfoDL-SIB* within *ServingCellConfigCommon / ServingCellConfigCommonSIB1*) corresponding to this subcarrier spacing. In case of TDD, a BWP-pair (UL BWP and DL BWP with the same *bwpld*) must have the same center frequency (see TS 38.213 [13], clause 12)

**subcarrierSpacing**

Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to TS 38.211 [16], table 4.2-1. The value *kHz15* corresponds to  $\mu=0$ , value *kHz30* corresponds to  $\mu=1$ , and so on. Only the values 15 kHz, 30 kHz, or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable. For the initial DL BWP this field has the same value as the field *subCarrierSpacingCommon* in *MIB* of the same serving cell.

– **BWP-Downlink**

The IE *BWP-Downlink* is used to configure an additional downlink bandwidth part (not for the initial BWP).

**BWP-Downlink information element**

```

-- ASN1START
-- TAG-BWP-DOWNLINK-START

BWP-Downlink ::=
    BWP-Id,
    BWP-Common          OPTIONAL, -- Cond SetupOtherBWP
    BWP-Dedicated       OPTIONAL, -- Cond SetupOtherBWP
    ...
}

```

```
-- TAG-BWP-DOWNLINK-STOP
-- ASN1STOP
```

| <b><i>BWP-Downlink</i> field descriptions</b>   |
|---|
| <p><b><i>bwp-Id</i></b><br/>An identifier for this bandwidth part. Other parts of the RRC configuration use the <i>BWP-Id</i> to associate themselves with a particular bandwidth part. The network configures the BWPs with consecutive IDs from 1. The Network does not include the value 0, since value 0 is reserved for the initial BWP.</p> |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>SetupOtherBWP</i>        | The field is mandatory present upon configuration of a new DL BWP. The field is optionally present, Need M, otherwise. |

### – *BWP-DownlinkCommon*

The IE *BWP-DownlinkCommon* is used to configure the common parameters of a downlink BWP. They are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

#### ***BWP-DownlinkCommon* information element**

```
-- ASN1START
-- TAG-BWP-DOWNLINKCOMMON-START

BWP-DownlinkCommon ::=
    genericParameters          SEQUENCE {
        pdcch-ConfigCommon    BWP,
        pdsch-ConfigCommon    SetupRelease { PDCCH-ConfigCommon } OPTIONAL, -- Need M
        ...                   SetupRelease { PDSCH-ConfigCommon } OPTIONAL, -- Need M
    }

-- TAG-BWP-DOWNLINKCOMMON-STOP
-- ASN1STOP
```

| <b><i>BWP-DownlinkCommon</i> field descriptions</b>  |
|--|
| <p><b><i>pdccch-ConfigCommon</i></b><br/>Cell specific parameters for the PDCCH of this BWP.</p> |
| <p><b><i>pdsch-ConfigCommon</i></b><br/>Cell specific parameters for the PDSCH of this BWP.</p>  |

### – *BWP-DownlinkDedicated*

The IE *BWP-DownlinkDedicated* is used to configure the dedicated (UE specific) parameters of a downlink BWP.

***BWP-DownlinkDedicated* information element**

```

-- ASN1START
-- TAG-BWP-DOWNLINKDEDICATED-START

BWP-DownlinkDedicated ::=
SEQUENCE {
    pdcch-Config          SetupRelease { PDCCH-Config }          OPTIONAL,  -- Need M
    pdsch-Config         SetupRelease { PDSCH-Config }         OPTIONAL,  -- Need M
    sps-Config           SetupRelease { SPS-Config }           OPTIONAL,  -- Need M
    radioLinkMonitoringConfig SetupRelease { RadioLinkMonitoringConfig } OPTIONAL,  -- Need M
    ...
}

-- TAG-BWP-DOWNLINKDEDICATED-STOP
-- ASN1STOP

```

***BWP-DownlinkDedicated* field descriptions*****pdccch-Config***

UE specific PDCCH configuration for one BWP.

***pdsch-Config***

UE specific PDSCH configuration for one BWP.

***sps-Config***

UE specific SPS (Semi-Persistent Scheduling) configuration for one BWP. Except for reconfiguration with sync, the NW does not reconfigure *sps-Config* when there is an active configured downlink assignment (see TS 38.321 [3]). However, the NW may release the *sps-Config* at any time.

***radioLinkMonitoringConfig***

UE specific configuration of radio link monitoring for detecting cell- and beam radio link failure occasions. The maximum number of failure detection resources should be limited up to 8 for both cell and beam radio link failure detection in Rel-15.

— ***BWP-Id***

The IE *BWP-Id* is used to refer to Bandwidth Parts (BWP). The initial BWP is referred to by *BWP-Id* 0. The other BWPs are referred to by *BWP-Id* 1 to *maxNrofBWPs*.

***BWP-Id* information element**

```

-- ASN1START
-- TAG-BWP-ID-START

BWP-Id ::=
INTEGER (0..maxNrofBWPs)

-- TAG-BWP-ID-STOP
-- ASN1STOP

```

— ***BWP-Uplink***

The IE *BWP-Uplink* is used to configure an additional uplink bandwidth part (not for the initial BWP).



**BWP-Uplink information element**

```

-- ASN1START
-- TAG-BWP-UPLINK-START

BWP-Uplink ::=
    bwp-Id
    bwp-Common
    bwp-Dedicated
    ...
}

SEQUENCE {
    BWP-Id,
    BWP-UplinkCommon
    BWP-UplinkDedicated
    ...
}

OPTIONAL, -- Cond SetupOtherBWP
OPTIONAL, -- Cond SetupOtherBWP

-- TAG-BWP-UPLINK-STOP
-- ASN1STOP

```

**BWP-Uplink field descriptions*****bwp-Id***

An identifier for this bandwidth part. Other parts of the RRC configuration use the *BWP-Id* to associate themselves with a particular bandwidth part. The network configures the BWPs with consecutive IDs from 1. The Network does not include the value 0, since value 0 is reserved for the initial BWP.

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>SetupOtherBWP</i> | The field is mandatory present upon configuration of a new UL BWP. The field is optionally present, Need M, otherwise. |

***BWP-UplinkCommon***

The IE *BWP-UplinkCommon* is used to configure the common parameters of an uplink BWP. They are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

**BWP-UplinkCommon information element**

```

-- ASN1START
-- TAG-BWP-UPLINKCOMMON-START

BWP-UplinkCommon ::=
    genericParameters
    rach-ConfigCommon
    pusch-ConfigCommon
    pucch-ConfigCommon
    ...
}

SEQUENCE {
    BWP,
    SetupRelease { RACH-ConfigCommon }
    SetupRelease { PUSCH-ConfigCommon }
    SetupRelease { PUCCH-ConfigCommon }
    ...
}

OPTIONAL, -- Need M
OPTIONAL, -- Need M
OPTIONAL, -- Need M

-- TAG-BWP-UPLINKCOMMON-STOP
-- ASN1STOP

```

| <i>BWP-UplinkCommon</i> field descriptions  |
|---|
| <p><b><i>pucch-ConfigCommon</i></b><br/>Cell specific parameters for the PUCCH of this BWP.</p>   |
| <p><b><i>pusch-ConfigCommon</i></b><br/>Cell specific parameters for the PUSCH of this BWP.</p>   |
| <p><b><i>rach-ConfigCommon</i></b><br/>Configuration of cell specific random access parameters which the UE uses for contention based and contention free random access as well as for contention based beam failure recovery in this BWP. The NW configures SSB-based RA (and hence <i>RACH-ConfigCommon</i>) only for UL BWPs if the linked DL BWPs (same <i>bwpld</i> as UL-BWP) are the initial DL BWPs or DL BWPs containing the SSB associated to the initial DL BWP. The network configures <i>rach-ConfigCommon</i>, whenever it configures contention free random access (for reconfiguration with sync or for beam failure recovery).</p> |

– *BWP-UplinkDedicated*

The IE *BWP-UplinkDedicated* is used to configure the dedicated (UE specific) parameters of an uplink BWP.

***BWP-UplinkDedicated* information element**

```

-- ASN1START
-- TAG-BWP-UPLINKDEDICATED-START

BWP-UplinkDedicated ::=
    SEQUENCE {
        pucch-Config          SetupRelease { PUCCH-Config }          OPTIONAL, -- Need M
        pusch-Config          SetupRelease { PUSCH-Config }          OPTIONAL, -- Need M
        configuredGrantConfig SetupRelease { ConfiguredGrantConfig } OPTIONAL, -- Need M
        srs-Config            SetupRelease { SRS-Config }            OPTIONAL, -- Need M
        beamFailureRecoveryConfig SetupRelease { BeamFailureRecoveryConfig } OPTIONAL, -- Cond SpCellOnly
        ...
    }

-- TAG-BWP-UPLINKDEDICATED-STOP
-- ASN1STOP

```

| <b>BWP-UplinkDedicated field descriptions</b>   |
|---|
| <p><b>beamFailureRecoveryConfig</b><br/>Configuration of beam failure recovery. If <i>supplementaryUplink</i> is present, the field is present only in one of the uplink carriers, either UL or SUL.</p>  |
| <p><b>configuredGrantConfig</b><br/>A <i>Configured-Grant</i> of <i>type1</i> or <i>type2</i>. It may be configured for UL or SUL but in case of <i>type1</i> not for both at a time. Except for reconfiguration with sync, the NW does not reconfigure <i>configuredGrantConfig</i> when there is an active configured uplink grant Type 2 (see TS 38.321 [3]). However, the NW may release the <i>configuredGrantConfig</i> at any time.</p>  |
| <p><b>pucch-Config</b><br/>PUCCH configuration for one BWP of the normal UL or SUL of a serving cell. If the UE is configured with SUL, the network configures PUCCH only on the BWPs of one of the uplinks (normal UL or SUL). The network configures <i>PUCCH-Config</i> at least on non-initial BWP(s) for SpCell and PUCCH SCell. If supported by the UE, the network may configure at most one additional SCell of a cell group with <i>PUCCH-Config</i> (i.e. PUCCH SCell).<br/>In EN-DC, The NW configures at most one serving cell per frequency range with PUCCH. And in EN-DC, if two PUCCH groups are configured, the serving cells of the NR PUCCH group in FR2 use the same numerology.<br/>The NW may configure PUCCH for a BWP when setting up the BWP. The network may also add/remove the <i>pucch-Config</i> in an <i>RRCReconfiguration</i> with <i>reconfigurationWithSync</i> (for SpCell or PUCCH SCell) or with SCell release and add (for PUCCH SCell) to move the PUCCH between the UL and SUL carrier of one serving cell. In other cases, only modifications of a previously configured <i>pucch-Config</i> are allowed.<br/>If one (S)UL BWP of a serving cell is configured with PUCCH, all other (S)UL BWPs must be configured with PUCCH, too.</p> |
| <p><b>pusch-Config</b><br/>PUSCH configuration for one BWP of the normal UL or SUL of a serving cell. If the UE is configured with SUL and if it has a <i>PUSCH-Config</i> for both UL and SUL, an UL/SUL indicator field in DCI indicates which of the two to use. See TS 38.212 [17], clause 7.3.1.</p>   |
| <p><b>srs-Config</b><br/>Uplink sounding reference signal configuration.</p>  |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>SpCellOnly</i>           | The field is optionally present, Need M, in the <i>BWP-UplinkDedicated</i> of an SpCell. It is absent otherwise. |

## – *CellAccessRelatedInfo*

The IE *CellAccessRelatedInfo* indicates cell access related information for this cell.

### ***CellAccessRelatedInfo* information element**

```

-- ASN1START
-- TAG-CELLACCESSRELATEDINFO-START

CellAccessRelatedInfo ::= SEQUENCE {
    plmn-IdentityList      PLMN-IdentityInfoList,
    cellReservedForOtherUse  ENUMERATED {true} OPTIONAL,      -- Need R
    ...
}

-- TAG-CELLACCESSRELATEDINFO-STOP
-- ASN1STOP

```

**CellAccessRelatedInfo field descriptions****cellReservedForOtherUse**

Indicates whether the cell is reserved, as defined in 38.304 [20]. The field is applicable to all PLMNs.

**plmn-IdentityList**

The *plmn-IdentityList* is used to configure a set of *PLMN-IdentityInfoList* elements. Each of those elements contains a list of one or more PLMN Identities and additional information associated with those PLMNs. The total number of PLMNs in the *PLMN-IdentityInfoList* does not exceed 12. The PLMN index is defined as  $b_1+b_2+\dots+b_{(n-1)}+i$  for the PLMN included at the *n*-th entry of *PLMN-IdentityInfoList* and the *i*-th entry of its corresponding *PLMN-IdentityInfo*, where  $b(j)$  is the number of *PLMN-Identity* entries in each *PLMN-IdentityInfo*, respectively.

– **CellAccessRelatedInfo-EUTRA-5GC**

The IE *CellAccessRelatedInfo-EUTRA-5GC* indicates cell access related information for an LTE cell connected to 5GC.

**CellAccessRelatedInfo-EUTRA-5GC information element**

```
-- ASN1START
-- TAG-CELLACCESSRELATEDINFOEUTRA-5GC-START

CellAccessRelatedInfo-EUTRA-5GC ::= SEQUENCE {
    plmn-IdentityList-eutra-5gc      PLMN-IdentityList-EUTRA-5GC,
    trackingAreaCode-eutra-5gc     TrackingAreaCode,
    ranac-5gc                       RAN-AreaCode                    OPTIONAL,
    cellIdentity-eutra-5gc         CellIdentity-EUTRA-5GC
}

PLMN-IdentityList-EUTRA-5GC ::= SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity-EUTRA-5GC

PLMN-Identity-EUTRA-5GC ::= CHOICE {
    plmn-Identity-EUTRA-5GC      PLMN-Identity,
    plmn-index                   INTEGER (1..maxPLMN)
}

CellIdentity-EUTRA-5GC ::= CHOICE {
    cellIdentity-EUTRA          BIT STRING (SIZE (28)),
    cellId-index                INTEGER (1..maxPLMN)
}

-- TAG-CELLACCESSRELATEDINFOEUTRA-5GC-STOP
-- ASN1STOP
```

– **CellAccessRelatedInfo-EUTRA-EPC**

The IE *CellAccessRelatedInfo-EUTRA-EPC* indicates cell access related information for an LTE cell connected to EPC.

**CellAccessRelatedInfo-EUTRA-EPC information element**

```

-- ASN1START
-- TAG-CELLACCESSRELATEDINFOEUTRA-EPC-START

CellAccessRelatedInfo-EUTRA-EPC ::= SEQUENCE {
    plmn-IdentityList-eutra-epc    PLMN-IdentityList-EUTRA-EPC,
    trackingAreaCode-eutra-epc    BIT STRING (SIZE (16)),
    cellIdentity-eutra-epc        BIT STRING (SIZE (28))
}

PLMN-IdentityList-EUTRA-EPC ::= SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity

-- TAG-CELLACCESSRELATEDINFOEUTRA-EPC-STOP
-- ASN1STOP

```

**CellGroupConfig**

The *CellGroupConfig* IE is used to configure a master cell group (MCG) or secondary cell group (SCG). A cell group comprises of one MAC entity, a set of logical channels with associated RLC entities and of a primary cell (SpCell) and one or more secondary cells (SCells).

**CellGroupConfig information element**

```

-- ASN1START
-- TAG-CELLGROUPCONFIG-START

-- Configuration of one Cell-Group:
CellGroupConfig ::= SEQUENCE {
    cellGroupId                CellGroupId,

    rlc-BearerToAddModList     SEQUENCE (SIZE(1..maxLC-ID)) OF RLC-BearerConfig    OPTIONAL, -- Need N
    rlc-BearerToReleaseList    SEQUENCE (SIZE(1..maxLC-ID)) OF LogicalChannelIdentity OPTIONAL, -- Need N

    mac-CellGroupConfig       MAC-CellGroupConfig    OPTIONAL, -- Need M

    physicalCellGroupConfig   PhysicalCellGroupConfig    OPTIONAL, -- Need M

    spCellConfig              SpCellConfig            OPTIONAL, -- Need M
    sCellToAddModList         SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellConfig    OPTIONAL, -- Need N
    sCellToReleaseList        SEQUENCE (SIZE (1..maxNrofSCells)) OF SCellIndex     OPTIONAL, -- Need N
    ...,
    [[
    reportUplinkTxDirectCurrent-v1530    ENUMERATED {true}    OPTIONAL -- Cond BWP-Reconfig
    ]]
}

-- Serving cell specific MAC and PHY parameters for a SpCell:
SpCellConfig ::= SEQUENCE {
    servCellIndex              ServCellIndex    OPTIONAL, -- Cond SCG
    reconfigurationWithSync    ReconfigurationWithSync    OPTIONAL, -- Cond ReconfWithSync
}

```

```

    rlf-TimersAndConstants          SetupRelease { RLF-TimersAndConstants }          OPTIONAL, -- Need M
    rlmInSyncOutOfSyncThreshold    ENUMERATED {nl}                          OPTIONAL, -- Need S
    spCellConfigDedicated          ServingCellConfig                          OPTIONAL, -- Need M
    ...
}

ReconfigurationWithSync ::=
    spCellConfigCommon              ServingCellConfigCommon              OPTIONAL, -- Need M
    newUE-Identity                  RNTI-Value,
    t304                             ENUMERATED {ms50, ms100, ms150, ms200, ms500, ms1000, ms2000, ms10000},
    rach-ConfigDedicated            CHOICE {
        uplink                       RACH-ConfigDedicated,
        supplementaryUplink           RACH-ConfigDedicated
    }                                OPTIONAL, -- Need N
    ...,
    [[
    smtc                             SSB-MTC                                OPTIONAL -- Need S
    ]]
}

SCellConfig ::=
    sCellIndex                      SCellIndex,
    sCellConfigCommon              ServingCellConfigCommon          OPTIONAL, -- Cond SCellAdd
    sCellConfigDedicated           ServingCellConfig                  OPTIONAL, -- Cond SCellAddMod
    ...,
    [[
    smtc                             SSB-MTC                                OPTIONAL -- Need S
    ]]
}

-- TAG-CELLGROUPCONFIG-STOP
-- ASN1STOP

```

| <b>CellGroupConfig field descriptions</b>  |
|--|
| <p><b>mac-CellGroupConfig</b><br/>MAC parameters applicable for the entire cell group.</p>   |
| <p><b>rlc-BearerToAddModList</b><br/>Configuration of the MAC Logical Channel, the corresponding RLC entities and association with radio bearers.</p>  |
| <p><b>reportUplinkTxDirectCurrent</b><br/>Enables reporting of uplink and supplementary uplink Direct Current location information upon BWP configuration and reconfiguration. This field is only present when the BWP configuration is modified or any serving cell is added or removed. This field is absent in the IE <i>CellGroupConfig</i> when provided as part of <i>RRCSetup</i> message. If UE is configured with SUL carrier, UE reports both UL and SUL Direct Current locations.</p> |
| <p><b>rlmInSyncOutOfSyncThreshold</b><br/>BLER threshold pair index for IS/OOS indication generation, see TS 38.133 [14], table 8.1.1-1. <i>n1</i> corresponds to the value 1. When the field is absent, the UE applies the value 0. Whenever this is reconfigured, UE resets N310 and N311, and stops T310, if running. Network does not include this field.</p>  |
| <p><b>sCellToAddModList</b><br/>List of secondary serving cells (SCells) to be added or modified.</p>  |
| <p><b>sCellToReleaseList</b><br/>List of secondary serving cells (SCells) to be released.</p>  |
| <p><b>spCellConfig</b><br/>Parameters for the SpCell of this cell group (PCell of MCG or PSCell of SCG).</p>   |

| <b>ReconfigurationWithSync field descriptions</b>  |
|--|
| <p><b>rach-ConfigDedicated</b><br/>Random access configuration to be used for the reconfiguration with sync (e.g. handover). The UE performs the RA according to these parameters in the <i>firstActiveUplinkBWP</i> (see <i>UplinkConfig</i>).</p>  |
| <p><b>smtc</b><br/>The SSB periodicity/offset/duration configuration of target cell for NR PSCell change and NR PCell change. The network sets the <i>periodicityAndOffset</i> to indicate the same periodicity as <i>ssb-periodicityServingCell</i> in <i>spCellConfigCommon</i>. For case of NR PCell change, the <i>smtc</i> is based on the timing reference of source PCell. For case of NR PSCell change, it is based on the timing reference of source PSCell. If the field is absent, the UE uses the SMTC in the <i>measObjectNR</i> having the same SSB frequency and subcarrier spacing, as configured before the reception of the RRC message.</p> |

| <b>SCellConfig field descriptions</b>  |
|--|
| <p><b>smtc</b><br/>The SSB periodicity/offset/duration configuration of target cell for NR SCell addition. The network sets the <i>periodicityAndOffset</i> to indicate the same periodicity as <i>ssb-periodicityServingCell</i> in <i>sCellConfigCommon</i>. The <i>smtc</i> is based on the timing of the SpCell of associated cell group. In case of inter-RAT handover to NR, the timing reference is the NR PCell. In case of intra-NR PCell change (standalone NR) or NR PSCell change (EN-DC), the timing reference is the target SpCell. If the field is absent, the UE uses the SMTC in the <i>measObjectNR</i> having the same SSB frequency and subcarrier spacing, as configured before the reception of the RRC message.</p> |

| <i>SpCellConfig</i> field descriptions  |
|---|
| <b><i>reconfigurationWithSync</i></b><br>Parameters for the synchronous reconfiguration to the target SpCell.   |
| <b><i>rlf-TimersAndConstants</i></b><br>Timers and constants for detecting and triggering cell-level radio link failure. For the SCG, <i>rlf-TimersAndConstants</i> can only be set to <i>setup</i> and is always included at SCG addition. |
| <b><i>servCellIndex</i></b><br>Serving cell ID of a PCell. The PCell of the Master Cell Group uses ID = 0.  |

| Conditional Presence  | Explanation   |
|-----------------------|---|
| <i>BWP-Reconfig</i>   | The field is optionally present, Need N, if the BWPs are reconfigured or if serving cells are added or removed. Otherwise it is absent.   |
| <i>ReconfWithSync</i> | The field is mandatory present in case of SpCell change, PCell addition, update of required SI for PCell and AS security key change; otherwise it is optionally present, need M. The field is absent in <i>RRCResume</i> or <i>RRCSetup</i> messages. |
| <i>SCellAdd</i>       | The field is mandatory present upon SCell addition; otherwise it is absent, Need M.   |
| <i>SCellAddMod</i>    | The field is mandatory present upon SCell addition; otherwise it is optionally present, need M.   |
| <i>SCG</i>            | The field is mandatory present in an <i>SpCellConfig</i> for the PCell. It is absent otherwise.   |

## – *CellGroupId*

The IE *CellGroupId* is used to identify a cell group. Value 0 identifies the master cell group. Other values identify secondary cell groups. In this version of the specification only values 0 and 1 are supported.

### ***CellGroupId* information element**

```
-- ASN1START
-- TAG-CELLGROUPID-START

CellGroupId ::=
    INTEGER (0.. maxSecondaryCellGroups)

-- TAG-CELLGROUPID-STOP
-- ASN1STOP
```

## – *CellIdentity*

The IE *CellIdentity* is used to unambiguously identify a cell within a PLMN.

### ***CellIdentity* information element**

```
-- ASN1START
-- TAG-CELLIDENTITY-START

CellIdentity ::=
    BIT STRING (SIZE (36))
```



```
-- TAG-CELLIDENTITY-STOP
-- ASN1STOP
```

### – *CellReselectionPriority*

The IE *CellReselectionPriority* concerns the absolute priority of the concerned carrier frequency, as used by the cell reselection procedure. Corresponds to parameter "priority" in TS 38.304 [20]. Value 0 means lowest priority. The UE behaviour for the case the field is absent, if applicable, is specified in TS 38.304 [20].

#### **CellReselectionPriority information element**

```
-- ASN1START
-- TAG-CELLRESELECTIONPRIORITY-START

CellReselectionPriority ::=          INTEGER (0..7)

-- TAG-CELLRESELECTIONPRIORITY-STOP
-- ASN1STOP
```

### – *CellReselectionSubPriority*

The IE *CellReselectionSubPriority* indicates a fractional value to be added to the value of *cellReselectionPriority* to obtain the absolute priority of the concerned carrier frequency for E-UTRA and NR. Value *oDot2* corresponds to 0.2, value *oDot4* corresponds to 0.4 and so on.

#### **CellReselectionSubPriority information element**

```
-- ASN1START
-- TAG-CELLRESELECTIONSUBPRIORITY-START

CellReselectionSubPriority ::=      ENUMERATED {oDot2, oDot4, oDot6, oDot8}

-- TAG-CELLRESELECTIONSUBPRIORITY-STOP
-- ASN1STOP
```

### – *CGI-InfoEUTRA*

The IE CGI-InfoEUTRA indicates EUTRA cell access related information, which is reported by the UE as part of E-UTRA report CGI procedure.

#### **CGI-InfoEUTRA information element**

```
-- ASN1START
-- TAG-CGI-Info-EUTRA-START

CGI-InfoEUTRA ::=                  SEQUENCE {
```

```

cgi-info-EPC          SEQUENCE {
  cgi-info-EPC-legacy CellAccessRelatedInfo-EUTRA-EPC,
  cgi-info-EPC-list   SEQUENCE (SIZE (1..maxPLMN)) OF CellAccessRelatedInfo-EUTRA-EPC
}
cgi-info-5GC          SEQUENCE (SIZE (1..maxPLMN)) OF CellAccessRelatedInfo-EUTRA-5GC
freqBandIndicator    FreqBandIndicatorEUTRA,
multiBandInfoList    MultiBandInfoListEUTRA
freqBandIndicatorPriority ENUMERATED {true}
}
-- TAG-CGI-Info-EUTRA-STOP
-- ASN1STOP

```

## – *CGI-InfoNR*

The IE *CGI-InfoNR* indicates cell access related information, which is reported by the UE as part of report CGI procedure.

### **CGI-InfoNR information element**

```

-- ASN1START
-- TAG-CGI-INFO-NR-START
CGI-InfoNR ::=
  plmn-IdentityInfoList    PLMN-IdentityInfoList          OPTIONAL,
  frequencyBandList       MultiFrequencyBandListNR        OPTIONAL,
  noSIB1                   SEQUENCE {
    ssb-SubcarrierOffset   INTEGER (0..15),
    pdcch-ConfigSIB1       PDCCH-ConfigSIB1
  }
  ...
}
-- TAG-CGI-INFO-NR-STOP
-- ASN1STOP

```

#### **CGI-InfoNR field descriptions**

##### ***noSIB1***

Contains *ssb-SubcarrierOffset* and *pdccch-ConfigSIB1* fields acquired by the UE from *MIB* of the cell for which report CGI procedure was requested by the network in case *SIB1* was not broadcast by the cell.

## – *CodebookConfig*

The IE *CodebookConfig* is used to configure codebooks of Type-I and Type-II (see TS 38.214 [19], clause 5.2.2.2)

**CodebookConfig** information element

```

-- ASN1START
-- TAG-CODEBOOKCONFIG-START

CodebookConfig ::=
  codebookType
    type1
      subType
        typeI-SinglePanel
          nrOfAntennaPorts
            two
              twoTX-CodebookSubsetRestriction
            },
            moreThanTwo
              n1-n2
                two-one-TypeI-SinglePanel-Restriction
                two-two-TypeI-SinglePanel-Restriction
                four-one-TypeI-SinglePanel-Restriction
                three-two-TypeI-SinglePanel-Restriction
                six-one-TypeI-SinglePanel-Restriction
                four-two-TypeI-SinglePanel-Restriction
                eight-one-TypeI-SinglePanel-Restriction
                four-three-TypeI-SinglePanel-Restriction
                six-two-TypeI-SinglePanel-Restriction
                twelve-one-TypeI-SinglePanel-Restriction
                four-four-TypeI-SinglePanel-Restriction
                eight-two-TypeI-SinglePanel-Restriction
                sixteen-one-TypeI-SinglePanel-Restriction
              },
              typeI-SinglePanel-codebookSubsetRestriction-i2
            },
            typeI-SinglePanel-ri-Restriction
          },
          typeI-MultiPanel
            ng-n1-n2
              two-two-one-TypeI-MultiPanel-Restriction
              two-four-one-TypeI-MultiPanel-Restriction
              four-two-one-TypeI-MultiPanel-Restriction
              two-two-two-TypeI-MultiPanel-Restriction
              two-eight-one-TypeI-MultiPanel-Restriction
              four-four-one-TypeI-MultiPanel-Restriction
              two-four-two-TypeI-MultiPanel-Restriction
              four-two-two-TypeI-MultiPanel-Restriction
            },
            ri-Restriction
          },
          codebookMode
        },
        type2
          subType

```

```

SEQUENCE {
  CHOICE {
    SEQUENCE {
      CHOICE {
        SEQUENCE {
          CHOICE {
            SEQUENCE {
              SEQUENCE {
                BIT STRING (SIZE (6))
              }
            }
          }
        }
      }
    }
  }
  BIT STRING (SIZE (16)) OPTIONAL -- Need R
  BIT STRING (SIZE (8))
  SEQUENCE {
    CHOICE {
      BIT STRING (SIZE (8)),
      BIT STRING (SIZE (16)),
      BIT STRING (SIZE (8)),
      BIT STRING (SIZE (64)),
      BIT STRING (SIZE (32)),
      BIT STRING (SIZE (16)),
      BIT STRING (SIZE (128)),
      BIT STRING (SIZE (64))
    }
  }
  BIT STRING (SIZE (4))
  INTEGER (1..2)
  SEQUENCE {
    CHOICE {

```

```

    typeII
      n1-n2-codebookSubsetRestriction SEQUENCE {
        CHOICE {
          two-one BIT STRING (SIZE (16)),
          two-two BIT STRING (SIZE (43)),
          four-one BIT STRING (SIZE (32)),
          three-two BIT STRING (SIZE (59)),
          six-one BIT STRING (SIZE (48)),
          four-two BIT STRING (SIZE (75)),
          eight-one BIT STRING (SIZE (64)),
          four-three BIT STRING (SIZE (107)),
          six-two BIT STRING (SIZE (107)),
          twelve-one BIT STRING (SIZE (96)),
          four-four BIT STRING (SIZE (139)),
          eight-two BIT STRING (SIZE (139)),
          sixteen-one BIT STRING (SIZE (128))
        },
        typeII-RI-Restriction BIT STRING (SIZE (2))
      },
    typeII-PortSelection SEQUENCE {
      portSelectionSamplingSize ENUMERATED {n1, n2, n3, n4} OPTIONAL, -- Need R
      typeII-PortSelectionRI-Restriction BIT STRING (SIZE (2))
    },
    phaseAlphabetSize ENUMERATED {n4, n8},
    subbandAmplitude BOOLEAN,
    numberOfBeams ENUMERATED {two, three, four}
  }
}
-- TAG-CODEBOOKCONFIG-STOP
-- ASN1STOP

```

| <b>CodebookConfig</b> field descriptions   |
|--|
| <b>codebookMode</b><br>CodebookMode as specified in TS 38.214 [19], clause 5.2.2.2.2.  |
| <b>codebookType</b><br>CodebookType including possibly sub-types and the corresponding parameters for each (see TS 38.214 [19], clause 5.2.2.2).   |
| <b>n1-n2-codebookSubsetRestriction</b><br>Number of antenna ports in first ( <i>n1</i> ) and second ( <i>n2</i> ) dimension and codebook subset restriction (see TS 38.214 [19] clause 5.2.2.2.3).<br>Number of bits for codebook subset restriction is $\text{CEIL}(\log_2(\text{nchoosek}(O1*O2,4)))+8*n1*n2$ where $\text{nchoosek}(a,b) = a!/(b!(a-b)!)$ . |
| <b>n1-n2</b><br>Number of antenna ports in first ( <i>n1</i> ) and second ( <i>n2</i> ) dimension and codebook subset restriction (see TS 38.214 [19] clause 5.2.2.2.1).   |
| <b>ng-n1-n2</b><br>Codebook subset restriction for Type I Multi-panel codebook (see TS 38.214 [19], clause 5.2.2.2.2).   |
| <b>numberOfBeams</b><br>Number of beams, <i>L</i> , used for linear combination.   |
| <b>phaseAlphabetSize</b><br>The size of the PSK alphabet, QPSK or 8-PSK.   |
| <b>portSelectionSamplingSize</b><br>The size of the port selection codebook (parameter <i>d</i> ).   |
| <b>ri-Restriction</b><br>Restriction for RI for <i>Type1-MultiPanel-RI-Restriction</i> (see TS 38.214 [19], clause 5.2.2.2.2).   |
| <b>subbandAmplitude</b><br>If subband amplitude reporting is activated ( <i>true</i> ).  |
| <b>twoTX-CodebookSubsetRestriction</b><br>Codebook subset restriction for 2TX codebook (see TS 38.214 [19] clause 5.2.2.2.1).  |
| <b>type1-SinglePanel-codebookSubsetRestriction-i2</b><br><i>i2</i> codebook subset restriction for Type I Single-panel codebook used when <i>reportQuantity</i> is CRI/RI/i1/CQI (see TS 38.214 [19] clause 5.2.2.2.1).  |
| <b>type1-SinglePanel-ri-Restriction</b><br>Restriction for RI for <i>Type1-SinglePanel-RI-Restriction</i> (see TS 38.214 [19], clause 5.2.2.2.1).  |
| <b>type1-PortSelectionRI-Restriction</b><br>Restriction for RI for <i>Type1-PortSelection-RI-Restriction</i> (see TS 38.214 [19], clause 5.2.2.4).   |
| <b>type1-RI-Restriction</b><br>Restriction for RI for <i>Type1-RI-Restriction</i> (see TS 38.214 [19], clause 5.2.2.2.3).  |

## – ConfiguredGrantConfig

The IE *ConfiguredGrantConfig* is used to configure uplink transmission without dynamic grant according to two possible schemes. The actual uplink grant may either be configured via RRC (*type1*) or provided via the PDCCH (addressed to CS-RNTI) (*type2*).

### **ConfiguredGrantConfig** information element

```
-- ASN1START
-- TAG-CONFIGUREDGRANTCONFIG-START

ConfiguredGrantConfig ::=
    frequencyHopping          SEQUENCE {
                                ENUMERATED {intraSlot, interSlot}
                                OPTIONAL,    -- Need S,
```

```

cg-DMRS-Configuration          DMRS-UplinkConfig,
mcs-Table                      ENUMERATED {qam256, qam64LowSE}                OPTIONAL,  -- Need S
mcs-TableTransformPrecoder     ENUMERATED {qam256, qam64LowSE}                OPTIONAL,  -- Need S
uci-OnPUSCH                    SetupRelease { CG-UCI-OnPUSCH }                OPTIONAL,  -- Need M
resourceAllocation             ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch },
rbg-Size                       ENUMERATED {config2}                                OPTIONAL,  -- Need S
powerControlLoopToUse         ENUMERATED {n0, n1},
p0-PUSCH-Alpha                P0-PUSCH-AlphaSetId,
transformPrecoder              ENUMERATED {enabled, disabled}                    OPTIONAL,  -- Need S
nrofHARQ-Processes            INTEGER(1..16),
repK                           ENUMERATED {n1, n2, n4, n8},
repK-RV                       ENUMERATED {s1-0231, s2-0303, s3-0000}            OPTIONAL,  -- Need R
periodicity                   ENUMERATED {
    sym2, sym7, sym1x14, sym2x14, sym4x14, sym5x14, sym8x14, sym10x14, sym16x14, sym20x14,
    sym32x14, sym40x14, sym64x14, sym80x14, sym128x14, sym160x14, sym256x14, sym320x14, sym512x14,
    sym640x14, sym1024x14, sym1280x14, sym2560x14, sym5120x14,
    sym6, sym1x12, sym2x12, sym4x12, sym5x12, sym8x12, sym10x12, sym16x12, sym20x12, sym32x12,
    sym40x12, sym64x12, sym80x12, sym128x12, sym160x12, sym256x12, sym320x12, sym512x12, sym640x12,
    sym1280x12, sym2560x12
},
configuredGrantTimer          INTEGER (1..64)                                OPTIONAL,  -- Need R
rrc-ConfiguredUplinkGrant     SEQUENCE {
    timeDomainOffset           INTEGER (0..5119),
    timeDomainAllocation       INTEGER (0..15),
    frequencyDomainAllocation  BIT STRING (SIZE(18)),
    antennaPort                INTEGER (0..31),
    dmrs-SeqInitialization     INTEGER (0..1)                                OPTIONAL,  -- Need R
    precodingAndNumberOfLayers INTEGER (0..63),
    srs-ResourceIndicator      INTEGER (0..15)                                OPTIONAL,  -- Need R
    mcsAndTBS                  INTEGER (0..31),
    frequencyHoppingOffset     INTEGER (1.. maxNrofPhysicalResourceBlocks-1)    OPTIONAL,  -- Need R
    pathlossReferenceIndex     INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1),
    ...
}
...
}
...
}

CG-UCI-OnPUSCH ::= CHOICE {
    dynamic
    semiStatic          SEQUENCE (SIZE (1..4)) OF BetaOffsets,
                        BetaOffsets
}

-- TAG-CONFIGUREDGRANTCONFIG-STOP
-- ASN1STOP

```

| <b>ConfiguredGrantConfig field descriptions</b>   |
|---|
| <p><b>antennaPort</b><br/>Indicates the antenna port(s) to be used for this configuration, and the maximum bitwidth is 5. See TS 38.214 [19], clause 6.1.2, and TS 38.212 [17], clause 7.3.1.</p>   |
| <p><b>cg-DMRS-Configuration</b><br/>DMRS configuration (see TS 38.214 [19], clause 6.1.2.3).</p>  |
| <p><b>configuredGrantTimer</b><br/>Indicates the initial value of the configured grant timer (see TS 38.321 [3]) in multiples of periodicity.</p>   |
| <p><b>dmrs-SeqInitialization</b><br/>The network configures this field if <i>transformPrecoder</i> is disabled. Otherwise the field is absent.</p>  |
| <p><b>frequencyDomainAllocation</b><br/>Indicates the frequency domain resource allocation, see TS 38.214 [19], clause 6.1.2, and TS 38.212 [17], clause 7.3.1).</p>  |
| <p><b>frequencyHopping</b><br/>The value <i>intraSlot</i> enables 'Intra-slot frequency hopping' and the value <i>interSlot</i> enables 'Inter-slot frequency hopping'. If the field is absent, frequency hopping is not configured.</p>  |
| <p><b>frequencyHoppingOffset</b><br/>Enables intra-slot frequency hopping with the given frequency hopping offset. Frequency hopping offset used when frequency hopping is enabled (see TS 38.214 [19], clause 6.1.2).</p>  |
| <p><b>mcs-Table</b><br/>Indicates the MCS table the UE shall use for PUSCH without transform precoding. If the field is absent the UE applies the value <i>qam64</i>.</p>   |
| <p><b>mcs-TableTransformPrecoder</b><br/>Indicates the MCS table the UE shall use for PUSCH with transform precoding. If the field is absent the UE applies the value <i>qam64</i>.</p>   |
| <p><b>mcsAndTBS</b><br/>The modulation order, target code rate and TB size (see TS 38.214 [19], clause 6.1.2). The NW does not configure the values 28–31 in this version of the specification.</p>   |
| <p><b>nrofHARQ-Processes</b><br/>The number of HARQ processes configured. It applies for both Type 1 and Type 2. See TS 38.321 [3], clause 5.4.1.</p>   |
| <p><b>p0-PUSCH-Alpha</b><br/>Index of the <i>P0-PUSCH-AlphaSet</i> to be used for this configuration.</p>   |
| <p><b>periodicity</b><br/>Periodicity for UL transmission without UL grant for type 1 and type 2 (see TS 38.321 [3], clause 5.8.2).<br/>The following periodicities are supported depending on the configured subcarrier spacing [symbols]:<br/>15 kHz: 2, 7, <math>n \cdot 14</math>, where <math>n = \{1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 320, 640\}</math><br/>30 kHz: 2, 7, <math>n \cdot 14</math>, where <math>n = \{1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 640, 1280\}</math><br/>60 kHz with normal CP: 2, 7, <math>n \cdot 14</math>, where <math>n = \{1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560\}</math><br/>60 kHz with ECP: 2, 6, <math>n \cdot 12</math>, where <math>n = \{1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1280, 2560\}</math><br/>120 kHz: 2, 7, <math>n \cdot 14</math>, where <math>n = \{1, 2, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 128, 160, 256, 320, 512, 640, 1024, 1280, 2560, 5120\}</math></p> |
| <p><b>powerControlLoopToUse</b><br/>Closed control loop to apply (see TS 38.213 [13], clause 7.1.1).</p>  |
| <p><b>rbg-Size</b><br/>Selection between configuration 1 and configuration 2 for RBG size for PUSCH. The UE does not apply this field if <i>resourceAllocation</i> is set to <i>resourceAllocationType1</i>. Otherwise, the UE applies the value <i>config1</i> when the field is absent. Note: <i>rbg-Size</i> is used when the <i>transformPrecoder</i> parameter is disabled.</p>  |
| <p><b>repK-RV</b><br/>The redundancy version (RV) sequence to use. See TS 38.214 [19], clause 6.1.2. The network configures this field if repetitions are used, i.e., if <i>repK</i> is set to <i>n2</i>, <i>n4</i> or <i>n8</i>. Otherwise, the field is absent.</p>   |
| <p><b>repK</b><br/>The number of repetitions of K.</p>  |

|  |
|--|
| <b>resourceAllocation</b><br>Configuration of resource allocation type 0 and resource allocation type 1. For Type 1 UL data transmission without grant, <i>resourceAllocation</i> should be <i>resourceAllocationType0</i> or <i>resourceAllocationType1</i> .   |
| <b>rrc-ConfiguredUplinkGrant</b><br>Configuration for "configured grant" transmission with fully RRC-configured UL grant (Type1). If this field is absent the UE uses UL grant configured by DCI addressed to CS-RNTI (Type2). Type 1 configured grant may be configured for UL or SUL, but not for both simultaneously. |
| <b>srs-ResourceIndicator</b><br>Indicates the SRS resource to be used.   |
| <b>timeDomainAllocation</b><br>Indicates a combination of start symbol and length and PUSCH mapping type, see TS 38.214 [19], clause 6.1.2 and TS 38.212 [17], clause 7.3.1.   |
| <b>timeDomainOffset</b><br>Offset related to SFN=0, see TS 38.321 [3], clause 5.8.2.   |
| <b>transformPrecoder</b><br>Enables or disables transform precoding for <i>type1</i> and <i>type2</i> . If the field is absent, the UE enables or disables transform precoding in accordance with the field <i>msg3-transformPrecoder</i> in <i>RACH-ConfigCommon</i> , see TS 38.214 [19], clause 6.1.3.                |
| <b>uci-OnPUSCH</b><br>Selection between and configuration of dynamic and semi-static beta-offset. For Type 1 UL data transmission without grant, <i>uci-OnPUSCH</i> should be set to <i>semiStatic</i> .   |

## – ConnEstFailureControl

The IE *ConnEstFailureControl* is used to configure parameters for connection establishment failure control.

### ConnEstFailureControl information element

```
-- ASN1START
-- TAG-CONNESTFAILURECONTROL-START

ConnEstFailureControl ::= SEQUENCE {
    connEstFailCount          ENUMERATED {n1, n2, n3, n4},
    connEstFailOffsetValidity ENUMERATED {s30, s60, s120, s240, s300, s420, s600, s900},
    connEstFailOffset        INTEGER (0..15)
}

-- TAG-CONNESTFAILURECONTROL-STOP
-- ASN1STOP
```

OPTIONAL    -- Need S

| <b>ConnEstFailureControl field descriptions</b>  |
|--|
| <b>connEstFailCount</b><br>Number of times that the UE detects T300 expiry on the same cell before applying <i>connEstFailOffset</i> .   |
| <b>connEstFailOffsetValidity</b><br>Parameter "Qoffset <sub>temp</sub> " in TS 38.304 [20]. If the field is absent the value of infinity shall be used for "Qoffset <sub>temp</sub> ".   |
| <b>connEstFailOffsetValidity</b><br>Amount of time that the UE applies <i>connEstFailOffset</i> before removing the offset from evaluation of the cell. Value <i>s30</i> corresponds to 30 seconds, value <i>s60</i> corresponds to 60 seconds, and so on. |



– *ControlResourceSet*

The IE *ControlResourceSet* is used to configure a time/frequency control resource set (CORESET) in which to search for downlink control information (see TS 38.213 [13], clause 10.1).

**ControlResourceSet information element**

```
-- ASN1START
-- TAG-CONTROLRESOURCESET-START

ControlResourceSet ::=
    controlResourceSetId          SEQUENCE {
        ControlResourceSetId,

        frequencyDomainResources  BIT STRING (SIZE (45)),
        duration                  INTEGER (1..maxCoReSetDuration),
        cce-REG-MappingType       CHOICE {
            interleaved           SEQUENCE {
                reg-BundleSize    ENUMERATED {n2, n3, n6},
                interleaverSize   ENUMERATED {n2, n3, n6},
                shiftIndex        INTEGER(0..maxNrofPhysicalResourceBlocks-1)  OPTIONAL -- Need S
            },
            nonInterleaved       NULL
        },
        precoderGranularity       ENUMERATED {sameAsREG-bundle, allContiguousRBs},
        tci-StatesPDCCH-ToAddList SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId OPTIONAL, -- Cond NotSIB1-initialBWP
        tci-StatesPDCCH-ToReleaseList SEQUENCE(SIZE (1..maxNrofTCI-StatesPDCCH)) OF TCI-StateId OPTIONAL, -- Cond NotSIB1-initialBWP
        tci-PresentInDCI         ENUMERATED {enabled}  OPTIONAL, -- Need S
        pdcch-DMRS-ScramblingID  INTEGER (0..65535)  OPTIONAL, -- Need S
        ...
    }

-- TAG-CONTROLRESOURCESET-STOP
-- ASN1STOP
```

| <b>ControlResourceSet field descriptions</b> |   |
|--|---|
| <b><i>cce-REG-MappingType</i></b>            | Mapping of Control Channel Elements (CCE) to Resource Element Groups (REG) (see TS 38.211 [16], clauses 7.3.2.2 and 7.4.1.3.2).   |
| <b><i>controlResourceSetId</i></b>           | Value 0 identifies the common CORESET configured in <i>MIB</i> and in <i>ServingCellConfigCommon</i> ( <i>controlResourceSetZero</i> ) and is hence not used here in the <i>ControlResourceSet</i> IE. Values 1.. <i>maxNrofControlResourceSets</i> -1 identify CORESETs configured by dedicated signalling or in <i>SIB1</i> . The <i>controlResourceSetId</i> is unique among the BWPs of a serving cell.   |
| <b><i>duration</i></b>                       | Contiguous time duration of the CORESET in number of symbols (see TS 38.211 [16], clause 7.3.2.2).  |
| <b><i>frequencyDomainResources</i></b>       | Frequency domain resources for the CORESET. Each bit corresponds a group of 6 RBs, with grouping starting from the first RB group (see TS 38.213 [13], clause 10.1) in the BWP. The first (left-most / most significant) bit corresponds to the first RB group in the BWP, and so on. A bit that is set to 1 indicates that this RB group belongs to the frequency domain resource of this CORESET. Bits corresponding to a group of RBs not fully contained in the bandwidth part within which the CORESET is configured are set to zero (see TS 38.211 [16], clause 7.3.2.2). |
| <b><i>interleaverSize</i></b>                | Interleaver-size (see TS 38.211 [16], clause 7.3.2.2).  |
| <b><i>pdccch-DMRS-ScramblingID</i></b>       | PDCCH DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.3.1). When the field is absent the UE applies the value of the <i>physCellId</i> configured for this serving cell.   |
| <b><i>precoderGranularity</i></b>            | Precoder granularity in frequency domain (see TS 38.211 [16], clauses 7.3.2.2 and 7.4.1.3.2).   |
| <b><i>reg-BundleSize</i></b>                 | Resource Element Groups (REGs) can be bundled to create REG bundles. This parameter defines the size of such bundles (see TS 38.211 [16], clause 7.3.2.2).  |
| <b><i>shiftIndex</i></b>                     | When the field is absent the UE applies the value of the <i>physCellId</i> configured for this serving cell (see TS 38.211 [16], clause 7.3.2.2).   |
| <b><i>tci-PresentInDCI</i></b>               | This field indicates if TCI field is present or absent in DL-related DCI. When the field is absent the UE considers the TCI to be absent/disabled. In case of cross carrier scheduling, the network sets this field to enabled for the <i>ControlResourceSet</i> used for cross carrier scheduling in the scheduling cell (see TS 38.214 [19], clause 5.1.5).   |
| <b><i>tci-StatesPDCCH-ToAddList</i></b>      | A subset of the TCI states defined in <i>pdsch-Config</i> included in the <i>BWP-DownlinkDedicated</i> corresponding to the serving cell and to the DL BWP to which the <i>ControlResourceSet</i> belong to. They are used for providing QCL relationships between the DL RS(s) in one RS Set (TCI-State) and the PDCCH DMRS ports (see TS 38.213 [13], clause 6.). The network configures at most <i>maxNrofTCI-StatesPDCCH</i> entries.   |

| Conditional Presence      | Explanation  |
|---------------------------|--|
| <i>NotSIB1-initialBWP</i> | The field is absent in <i>SIB1</i> and in the <i>PDCCH-ConfigCommon</i> of the initial BWP in <i>ServingCellConfigCommon</i> , if <i>SIB1</i> is broadcasted. Otherwise, it is optionally present, Need N. |

### – *ControlResourceSetId*

The *ControlResourceSetId* IE concerns a short identity, used to identify a control resource set within a serving cell. The *ControlResourceSetId* = 0 identifies the *ControlResourceSet#0* configured via PBCH (*MIB*) and in *controlResourceSetZero* (*ServingCellConfigCommon*). The ID space is used across the BWPs of a Serving Cell. The number of CORESETs per BWP is limited to 3 (including common and UE-specific CORESETs).

**ControlResourceSetId** information element

```

-- ASN1START
-- TAG-CONTROLRESOURCESETID-START

ControlResourceSetId ::=                INTEGER (0..maxNrofControlResourceSets-1)

-- TAG-CONTROLRESOURCESETID-STOP
-- ASN1STOP

```

– **ControlResourceSetZero**

The IE *ControlResourceSetZero* is used to configure CORESET#0 of the initial BWP (see TS 38.213 [13], clause 13).

**ControlResourceSetZero** information element

```

-- ASN1START
-- TAG-CONTROLRESOURCESETZERO-START

ControlResourceSetZero ::=              INTEGER (0..15)

-- TAG-CONTROLRESOURCESETZERO-STOP
-- ASN1STOP

```

– **CrossCarrierSchedulingConfig**

The IE *CrossCarrierSchedulingConfig* is used to specify the configuration when the cross-carrier scheduling is used in a cell.

**CrossCarrierSchedulingConfig** information element

```

-- ASN1START
-- TAG-CrossCarrierSchedulingConfig-START

CrossCarrierSchedulingConfig ::=        SEQUENCE {
  schedulingCellInfo                    CHOICE {
    own                                  SEQUENCE {
      cif-Presence                       BOOLEAN                               -- Cross carrier scheduling: scheduling cell
    },
    other                                 SEQUENCE {
      schedulingCellId                   ServCellIndex,
      cif-InSchedulingCell                INTEGER (1..7)
    }
  },
  ...
}

-- TAG-CrossCarrierSchedulingConfig-STOP

```

-- ASN1STOP

| <b>CrossCarrierSchedulingConfig</b> field descriptions   |
|--|
| <p><b>cif-Presence</b><br/>The field is used to indicate whether carrier indicator field is present (value <i>true</i>) or not (value <i>false</i>) in PDCCH DCI formats, see TS 38.213 [13]. If <i>cif-Presence</i> is set to <i>true</i>, the CIF value indicating a grant or assignment for this cell is 0.</p> |
| <p><b>cif-InSchedulingCell</b><br/>The field indicates the CIF value used in the scheduling cell to indicate a grant or assignment applicable for this cell, see TS 38.213 [13].</p>   |
| <p><b>other</b><br/>Parameters for cross-carrier scheduling, i.e., a serving cell is scheduled by a PDCCH on another (scheduling) cell. The network configures this field only for SCells.</p>   |
| <p><b>own</b><br/>Parameters for self-scheduling, i.e., a serving cell is scheduled by its own PDCCH.</p>  |
| <p><b>schedulingCellId</b><br/>Indicates which cell signals the downlink allocations and uplink grants, if applicable, for the concerned SCell. In case the UE is configured with DC, the scheduling cell is part of the same cell group (i.e. MCG or SCG) as the scheduled cell.</p>                              |

### – *CSI-AperiodicTriggerStateList*

The *CSI-AperiodicTriggerStateList* IE is used to configure the UE with a list of aperiodic trigger states. Each codepoint of the DCI field "CSI request" is associated with one trigger state (see TS 38.321 [3], clause 6.1.3.13). Upon reception of the value associated with a trigger state, the UE will perform measurement of CSI-RS, CSI-IM and/or SSB (reference signals) and aperiodic reporting on L1 according to all entries in the *associatedReportConfigInfoList* for that trigger state. Reconfiguration of *CSI-AssociatedReportConfigInfo* is not supported.

#### **CSI-AperiodicTriggerStateList** information element

```
-- ASN1START
-- TAG-CSI-APERIODICTRIGGERSTATELIST-START

CSI-AperiodicTriggerStateList ::= SEQUENCE (SIZE (1..maxNrOfCSI-AperiodicTriggers)) OF CSI-AperiodicTriggerState
CSI-AperiodicTriggerState ::= SEQUENCE {
    associatedReportConfigInfoList SEQUENCE (SIZE(1..maxNrofReportConfigPerAperiodicTrigger)) OF CSI-AssociatedReportConfigInfo,
    ...
}
CSI-AssociatedReportConfigInfo ::= SEQUENCE {
    reportConfigId          CSI-ReportConfigId,
    resourcesForChannel     CHOICE {
        nzp-CSI-RS          SEQUENCE {
            resourceSet     INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig),
            qcl-info        SEQUENCE (SIZE(1..maxNrofAP-CSI-RS-ResourcesPerSet)) OF TCI-StateId
        },
        csi-SSB-ResourceSet INTEGER (1..maxNrofCSI-SSB-ResourceSetsPerConfig)
    },
    csi-IM-ResourcesForInterference INTEGER(1..maxNrofCSI-IM-ResourceSetsPerConfig)
}
OPTIONAL, -- Cond CSI-IM-ForInterference
```

```

nzp-CSI-RS-ResourcesForInterference INTEGER (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)
OPTIONAL, -- Cond NZP-CSI-RS-ForInterference
...
}
-- TAG-CSI-APERIODICTRIGGERSTATELIST-STOP
-- ASN1STOP
    
```

| <b>CSI-AssociatedReportConfigInfo field descriptions</b>   |
|--|
| <p><b>csi-IM-ResourcesForInterference</b><br/> <i>CSI-IM-ResourceSet</i> for interference measurement. Entry number in <i>csi-IM-ResourceSetList</i> in the <i>CSI-ResourceConfig</i> indicated by <i>csi-IM-ResourcesForInterference</i> in the <i>CSI-ReportConfig</i> indicated by <i>reportConfigId</i> above (value 1 corresponds to the first entry, value 2 to the second entry, and so on). The indicated <i>CSI-IM-ResourceSet</i> should have exactly the same number of resources like the <i>NZP-CSI-RS-ResourceSet</i> indicated in <i>nzp-CSI-RS-ResourcesforChannel</i>.</p>  |
| <p><b>csi-SSB-ResourceSet</b><br/> <i>CSI-SSB-ResourceSet</i> for channel measurements. Entry number in <i>csi-SSB-ResourceSetList</i> in the <i>CSI-ResourceConfig</i> indicated by <i>resourcesForChannelMeasurement</i> in the <i>CSI-ReportConfig</i> indicated by <i>reportConfigId</i> above (value 1 corresponds to the first entry, value 2 to the second entry, and so on).</p>   |
| <p><b>nzp-CSI-RS-ResourcesForInterference</b><br/> <i>NZP-CSI-RS-ResourceSet</i> for interference measurement. Entry number in <i>nzp-CSI-RS-ResourceSetList</i> in the <i>CSI-ResourceConfig</i> indicated by <i>nzp-CSI-RS-ResourcesForInterference</i> in the <i>CSI-ReportConfig</i> indicated by <i>reportConfigId</i> above (value 1 corresponds to the first entry, value 2 to the second entry, and so on).</p>  |
| <p><b>qcl-info</b><br/>                     List of references to TCI-States for providing the QCL source and QCL type for each <i>NZP-CSI-RS-Resource</i> listed in <i>nzp-CSI-RS-Resources</i> of the <i>NZP-CSI-RS-ResourceSet</i> indicated by <i>nzp-CSI-RS-ResourcesforChannel</i>. Each <i>TCI-StateId</i> refers to the <i>TCI-State</i> which has this value for <i>tci-StateId</i> and is defined in <i>tci-StatesToAddModList</i> in the <i>PDSCH-Config</i> included in the <i>BWP-Downlink</i> corresponding to the serving cell and to the DL BWP to which the <i>resourcesForChannelMeasurement</i> (in the <i>CSI-ReportConfig</i> indicated by <i>reportConfigId</i> above) belong to. First entry in <i>qcl-info-forChannel</i> corresponds to first entry in <i>nzp-CSI-RS-Resources</i> of that <i>NZP-CSI-RS-ResourceSet</i>, second entry in <i>qcl-info-forChannel</i> corresponds to second entry in <i>nzp-CSI-RS-Resources</i>, and so on (see TS 38.214 [19], clause 5.2.1.5.1)</p> |
| <p><b>reportConfigId</b><br/>                     The <i>reportConfigId</i> of one of the <i>CSI-ReportConfigToAddMod</i> configured in <i>CSI-MeasConfig</i></p>  |
| <p><b>resourceSet</b><br/> <i>NZP-CSI-RS-ResourceSet</i> for channel measurements. Entry number in <i>nzp-CSI-RS-ResourceSetList</i> in the <i>CSI-ResourceConfig</i> indicated by <i>resourcesForChannelMeasurement</i> in the <i>CSI-ReportConfig</i> indicated by <i>reportConfigId</i> above (value 1 corresponds to the first entry, value 2 to thesecond entry, and so on).</p>  |

| <b>Conditional Presence</b>       | <b>Explanation</b>  |
|-----------------------------------|---|
| <i>Aperiodic</i>                  | The field is mandatory present if the <i>NZP-CSI-RS-Resources</i> in the associated <i>resourceSet</i> have the <i>resourceType</i> <i>aperiodic</i> . The field is absent otherwise.               |
| <i>CSI-IM-ForInterference</i>     | This field is optionally present, need M if the <i>CSI-ReportConfig</i> identified by <i>reportConfigId</i> is configured with <i>csi-IM-ResourcesForInterference</i> ; otherwise it is absent.     |
| <i>NZP-CSI-RS-ForInterference</i> | This field is optionally present, need M if the <i>CSI-ReportConfig</i> identified by <i>reportConfigId</i> is configured with <i>nzp-CSI-RS-ResourcesForInterference</i> ; otherwise it is absent. |

– **CSI-FrequencyOccupation**

The IE *CSI-FrequencyOccupation* is used to configure the frequency domain occupation of a channel state information measurement resource (e.g. *NZP-CSI-RS-Resource*, *CSI-IM-Resource*).

**CSI-FrequencyOccupation information element**

```

-- ASN1START
-- TAG-CSI-FREQUENCYOCCUPATION-START

CSI-FrequencyOccupation ::=          SEQUENCE {
    startingRB                        INTEGER (0..maxNrofPhysicalResourceBlocks-1),
    nrofRBs                          INTEGER (24..maxNrofPhysicalResourceBlocksPlus1),
    ...
}

-- TAG-CSI-FREQUENCYOCCUPATION-STOP
-- ASN1STOP

```

**CSI-FrequencyOccupation field descriptions****nrofRBs**

Number of PRBs across which this CSI resource spans. Only multiples of 4 are allowed. The smallest configurable number is the minimum of 24 and the width of the associated BWP. If the configured value is larger than the width of the corresponding BWP, the UE shall assume that the actual CSI-RS bandwidth is equal to the width of the BWP.

**startingRB**

PRB where this CSI resource starts in relation to common resource block #0 (CRB#0) on the common resource block grid. Only multiples of 4 are allowed (0, 4, ...)

– **CSI-IM-Resource**

The IE *CSI-IM-Resource* is used to configure one CSI Interference Management (IM) resource.

**CSI-IM-Resource information element**

```

-- ASN1START
-- TAG-CSI-IM-RESOURCE-START

CSI-IM-Resource ::=
    SEQUENCE {
        csi-IM-ResourceId              CSI-IM-ResourceId,
        csi-IM-ResourceElementPattern CHOICE {
            pattern0                    SEQUENCE {
                subcarrierLocation-p0   ENUMERATED { s0, s2, s4, s6, s8, s10 },
                symbolLocation-p0       INTEGER (0..12)
            },
            pattern1                    SEQUENCE {
                subcarrierLocation-p1   ENUMERATED { s0, s4, s8 },
                symbolLocation-p1       INTEGER (0..13)
            }
        }
        freqBand                        OPTIONAL, -- Need M
        periodicityAndOffset           OPTIONAL, -- Need M
        ...
    }

```

```
-- TAG-CSI-IM-RESOURCE-STOP
-- ASN1STOP
```

| <b>CSI-IM-Resource field descriptions</b>   |
|---|
| <p><b><i>csi-IM-ResourceElementPattern</i></b><br/>The resource element pattern (Pattern0 (2,2) or Pattern1 (4,1)) with corresponding parameters (see TS 38.214 [19], clause 5.2.2.4)</p>   |
| <p><b><i>freqBand</i></b><br/>Frequency-occupancy of CSI-IM (see TS 38.214 [19], clause 5.2.2.4)</p>  |
| <p><b><i>periodicityAndOffset</i></b><br/>Periodicity and slot offset for periodic/semi-persistent CSI-IM. Network always configures the UE with a value for this field for periodic and semi-persistent CSI-IM-Resources (as indicated in CSI-ResourceConfig). A change of configuration between periodic or semi-persistent and aperiodic for a CSI-IM-Resource is not supported without a release and add.</p> |
| <p><b><i>subcarrierLocation-p0</i></b><br/>OFDM subcarrier occupancy of the CSI-IM resource for Pattern0 (see TS 38.214 [19], clause 5.2.2.4)</p>   |
| <p><b><i>subcarrierLocation-p1</i></b><br/>OFDM subcarrier occupancy of the CSI-IM resource for Pattern1 (see TS 38.214 [19], clause 5.2.2.4)</p>   |
| <p><b><i>symbolLocation-p0</i></b><br/>OFDM symbol location of the CSI-IM resource for Pattern0 (see TS 38.214 [19], clause 5.2.2.4)</p>  |
| <p><b><i>symbolLocation-p1</i></b><br/>OFDM symbol location of the CSI-IM resource for Pattern1 (see TS 38.214 [19], clause 5.2.2.4)</p>  |

| <b>Conditional Presence</b>     | <b>Explanation</b>  |
|---------------------------------|---|
| <i>PeriodicOrSemiPersistent</i> | The field is optionally present, Need M, for periodic and semi-persistent CSI-IM-Resources (as indicated in CSI-ResourceConfig). The field is absent otherwise. |

### – *CSI-IM-ResourceId*

The IE *CSI-IM-ResourceId* is used to identify one *CSI-IM-Resource*.

#### ***CSI-IM-ResourceId* information element**

```
-- ASN1START
-- TAG-CSI-IM-RESOURCEID-START
```

```
CSI-IM-ResourceId ::= INTEGER (0..maxNrofCSI-IM-Resources-1)
```

```
-- TAG-CSI-IM-RESOURCEID-STOP
-- ASN1STOP
```

### – *CSI-IM-ResourceSet*

The IE *CSI-IM-ResourceSet* is used to configure a set of one or more CSI Interference Management (IM) resources (their IDs) and set-specific parameters.

**CSI-IM-ResourceSet** information element

```

-- ASN1START
-- TAG-CSI-IM-RESOURCESET-START

CSI-IM-ResourceSet ::=
    SEQUENCE {
        csi-IM-ResourceSetId      CSI-IM-ResourceSetId,
        csi-IM-Resources          SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourcesPerSet)) OF CSI-IM-ResourceId,
        ...
    }
-- TAG-CSI-IM-RESOURCESET-STOP
-- ASN1STOP

```

**CSI-IM-ResourceSet** field descriptions**csi-IM-Resources**

CSI-IM-Resources associated with this CSI-IM-ResourceSet (see TS 38.214 [19], clause 5.2).

– **CSI-IM-ResourceSetId**

The IE *CSI-IM-ResourceSetId* is used to identify *CSI-IM-ResourceSets*.

**CSI-IM-ResourceSetId** information element

```

-- ASN1START
-- TAG-CSI-IM-RESOURCESETID-START

CSI-IM-ResourceSetId ::=
    INTEGER (0..maxNrofCSI-IM-ResourceSets-1)

-- TAG-CSI-IM-RESOURCESETID-STOP
-- ASN1STOP

```

– **CSI-MeasConfig**

The IE *CSI-MeasConfig* is used to configure CSI-RS (reference signals) belonging to the serving cell in which *CSI-MeasConfig* is included, channel state information reports to be transmitted on PUCCH on the serving cell in which *CSI-MeasConfig* is included and channel state information reports on PUSCH triggered by DCI received on the serving cell in which *CSI-MeasConfig* is included. See also TS 38.214 [19], clause 5.2.

**CSI-MeasConfig** information element

```

-- ASN1START
-- TAG-CSI-MEASCONFIG-START

CSI-MeasConfig ::=
    SEQUENCE {
        nzp-CSI-RS-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-Resource OPTIONAL, -- Need N
        nzp-CSI-RS-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-Resources)) OF NZP-CSI-RS-ResourceId OPTIONAL, -- Need N
    }

```



```

nzp-CSI-RS-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofNzp-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSet
nzp-CSI-RS-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofNzp-CSI-RS-ResourceSets)) OF NZP-CSI-RS-ResourceSetId
csi-IM-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-Resource
csi-IM-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-IM-Resources)) OF CSI-IM-ResourceId
csi-IM-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSet
csi-IM-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSets)) OF CSI-IM-ResourceSetId
csi-SSB-ResourceSetToAddModList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSet
csi-SSB-ResourceSetToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSets)) OF CSI-SSB-ResourceSetId
csi-ResourceConfigToAddModList SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfig
csi-ResourceConfigToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-ResourceConfigurations)) OF CSI-ResourceConfigId
csi-ReportConfigToAddModList SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfig
csi-ReportConfigToReleaseList SEQUENCE (SIZE (1..maxNrofCSI-ReportConfigurations)) OF CSI-ReportConfigId
reportTriggerSize INTEGER (0..6)
aperiodicTriggerStateList SetupRelease { CSI-AperiodicTriggerStateList }
semiPersistentOnPUSCH-TriggerStateList SetupRelease { CSI-SemiPersistentOnPUSCH-TriggerStateList }
...
}
-- TAG-CSI-MEASCONFIG-STOP
-- ASN1STOP

```

#### CSI-MeasConfig field descriptions

##### **aperiodicTriggerStateList**

Contains trigger states for dynamically selecting one or more aperiodic and semi-persistent reporting configurations and/or triggering one or more aperiodic CSI-RS resource sets for channel and/or interference measurement.

##### **csi-IM-ResourceSetToAddModList**

Pool of *CSI-IM-ResourceSet* which can be referred to from *CSI-ResourceConfig* or from MAC CEs.

##### **csi-IM-ResourceToAddModList**

Pool of *CSI-IM-Resource* which can be referred to from *CSI-IM-ResourceSet*.

##### **csi-ReportConfigToAddModList**

Configured CSI report settings as specified in TS 38.214 [19] clause 5.2.1.1.

##### **csi-ResourceConfigToAddModList**

Configured CSI resource settings as specified in TS 38.214 [19] clause 5.2.1.2.

##### **csi-SSB-ResourceSetToAddModList**

Pool of *CSI-SSB-ResourceSet* which can be referred to from *CSI-ResourceConfig*.

##### **nzp-CSI-RS-ResourceSetToAddModList**

Pool of *NZP-CSI-RS-ResourceSet* which can be referred to from *CSI-ResourceConfig* or from MAC CEs.

##### **nzp-CSI-RS-ResourceToAddModList**

Pool of *NZP-CSI-RS-Resource* which can be referred to from *NZP-CSI-RS-ResourceSet*.

##### **reportTriggerSize**

Size of CSI request field in DCI (bits) (see TS 38.214 [19], clause 5.2.1.5.1).

## – CSI-ReportConfig

The IE *CSI-ReportConfig* is used to configure a periodic or semi-persistent report sent on PUCCH on the cell in which the *CSI-ReportConfig* is included, or to configure a semi-persistent or aperiodic report sent on PUSCH triggered by DCI received on the cell in which the *CSI-ReportConfig* is included (in this case, the cell on which the report is sent is determined by the received DCI). See TS 38.214 [19], clause 5.2.1.

### CSI-ReportConfig information element

```

-- ASN1START
-- TAG-CSI-REPORTCONFIG-START

CSI-ReportConfig ::=
    SEQUENCE {
        reportConfigId
            CSI-ReportConfigId,
        carrier
            ServCellIndex
            OPTIONAL, -- Need S
        resourcesForChannelMeasurement
            CSI-ResourceConfigId,
        csi-IM-ResourcesForInterference
            CSI-ResourceConfigId
            OPTIONAL, -- Need R
        nzp-CSI-RS-ResourcesForInterference
            CSI-ResourceConfigId
            OPTIONAL, -- Need R
        reportConfigType
            CHOICE {
                periodic
                    SEQUENCE {
                        reportSlotConfig
                            CSI-ReportPeriodicityAndOffset,
                        pucch-CSI-ResourceList
                            SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
                    },
                semiPersistentOnPUCCH
                    SEQUENCE {
                        reportSlotConfig
                            CSI-ReportPeriodicityAndOffset,
                        pucch-CSI-ResourceList
                            SEQUENCE (SIZE (1..maxNrofBWPs)) OF PUCCH-CSI-Resource
                    },
                semiPersistentOnPUSCH
                    SEQUENCE {
                        reportSlotConfig
                            ENUMERATED {s15, s110, s120, s140, s180, s1160, s1320},
                        reportSlotOffsetList
                            SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32),
                        p0alpha
                            P0-PUSCH-AlphaSetId
                    },
                aperiodic
                    SEQUENCE {
                        reportSlotOffsetList
                            SEQUENCE (SIZE (1..maxNrofUL-Allocations)) OF INTEGER(0..32)
                    }
            },
        reportQuantity
            CHOICE {
                none
                    NULL,
                cri-RI-PMI-CQI
                    NULL,
                cri-RI-il
                    NULL,
                cri-RI-il-CQI
                    SEQUENCE {
                        pdsch-BundleSizeForCSI
                            ENUMERATED {n2, n4}
                            OPTIONAL -- Need S
                    },
                cri-RI-CQI
                    NULL,
                cri-RSRP
                    NULL,
                ssb-Index-RSRP
                    NULL,
                cri-RI-LI-PMI-CQI
                    NULL
            },
        reportFreqConfiguration
            SEQUENCE {
                cqi-FormatIndicator
                    ENUMERATED { widebandCQI, subbandCQI }
                    OPTIONAL, -- Need R
                pmi-FormatIndicator
                    ENUMERATED { widebandPMI, subbandPMI }
                    OPTIONAL, -- Need R
                csi-ReportingBand
                    CHOICE {
                        subbands3
                            BIT STRING(SIZE(3)),
            }
    }

```

```

subbands4          BIT STRING(SIZE(4)),
subbands5          BIT STRING(SIZE(5)),
subbands6          BIT STRING(SIZE(6)),
subbands7          BIT STRING(SIZE(7)),
subbands8          BIT STRING(SIZE(8)),
subbands9          BIT STRING(SIZE(9)),
subbands10         BIT STRING(SIZE(10)),
subbands11         BIT STRING(SIZE(11)),
subbands12         BIT STRING(SIZE(12)),
subbands13         BIT STRING(SIZE(13)),
subbands14         BIT STRING(SIZE(14)),
subbands15         BIT STRING(SIZE(15)),
subbands16         BIT STRING(SIZE(16)),
subbands17         BIT STRING(SIZE(17)),
subbands18         BIT STRING(SIZE(18)),
...
subbands19-v1530   BIT STRING(SIZE(19))
} OPTIONAL -- Need S

}
timeRestrictionForChannelMeasurements  ENUMERATED {configured, notConfigured}, OPTIONAL, -- Need R
timeRestrictionForInterferenceMeasurements  ENUMERATED {configured, notConfigured},
codebookConfig                          CodebookConfig  OPTIONAL, -- Need R
dummy                                    ENUMERATED {n1, n2}  OPTIONAL, -- Need R
groupBasedBeamReporting                  CHOICE {
  enabled                                NULL,
  disabled                                SEQUENCE {
    nrofReportedRS                      ENUMERATED {n1, n2, n3, n4}  OPTIONAL -- Need S
  }
},
cqi-Table                                ENUMERATED {table1, table2, table3, spare1}  OPTIONAL, -- Need R
subbandSize                              ENUMERATED {value1, value2},
non-PMI-PortIndication                   SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerConfig)) OF PortIndexFor8Ranks  OPTIONAL, -- Need R
...
[[
semiPersistentOnPUSCH-v1530              SEQUENCE {
  reportSlotConfig-v1530                 ENUMERATED {s14, s18, s116}
}
]]
}

CSI-ReportPeriodicityAndOffset ::= CHOICE {
  slots4                                  INTEGER(0..3),
  slots5                                  INTEGER(0..4),
  slots8                                  INTEGER(0..7),
  slots10                                 INTEGER(0..9),
  slots16                                 INTEGER(0..15),
  slots20                                 INTEGER(0..19),
  slots40                                 INTEGER(0..39),
  slots80                                 INTEGER(0..79),
  slots160                                INTEGER(0..159),
  slots320                                INTEGER(0..319)
}

```

```

PUCCH-CSI-Resource ::=
    uplinkBandwidthPartId
    pucch-Resource
}

PortIndexFor8Ranks ::=
    portIndex8
        rank1-8
        rank2-8
        rank3-8
        rank4-8
        rank5-8
        rank6-8
        rank7-8
        rank8-8
    },
    portIndex4
        rank1-4
        rank2-4
        rank3-4
        rank4-4
    },
    portIndex2
        rank1-2
        rank2-2
    },
    portIndex1
}

PortIndex8 ::=
    INTEGER (0..7)
PortIndex4 ::=
    INTEGER (0..3)
PortIndex2 ::=
    INTEGER (0..1)

-- TAG-CSI-REPORTCONFIG-STOP
-- ASN1STOP

```

|  |                                 |           |           |
|--|---------------------------------|-----------|-----------|
|  | SEQUENCE {                      |           |           |
|  | BWP-Id,                         |           |           |
|  | PUCCH-ResourceId                |           |           |
|  | }                               |           |           |
|  | CHOICE {                        |           |           |
|  | SEQUENCE{                       |           |           |
|  | PortIndex8                      | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(2)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(3)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(4)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(5)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(6)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(7)) OF PortIndex8 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(8)) OF PortIndex8 | OPTIONAL  | -- Need R |
|  | },                              |           |           |
|  | SEQUENCE{                       |           |           |
|  | PortIndex4                      | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(2)) OF PortIndex4 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(3)) OF PortIndex4 | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(4)) OF PortIndex4 | OPTIONAL  | -- Need R |
|  | },                              |           |           |
|  | SEQUENCE{                       |           |           |
|  | PortIndex2                      | OPTIONAL, | -- Need R |
|  | SEQUENCE(SIZE(2)) OF PortIndex2 | OPTIONAL  | -- Need R |
|  | },                              |           |           |
|  | NULL                            |           |           |
|  | }                               |           |           |

| <b>CSI-ReportConfig field descriptions</b>   |
|--|
| <p><b>carrier</b><br/>Indicates in which serving cell the <i>CSI-ResourceConfig</i> indicated below are to be found. If the field is absent, the resources are on the same serving cell as this report configuration.</p>  |
| <p><b>codebookConfig</b><br/>Codebook configuration for Type-1 or Type-2 including codebook subset restriction.</p>  |
| <p><b>cqi-FormatIndicator</b><br/>Indicates whether the UE shall report a single (wideband) or multiple (subband) CQI. (see TS 38.214 [19], clause 5.2.1.4).</p>   |
| <p><b>cqi-Table</b><br/>Which CQI table to use for CQI calculation (see TS 38.214 [19], clause 5.2.2.1).</p>   |
| <p><b>csi-IM-ResourcesForInterference</b><br/>CSI IM resources for interference measurement. <i>csi-ResourceConfigId</i> of a <i>CSI-ResourceConfig</i> included in the configuration of the serving cell indicated with the field "carrier" above. The <i>CSI-ResourceConfig</i> indicated here contains only CSI-IM resources. The <i>bwp-Id</i> in that <i>CSI-ResourceConfig</i> is the same value as the <i>bwp-Id</i> in the <i>CSI-ResourceConfig</i> indicated by <i>resourcesForChannelMeasurement</i>.</p>   |
| <p><b>csi-ReportingBand</b><br/>Indicates a contiguous or non-contiguous subset of subbands in the bandwidth part which CSI shall be reported for. Each bit in the bit-string represents one subband. The right-most bit in the bit string represents the lowest subband in the BWP. The choice determines the number of subbands (subbands3 for 3 subbands, subbands4 for 4 subbands, and so on) (see TS 38.214 [19], clause 5.2.1.4). This field is absent if there are less than 24 PRBs (no sub band) and present otherwise, the number of sub bands can be from 3 (24 PRBs, sub band size 8) to 18 (72 PRBs, sub band size 4).</p>  |
| <p><b>dummy</b><br/>This field is not used in the specification. If received it shall be ignored by the UE.</p>  |
| <p><b>groupBasedBeamReporting</b><br/>Turning on/off group beam based reporting (see TS 38.214 [19], clause 5.2.1.4).</p>  |
| <p><b>non-PMI-PortIndication</b><br/>Port indication for RI/CQI calculation. For each CSI-RS resource in the linked ResourceConfig for channel measurement, a port indication for each rank R, indicating which R ports to use. Applicable only for non-PMI feedback (see TS 38.214 [19], clause 5.2.1.4.2).<br/>The first entry in <i>non-PMI-PortIndication</i> corresponds to the NZP-CSI-RS-Resource indicated by the first entry in <i>nzp-CSI-RS-Resources</i> in the <i>NZP-CSI-RS-ResourceSet</i> indicated in the first entry of <i>nzp-CSI-RS-ResourceSetList</i> of the <i>CSI-ResourceConfig</i> whose <i>CSI-ResourceConfigId</i> is indicated in a CSI-MeasId together with the above <i>CSI-ReportConfigId</i>; the second entry in <i>non-PMI-PortIndication</i> corresponds to the NZP-CSI-RS-Resource indicated by the second entry in <i>nzp-CSI-RS-Resources</i> in the <i>NZP-CSI-RS-ResourceSet</i> indicated in the first entry of <i>nzp-CSI-RS-ResourceSetList</i> of the same <i>CSI-ResourceConfig</i>, and so on until the NZP-CSI-RS-Resource indicated by the last entry in <i>nzp-CSI-RS-Resources</i> in the in the <i>NZP-CSI-RS-ResourceSet</i> indicated in the first entry of <i>nzp-CSI-RS-ResourceSetList</i> of the same <i>CSI-ResourceConfig</i>. Then the next entry corresponds to the NZP-CSI-RS-Resource indicated by the first entry in <i>nzp-CSI-RS-Resources</i> in the <i>NZP-CSI-RS-ResourceSet</i> indicated in the second entry of <i>nzp-CSI-RS-ResourceSetList</i> of the same <i>CSI-ResourceConfig</i> and so on.</p> |
| <p><b>nrofReportedRS</b><br/>The number (N) of measured RS resources to be reported per report setting in a non-group-based report. <math>N \leq N_{max}</math>, where <math>N_{max}</math> is either 2 or 4 depending on UE capability.<br/>(see TS 38.214 [19], clause 5.2.1.4) When the field is absent the UE applies the value 1.</p>   |
| <p><b>nzp-CSI-RS-ResourcesForInterference</b><br/>NZP CSI RS resources for interference measurement. <i>csi-ResourceConfigId</i> of a <i>CSI-ResourceConfig</i> included in the configuration of the serving cell indicated with the field "carrier" above. The <i>CSI-ResourceConfig</i> indicated here contains only NZP-CSI-RS resources. The <i>bwp-Id</i> in that <i>CSI-ResourceConfig</i> is the same value as the <i>bwp-Id</i> in the <i>CSI-ResourceConfig</i> indicated by <i>resourcesForChannelMeasurement</i>.</p>   |
| <p><b>p0alpha</b><br/>Index of the p0-alpha set determining the power control for this CSI report transmission (see TS 38.214 [19], clause 6.2.1.2).</p>   |
| <p><b>pdsch-BundleSizeForCSI</b><br/>PRB bundling size to assume for CQI calculation when <i>reportQuantity</i> is CRI/RI/i1/CQI. If the field is absent, the UE assumes that no PRB bundling is applied (see TS 38.214 [19], clause 5.2.1.4.2).</p>   |

|   |
|---|
| <b><i>pmi-FormatIndicator</i></b><br>Indicates whether the UE shall report a single (wideband) or multiple (subband) PMI. (see TS 38.214 [19], clause 5.2.1.4).   |
| <b><i>pucch-CSI-ResourceList</i></b><br>Indicates which PUCCH resource to use for reporting on PUCCH.   |
| <b><i>reportConfigType</i></b><br>Time domain behavior of reporting configuration.  |
| <b><i>reportFreqConfiguration</i></b><br>Reporting configuration in the frequency domain. (see TS 38.214 [19], clause 5.2.1.4).   |
| <b><i>reportQuantity</i></b><br>The CSI related quantities to report. see TS 38.214 [19], clause 5.2.1.   |
| <b><i>reportSlotConfig</i></b><br>Periodicity and slot offset (see TS 38.214 [19], clause 5.2.1.4). If the field <i>reportSlotConfig-v1530</i> is present, the UE shall ignore the value provided in <i>reportSlotConfig</i> (without suffix).  |
| <b><i>reportSlotOffsetList</i></b><br>Timing offset Y for semi persistent reporting using PUSCH. This field lists the allowed offset values. This list must have the same number of entries as the <i>pusch-TimeDomainAllocationList</i> in <i>PUSCH-Config</i> . A particular value is indicated in DCI. The network indicates in the DCI field of the UL grant, which of the configured report slot offsets the UE shall apply. The DCI value 0 corresponds to the first report slot offset in this list, the DCI value 1 corresponds to the second report slot offset in this list, and so on. The first report is transmitted in slot n+Y, second report in n+Y+P, where P is the configured periodicity.<br>Timing offset Y for aperiodic reporting using PUSCH. This field lists the allowed offset values. This list must have the same number of entries as the <i>pusch-TimeDomainAllocationList</i> in <i>PUSCH-Config</i> . A particular value is indicated in DCI. The network indicates in the DCI field of the UL grant, which of the configured report slot offsets the UE shall apply. The DCI value 0 corresponds to the first report slot offset in this list, the DCI value 1 corresponds to the second report slot offset in this list, and so on (see TS 38.214 [19], clause 5.2.3). |
| <b><i>resourcesForChannelMeasurement</i></b><br>Resources for channel measurement. <i>csi-ResourceConfigId</i> of a <i>CSI-ResourceConfig</i> included in the configuration of the serving cell indicated with the field "carrier" above. The <i>CSI-ResourceConfig</i> indicated here contains only NZP-CSI-RS resources and/or SSB resources. This <i>CSI-ReportConfig</i> is associated with the DL BWP indicated by <i>bwp-Id</i> in that <i>CSI-ResourceConfig</i> .   |
| <b><i>subbandSize</i></b><br>Indicates one out of two possible BWP-dependent values for the subband size as indicated in TS 38.214 [19], table 5.2.1.4-2 . If <i>csi-ReportingBand</i> is absent, the UE shall ignore this field.   |
| <b><i>timeRestrictionForChannelMeasurements</i></b><br>Time domain measurement restriction for the channel (signal) measurements (see TS 38.214 [19], clause 5.2.1.1).  |
| <b><i>timeRestrictionForInterferenceMeasurements</i></b><br>Time domain measurement restriction for interference measurements (see TS 38.214 [19], clause 5.2.1.1).   |

| <b><i>PortIndexFor8Ranks</i> field descriptions</b>   |
|---|
| <b><i>portIndex8</i></b><br>Port-Index configuration for up to rank 8. If present, the network configures port indexes for at least one of the ranks. |
| <b><i>portIndex4</i></b><br>Port-Index configuration for up to rank 4. If present, the network configures port indexes for at least one of the ranks. |
| <b><i>portIndex2</i></b><br>Port-Index configuration for up to rank 2. If present, the network configures port indexes for at least one of the ranks. |
| <b><i>portIndex1</i></b><br>Port-Index configuration for rank 1.  |

**PUCCH-CSI-Resource field descriptions*****pucch-Resource***

PUCCH resource for the associated uplink BWP. Only PUCCH-Resource of format 2, 3 and 4 is supported. The actual PUCCH-Resource is configured in *PUCCH-Config* and referred to by its ID.

– ***CSI-ReportConfigId***

The IE *CSI-ReportConfigId* is used to identify one *CSI-ReportConfig*.

***CSI-ReportConfigId* information element**

```
-- ASN1START
-- TAG-CSI-REPORTCONFIGID-START

CSI-ReportConfigId ::=          INTEGER (0..maxNrofCSI-ReportConfigurations-1)

-- TAG-CSI-REPORTCONFIGID-STOP
-- ASN1STOP
```

– ***CSI-ResourceConfig***

The IE *CSI-ResourceConfig* defines a group of one or more *NZP-CSI-RS-ResourceSet*, *CSI-IM-ResourceSet* and/or *CSI-SSB-ResourceSet*.

***CSI-ResourceConfig* information element**

```
-- ASN1START
-- TAG-CSI-RESOURCECONFIG-START

CSI-ResourceConfig ::=          SEQUENCE {
  csi-ResourceConfigId          CSI-ResourceConfigId,
  csi-RS-ResourceSetList        CHOICE {
    nzp-CSI-RS-SSB              SEQUENCE {
      nzp-CSI-RS-ResourceSetList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)) OF NZP-CSI-RS-ResourceSetId
                                                                    OPTIONAL, -- Need R
    },
    csi-SSB-ResourceSetList      SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSetsPerConfig)) OF CSI-SSB-ResourceSetId
                                                                    OPTIONAL  -- Need R
  },
  csi-IM-ResourceSetList        SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSetsPerConfig)) OF CSI-IM-ResourceSetId
},
  bwp-Id                        BWP-Id,
  resourceType                  ENUMERATED { aperiodic, semiPersistent, periodic },
  ...
}

-- TAG-CSI-RESOURCECONFIG-STOP
-- ASN1STOP
```

| <b>CSI-ResourceConfig field descriptions</b>  |
|---|
| <b>bwp-Id</b><br>The DL BWP which the CSI-RS associated with this <i>CSI-ResourceConfig</i> are located in (see TS 38.214 [19], clause 5.2.1.2).  |
| <b>csi-IM-ResourceSetList</b><br>List of references to CSI-IM resources used for beam measurement and reporting in a CSI-RS resource set. Contains up to <i>maxNrofCSI-IM-ResourceSetsPerConfig</i> resource sets if <i>resourceType</i> is 'aperiodic' and 1 otherwise (see TS 38.214 [19], clause 5.2.1.2).             |
| <b>csi-ResourceConfigId</b><br>Used in <i>CSI-ReportConfig</i> to refer to an instance of <i>CSI-ResourceConfig</i> .   |
| <b>csi-SSB-ResourceSetList</b><br>List of references to SSB resources used for beam measurement and reporting in a CSI-RS resource set (see TS 38.214 [19], section 5.2.1.2).   |
| <b>nzp-CSI-RS-ResourceSetList</b><br>List of references to NZP CSI-RS resources used for beam measurement and reporting in a CSI-RS resource set. Contains up to <i>maxNrofNZP-CSI-RS-ResourceSetsPerConfig</i> resource sets if <i>resourceType</i> is 'aperiodic' and 1 otherwise (see TS 38.214 [19], clause 5.2.1.2). |
| <b>resourceType</b><br>Time domain behavior of resource configuration (see TS 38.214 [19], clause 5.2.1.2). It does not apply to resources provided in the <i>csi-SSB-ResourceSetList</i> .   |

– **CSI-ResourceConfigId**

The IE *CSI-ResourceConfigId* is used to identify a *CSI-ResourceConfig*.

**CSI-ResourceConfigId information element**

```
-- ASN1START
-- TAG-CSI-RESOURCECONFIGID-START

CSI-ResourceConfigId ::=          INTEGER (0..maxNrofCSI-ResourceConfigurations-1)

-- TAG-CSI-RESOURCECONFIGID-STOP
-- ASN1STOP
```

– **CSI-ResourcePeriodicityAndOffset**

The IE *CSI-ResourcePeriodicityAndOffset* is used to configure a periodicity and a corresponding offset for periodic and semi-persistent CSI resources, and for periodic and semi-persistent reporting on PUCCH. both, the periodicity and the offset are given in number of slots. The periodicity value *slots4* corresponds to 4 slots, value *slots5* corresponds to 5 slots, and so on.

**CSI-ResourcePeriodicityAndOffset information element**

```
-- ASN1START
-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-START

CSI-ResourcePeriodicityAndOffset ::= CHOICE {
```



```

slots4          INTEGER (0..3),
slots5          INTEGER (0..4),
slots8          INTEGER (0..7),
slots10         INTEGER (0..9),
slots16         INTEGER (0..15),
slots20         INTEGER (0..19),
slots32         INTEGER (0..31),
slots40         INTEGER (0..39),
slots64         INTEGER (0..63),
slots80         INTEGER (0..79),
slots160        INTEGER (0..159),
slots320        INTEGER (0..319),
slots640        INTEGER (0..639)
}

-- TAG-CSI-RESOURCEPERIODICITYANDOFFSET-STOP
-- ASN1STOP

```

### – *CSI-RS-ResourceConfigMobility*

The IE *CSI-RS-ResourceConfigMobility* is used to configure CSI-RS based RRM measurements.

#### **CSI-RS-ResourceConfigMobility information element**

```

-- ASN1START
-- TAG-CSI-RS-RESOURCECONFIGMOBILITY-START

CSI-RS-ResourceConfigMobility ::= SEQUENCE {
  subcarrierSpacing          SubcarrierSpacing,
  csi-RS-CellList-Mobility   SEQUENCE (SIZE (1..maxNrofCSI-RS-CellsRRM)) OF CSI-RS-CellMobility,
  ... ,
  [[
  refServCellIndex-v1530    ServCellIndex                                OPTIONAL    -- Need S
  ]]
}

CSI-RS-CellMobility ::= SEQUENCE {
  cellId                    PhysCellId,
  csi-rs-MeasurementBW      SEQUENCE {
    nrofPRBs                ENUMERATED { size24, size48, size96, size192, size264},
    startPRB                INTEGER(0..2169)
  },
  density                   ENUMERATED {d1,d3}                                OPTIONAL,    -- Need R
  csi-rs-ResourceList-Mobility SEQUENCE (SIZE (1..maxNrofCSI-RS-ResourcesRRM)) OF CSI-RS-Resource-Mobility
}

CSI-RS-Resource-Mobility ::= SEQUENCE {
  csi-RS-Index              CSI-RS-Index,
  slotConfig                CHOICE {

```

```

ms4                INTEGER (0..31),
ms5                INTEGER (0..39),
ms10               INTEGER (0..79),
ms20               INTEGER (0..159),
ms40               INTEGER (0..319)
},
associatedSSB      SEQUENCE {
  ssb-Index        SSB-Index,
  isQuasiColocated BOOLEAN
}
frequencyDomainAllocation CHOICE {
  row1             BIT STRING (SIZE (4)),
  row2             BIT STRING (SIZE (12))
},
firstOFDMSymbolInTimeDomain INTEGER (0..13),
sequenceGenerationConfig  INTEGER (0..1023),
...
}

CSI-RS-Index ::= INTEGER (0..maxNrofCSI-RS-ResourcesRRM-1)

-- TAG-CSI-RS-RESOURCECONFIGMOBILITY-STOP
-- ASN1STOP

```

OPTIONAL, -- Need R

#### **CSI-RS-CellMobility field descriptions**

##### **csi-rs-ResourceList-Mobility**

List of CSI-RS resources for mobility. The maximum number of CSI-RS resources that can be configured per *measObjectNR* depends on the configuration of *associatedSSB* (see TS 38.214 [19], clause 5.1.6.1.3).

##### **density**

Frequency domain density for the 1-port CSI-RS for L3 mobility. See TS 38.211 [16], clause 7.4.1.

##### **nrofPRBs**

Allowed size of the measurement BW in PRBs. See TS 38.211 [16], clause 7.4.1.

##### **startPRB**

Starting PRB index of the measurement bandwidth. See TS 38.211 [16], clause 7.4.1.

#### **CSI-RS-ResourceConfigMobility field descriptions**

##### **csi-RS-CellList-Mobility**

List of cells for CSI-RS based RRM measurements.

##### **refServCellIndex**

Indicates the serving cell providing the timing reference for CSI-RS resources without *associatedSSB*. The field may be present only if there is at least one CSI-RS resource configured without *associatedSSB*. If this field is absent, the UE shall use the timing of the PCell for measurements on the CSI-RS resources without *associatedSSB*. The CSI-RS resources and the serving cell indicated by *refServCellIndex* for timing reference should be located in the same band.

##### **subcarrierSpacing**

Subcarrier spacing of CSI-RS. Only the values 15, 30 kHz or 60 kHz (FR1), and 60 or 120 kHz (FR2) are applicable.

| <b>CSI-RS-Resource-Mobility field descriptions</b>   |
|--|
| <p><b>associatedSSB</b><br/>If this field is present, the UE may base the timing of the CSI-RS resource indicated in <i>CSI-RS-Resource-Mobility</i> on the timing of the cell indicated by the <i>cellId</i> in the <i>CSI-RS-CellMobility</i>. In this case, the UE is not required to monitor that CSI-RS resource if the UE cannot detect the SS/PBCH block indicated by this <i>associatedSSB</i> and <i>cellId</i>. If this field is absent, the UE shall base the timing of the CSI-RS resource indicated in <i>CSI-RS-Resource-Mobility</i> on the timing of the serving cell indicated by <i>refServCellIndex</i>. In this case, the UE is required to measure the CSI-RS resource even if SS/PBCH block(s) with <i>cellId</i> in the <i>CSI-RS-CellMobility</i> are not detected. CSI-RS resources with and without <i>associatedSSB</i> may be configured in accordance with the rules in TS 38.214 [19], clause 5.1.6.1.3.</p> |
| <p><b>csi-RS-Index</b><br/>CSI-RS resource index associated to the CSI-RS resource to be measured (and used for reporting).</p>  |
| <p><b>firstOFDMSymbolInTimeDomain</b><br/>Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS, see TS 38.211 [16], clause 7.4.1.5.3. Value 2 is supported only when <i>dmrs-TypeA-Position</i> equals <i>pos3</i>.</p>   |
| <p><b>frequencyDomainAllocation</b><br/>Frequency domain allocation within a physical resource block in accordance with TS 38.211 [16], clause 7.4.1.5.3 including table 7.4.1.5.2-1. The number of bits that may be set to one depend on the chosen row in that table.</p>  |
| <p><b>isQuasiColocated</b><br/>Indicates that the CSI-RS resource is quasi co-located with the associated SS/PBCH block, see TS 38.214 [19], clause 5.1.6.1.3.</p>   |
| <p><b>sequenceGenerationConfig</b><br/>Scrambling ID for CSI-RS (see TS 38.211 [16], clause 7.4.1.5.2).</p>  |
| <p><b>slotConfig</b><br/>Indicates the CSI-RS periodicity (in milliseconds) and for each periodicity the offset (in number of slots). When <i>subcarrierSpacingCSI-RS</i> is set to <i>kHz15</i>, the maximum offset values for periodicities <i>ms4/ms5/ms10/ms20/ms40</i> are 3/4/9/19/39 slots. When <i>subcarrierSpacingCSI-RS</i> is set to <i>kHz30</i>, the maximum offset values for periodicities <i>ms4/ms5/ms10/ms20/ms40</i> are 7/9/19/39/79 slots. When <i>subcarrierSpacingCSI-RS</i> is set to <i>kHz60</i>, the maximum offset values for periodicities <i>ms4/ms5/ms10/ms20/ms40</i> are 15/19/39/79/159 slots. When <i>subcarrierSpacingCSI-RS</i> is set <i>kHz120</i>, the maximum offset values for periodicities <i>ms4/ms5/ms10/ms20/ms40</i> are 31/39/79/159/319 slots.</p>  |

## – CSI-RS-ResourceMapping

The IE *CSI-RS-ResourceMapping* is used to configure the resource element mapping of a CSI-RS resource in time- and frequency domain.

### **CSI-RS-ResourceMapping information element**

```

-- ASN1START
-- TAG-CSI-RS-RESOURCEMAPPING-START

CSI-RS-ResourceMapping ::=
    SEQUENCE {
        frequencyDomainAllocation
            CHOICE {
                row1
                    BIT STRING (SIZE (4)),
                row2
                    BIT STRING (SIZE (12)),
                row4
                    BIT STRING (SIZE (3)),
                other
                    BIT STRING (SIZE (6))
            },
        nrofPorts
            ENUMERATED {p1,p2,p4,p8,p12,p16,p24,p32},
        firstOFDMSymbolInTimeDomain
            INTEGER (0..13),
        firstOFDMSymbolInTimeDomain2
            INTEGER (2..12)
            OPTIONAL, -- Need R
        cdm-Type
            ENUMERATED {noCDM, fd-CDM2, cdm4-FD2-TD2, cdm8-FD2-TD4},
        density
            CHOICE {
                dot5
                    ENUMERATED {evenPRBs, oddPRBs},

```

```

        one          NULL,
        three       NULL,
        spare       NULL
    },
    freqBand        CSI-FrequencyOccupation,
    ...
}
-- TAG-CSI-RS-RESOURCEMAPPING-STOP
-- ASN1STOP

```

| <b>CSI-RS-ResourceMapping field descriptions</b>   |
|--|
| <p><b>cdm-Type</b><br/>CDM type (see TS 38.214 [19], clause 5.2.2.3.1).</p>  |
| <p><b>density</b><br/>Density of CSI-RS resource measured in RE/port/PRB (see TS 38.211 [16], clause 7.4.1.5.3).<br/>Values 0.5 (<i>dot5</i>), 1 (<i>one</i>) and 3 (<i>three</i>) are allowed for X=1, values 0.5 (<i>dot5</i>) and 1 (<i>one</i>) are allowed for X=2, 16, 24 and 32, value 1 (<i>one</i>) is allowed for X=4, 8, 12.<br/>For density = 1/2, includes 1-bit indication for RB level comb offset indicating whether odd or even RBs are occupied by CSI-RS.</p>   |
| <p><b>firstOFDMSymbolInTimeDomain2</b><br/>Time domain allocation within a physical resource block. See TS 38.211 [16], clause 7.4.1.5.3.</p>  |
| <p><b>firstOFDMSymbolInTimeDomain</b><br/>Time domain allocation within a physical resource block. The field indicates the first OFDM symbol in the PRB used for CSI-RS. See TS 38.211 [16], clause 7.4.1.5.3. Value 2 is supported only when <i>dmrs-TypeA-Position</i> equals <i>pos3</i>.</p>   |
| <p><b>freqBand</b><br/>Wideband or partial band CSI-RS, (see TS 38.214 [19], clause 5.2.2.3.1).</p>  |
| <p><b>frequencyDomainAllocation</b><br/>Frequency domain allocation within a physical resource block in accordance with TS 38.211 [16], clause 7.4.1.5.3. The applicable row number in table 7.4.1.5.3-1 is determined by the <i>frequencyDomainAllocation</i> for rows 1, 2 and 4, and for other rows by matching the values in the column Ports, Density and CDMtype in table 7.4.1.5.3-1 with the values of <i>nrofPorts</i>, <i>cdm-Type</i> and <i>density</i> below and, when more than one row has the 3 values matching, by selecting the row where the column (k bar, l bar) in table 7.4.1.5.3-1 has indexes for k ranging from 0 to 2*n-1 where n is the number of bits set to 1 in <i>frequencyDomainAllocation</i>.</p> |
| <p><b>nrofPorts</b><br/>Number of ports (see TS 38.214 [19], clause 5.2.2.3.1).</p>  |

## – *CSI-SemiPersistentOnPUSCH-TriggerStateList*

The *CSI-SemiPersistentOnPUSCH-TriggerStateList* IE is used to configure the UE with list of trigger states for semi-persistent reporting of channel state information on L1. See also TS 38.214 [19], clause 5.2.

### **CSI-SemiPersistentOnPUSCH-TriggerStateList information element**

```

-- ASN1START
-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-START

CSI-SemiPersistentOnPUSCH-TriggerStateList ::=
    SEQUENCE (SIZE (1..maxNrOfSemiPersistentPUSCH-Triggers)) OF CSI-SemiPersistentOnPUSCH-TriggerState

```

```

CSI-SemiPersistentOnPUSCH-TriggerState ::= SEQUENCE {
    associatedReportConfigInfo
    ...
}
-- TAG-CSI-SEMIPERSISTENTONPUSCHTRIGGERSTATELIST-STOP
-- ASN1STOP

```

### – *CSI-SSB-ResourceSet*

The IE *CSI-SSB-ResourceSet* is used to configure one SS/PBCH block resource set which refers to SS/PBCH as indicated in *ServingCellConfigCommon*.

#### **CSI-SSB-ResourceSet information element**

```

-- ASN1START
-- TAG-CSI-SSB-RESOURCESET-START

CSI-SSB-ResourceSet ::= SEQUENCE {
    csi-SSB-ResourceSetId      CSI-SSB-ResourceSetId,
    csi-SSB-ResourceList      SEQUENCE (SIZE(1..maxNrofCSI-SSB-ResourcePerSet)) OF SSB-Index,
    ...
}
-- TAG-CSI-SSB-RESOURCESET-STOP
-- ASN1STOP

```

### – *CSI-SSB-ResourceSetId*

The IE *CSI-SSB-ResourceSetId* is used to identify one SS/PBCH block resource set.

#### **CSI-SSB-ResourceSetId information element**

```

-- ASN1START
-- TAG-CSI-SSB-RESOURCESETID-START

CSI-SSB-ResourceSetId ::= INTEGER (0..maxNrofCSI-SSB-ResourceSets-1)

-- TAG-CSI-SSB-RESOURCESETID-STOP
-- ASN1STOP

```

### – *DedicatedNAS-Message*

The IE *DedicatedNAS-Message* is used to transfer UE specific NAS layer information between the 5GC CN and the UE. The RRC layer is transparent for this information.

***DedicatedNAS-Message* information element**

```

-- ASN1START
-- TAG-DEDICATED-NAS-MESSAGE-START

DedicatedNAS-Message ::=          OCTET STRING

-- TAG-DEDICATED-NAS-MESSAGE-STOP
-- ASN1STOP

```

***DMRS-DownlinkConfig***

The IE *DMRS-DownlinkConfig* is used to configure downlink demodulation reference signals for PDSCH.

***DMRS-DownlinkConfig* information element**

```

-- ASN1START
-- TAG-DMRS-DOWNLINKCONFIG-START

DMRS-DownlinkConfig ::=          SEQUENCE {
  dmrs-Type                ENUMERATED {type2}                OPTIONAL, -- Need S
  dmrs-AdditionalPosition  ENUMERATED {pos0, pos1, pos3}      OPTIONAL, -- Need S
  maxLength                ENUMERATED {len2}                 OPTIONAL, -- Need S
  scramblingID0            INTEGER (0..65535)                 OPTIONAL, -- Need S
  scramblingID1            INTEGER (0..65535)                 OPTIONAL, -- Need S
  phaseTrackingRS         SetupRelease { PTRS-DownlinkConfig } OPTIONAL, -- Need M
  ...
}

-- TAG-DMRS-DOWNLINKCONFIG-STOP
-- ASN1STOP

```

| <b>DMRS-DownlinkConfig field descriptions</b>   |
|---|
| <b>dmrs-AdditionalPosition</b><br>Position for additional DM-RS in DL, see Tables 7.4.1.1.2-3 and 7.4.1.1.2-4 in TS 38.211 [16]. If the field is absent, the UE applies the value pos2. See also clause 7.4.1.1.2 for additional constraints on how the network may set this field depending on the setting of other fields.                                    |
| <b>dmrs-Type</b><br>Selection of the DMRS type to be used for DL (see TS 38.211 [16], clause 7.4.1.1.1). If the field is absent, the UE uses DMRS type 1.   |
| <b>maxLength</b><br>The maximum number of OFDM symbols for DL front loaded DMRS. <i>len1</i> corresponds to value 1. <i>len2</i> corresponds to value 2. If the field is absent, the UE applies value <i>len1</i> . If set to <i>len2</i> , the UE determines the actual number of DM-RS symbols by the associated DCI. (see TS 38.214 [19], clause 7.4.1.1.2). |
| <b>phaseTrackingRS</b><br>Configures downlink PTRS. If the field is not configured, the UE assumes that downlink PTRS are absent. See TS 38.214 [19] clause 5.1.6.3.  |
| <b>scramblingID0</b><br>DL DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.1.1). When the field is absent the UE applies the value <i>physCellId</i> configured for this serving cell.   |
| <b>scramblingID1</b><br>DL DMRS scrambling initialization (see TS 38.211 [16], clause 7.4.1.1.1). When the field is absent the UE applies the value <i>physCellId</i> configured for this serving cell.   |

## – DMRS-UplinkConfig

The IE *DMRS-UplinkConfig* is used to configure uplink demodulation reference signals for PUSCH.

### **DMRS-UplinkConfig information element**

```

-- ASN1START
-- TAG-DMRS-UPLINKCONFIG-START

DMRS-UplinkConfig ::=
    SEQUENCE {
        dmrs-Type                ENUMERATED {type2}                OPTIONAL, -- Need S
        dmrs-AdditionalPosition  ENUMERATED {pos0, pos1, pos3}    OPTIONAL, -- Need S
        phaseTrackingRS          SetupRelease { PTRS-UplinkConfig } OPTIONAL, -- Need M
        maxLength                ENUMERATED {len2}                OPTIONAL, -- Need S
        transformPrecodingDisabled
            SEQUENCE {
                scramblingID0    INTEGER (0..65535)                OPTIONAL, -- Need S
                scramblingID1    INTEGER (0..65535)                OPTIONAL, -- Need S
                ...
            }
            OPTIONAL, -- Need R
        transformPrecodingEnabled
            SEQUENCE {
                nPUSCH-Identity  INTEGER(0..1007)                OPTIONAL, -- Need S
                sequenceGroupHopping
                    ENUMERATED {disabled}                OPTIONAL, -- Need S
                sequenceHopping  ENUMERATED {enabled}            OPTIONAL, -- Need S
                ...
            }
            OPTIONAL, -- Need R
        ...
    }

-- TAG-DMRS-UPLINKCONFIG-STOP
-- ASN1STOP

```

| <b>DMRS-UplinkConfig field descriptions</b>  |
|--|
| <p><b>dmrs-AdditionalPosition</b><br/>Position for additional DM-RS in UL (see TS 38.211 [16], clause 6.4.1.1.3). If the field is absent, the UE applies the value pos2. See also clause 6.4.1.1.3 for additional constraints on how the network may set this field depending on the setting of other fields.</p>  |
| <p><b>dmrs-Type</b><br/>Selection of the DMRS type to be used for UL (see TS 38.211 [16], clause 6.4.1.1.3) If the field is absent, the UE uses DMRS type 1.</p>   |
| <p><b>maxLength</b><br/>The maximum number of OFDM symbols for UL front loaded DMRS. <i>len1</i> corresponds to value 1. <i>len2</i> corresponds to value 2. If the field is absent, the UE applies value <i>len1</i>. If set to <i>len2</i>, the UE determines the actual number of DM-RS symbols by the associated DCI. (see TS 38.214 [19], clause 6.4.1.1.3).</p>  |
| <p><b>nPUSCH-Identity</b><br/>Parameter: <math>N_{ID}^{PUSCH}</math> for DFT-s-OFDM DMRS. If the value is absent or released, the UE uses the value Physical cell ID (<i>physCellId</i>). See TS 38.211 [16].</p>  |
| <p><b>phaseTrackingRS</b><br/>Configures uplink PTRS (see TS 38.211 [16]).</p>   |
| <p><b>scramblingID0</b><br/>UL DMRS scrambling initialization for CP-OFDM (see TS 38.211 [16], clause 6.4.1.1.1.1). When the field is absent the UE applies the value Physical cell ID (<i>physCellId</i>).</p>  |
| <p><b>scramblingID1</b><br/>UL DMRS scrambling initialization for CP-OFDM. (see TS 38.211 [16], clause 6.4.1.1.1.1). When the field is absent the UE applies the value Physical cell ID (<i>physCellId</i>).</p>   |
| <p><b>sequenceGroupHopping</b><br/>For DMRS transmission with transform precoder the NW may configure group hopping by the cell-specific parameter <i>groupHoppingEnabledTransformPrecoding</i> in <i>PUSCH-ConfigCommon</i>. In this case, the NW may include this UE specific field to disable group hopping for PUSCH transmission except for Msg3, i.e., to override the configuration in <i>PUSCH-ConfigCommon</i> (see TS 38.211 [16]). If the field is absent, the UE uses the same hopping mode as for Msg3.</p> |
| <p><b>sequenceHopping</b><br/>Determines if sequence hopping is enabled for DMRS transmission with transform precoder for PUSCH transmission other than Msg3 (sequence hopping is always disabled for Msg3). If the field is absent, the UE uses the same hopping mode as for msg3. The network does not configure simultaneous group hopping and sequence hopping. See TS 38.211 [16], clause 6.4.1.1.1.2.</p>  |
| <p><b>transformPrecodingDisabled</b><br/>DMRS related parameters for Cyclic Prefix OFDM.</p>   |
| <p><b>transformPrecodingEnabled</b><br/>DMRS related parameters for DFT-s-OFDM (Transform Precoding).</p>  |

## – DownlinkConfigCommon

The IE *DownlinkConfigCommon* provides common downlink parameters of a cell.

### DownlinkConfigCommon information element

```

-- ASN1START
-- TAG-DOWNLINKCONFIGCOMMON-START

DownlinkConfigCommon ::=          SEQUENCE {
    frequencyInfoDL                FrequencyInfoDL                OPTIONAL,  -- Cond InterFreqHOAndServCellAdd
    initialDownlinkBWP              BWP-DownlinkCommon                OPTIONAL,  -- Cond ServCellAdd
    ...
}

-- TAG-DOWNLINKCONFIGCOMMON-STOP

```



-- ASN1STOP

| <i>DownlinkConfigCommon</i> field descriptions   |
|--|
| <p><b><i>frequencyInfoDL</i></b><br/>Basic parameters of a downlink carrier and transmission thereon.</p>  |
| <p><b><i>initialDownlinkBWP</i></b><br/>The initial downlink BWP configuration for a SpCell (PCell of MCG or SCG) and SCell. The network configures the <i>locationAndBandwidth</i> so that the initial downlink BWP contains the entire CORESET#0 of this serving cell in the frequency domain.</p> |

| Conditional Presence             | Explanation  |
|----------------------------------|--|
| <i>InterFreqHOAndServCellAdd</i> | This field is mandatory present for inter-frequency handover, and upon serving cell (PSCell/SCell) addition. Otherwise, the field is optionally present, Need M.   |
| <i>ServCellAdd</i>               | This field is mandatory present upon serving cell addition (for PSCell and SCell) and upon handover from E-UTRA to NR. It is optionally present, Need M otherwise. |

## – *DownlinkConfigCommonSIB*

The IE *DownlinkConfigCommonSIB* provides common downlink parameters of a cell.

### *DownlinkConfigCommonSIB* information element

```
-- ASN1START
-- TAG-DOWNLINKCONFIGCOMMONSIB-START

DownlinkConfigCommonSIB ::= SEQUENCE {
    frequencyInfoDL      FrequencyInfoDL-SIB,
    initialDownlinkBWP   BWP-DownlinkCommon,
    bcch-Config          BCCH-Config,
    pcch-Config          PCCH-Config,
    ...
}

BCCH-Config ::= SEQUENCE {
    modificationPeriodCoeff  ENUMERATED {n2, n4, n8, n16},
    ...
}

PCCH-Config ::= SEQUENCE {
    defaultPagingCycle      PagingCycle,
    nAndPagingFrameOffset  CHOICE {
        oneT                NULL,
        halfT               INTEGER (0..1),
        quarterT            INTEGER (0..3),
        oneEighthT          INTEGER (0..7),
    }
}
```

```

    oneSixteenthT                INTEGER (0..15)
  },
  ns                             ENUMERATED {four, two, one},
  firstPDCCH-MonitoringOccasionOfPO CHOICE {
    sCS15KHZoneT                  SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),
    sCS30KHZoneT-SCS15KHZhalfT    SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),
    sCS60KHZoneT-SCS30KHZhalfT-SCS15KHZquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),
    sCS120KHZoneT-SCS60KHZhalfT-SCS30KHZquarterT-SCS15KHZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),
    sCS120KHZhalfT-SCS60KHZquarterT-SCS30KHZoneEighthT-SCS15KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),
    sCS120KHZquarterT-SCS60KHZoneEighthT-SCS30KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),
    sCS120KHZoneEighthT-SCS60KHZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),
    sCS120KHZoneSixteenthT       SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)
  } OPTIONAL,                    -- Need R
  ...
}

-- TAG-DOWNLINKCONFIGCOMMONSIB-STOP
-- ASN1STOP

```

#### **DownlinkConfigCommonSIB field descriptions**

##### **frequencyInfoDL-SIB**

Basic parameters of a downlink carrier and transmission thereon.

##### **initialDownlinkBWP**

The initial downlink BWP configuration for a SpCell (PCell of MCG or SCG). The network configures the *locationAndBandwidth* so that the initial downlink BWP contains the entire CORESET#0 of this serving cell in the frequency domain. The UE applies the *locationAndBandwidth* upon reception of this field (e.g. to determine the frequency position of signals described in relation to this *locationAndBandwidth*) but it may keep the bandwidth of CORESET#0 until after reception of *RRCSetup/RRCResume/RRCReestablishment*.

##### **bcch-Config**

The modification period related configuration.

##### **pcch-Config**

The paging related configuration.

#### **BCCH-Config field descriptions**

##### **modificationPeriodCoeff**

Actual modification period, expressed in number of radio frames  $m = \text{modificationPeriodCoeff} * \text{defaultPagingCycle}$ , see clause 5.2.2.2.2. *n2* corresponds to value 2, *n4* corresponds to value 4, and so on.

| <b>PCCH-Config field descriptions</b>   |
|---|
| <p><b>defaultPagingCycle</b><br/>Default paging cycle, used to derive 'T' in TS 38.304 [20]. Value <i>rf32</i> corresponds to 32 radio frames, value <i>rf64</i> corresponds to 64 radio frames and so on.</p>  |
| <p><b>firstPDCCH-MonitoringOccasionOfPO</b><br/>Points out the first PDCCH monitoring occasion for paging of each PO of the PF, see TS 38.304 [20].</p>   |
| <p><b>nAndPagingFrameOffset</b><br/>Used to derive the number of total paging frames in T (corresponding to parameter N in TS 38.304 [20]) and paging frame offset (corresponding to parameter PF_offset in TS 38.304 [20]). A value of <i>oneSixteenthT</i> corresponds to T / 16, a value of <i>oneEighthT</i> corresponds to T / 8, and so on.<br/>If <i>pagingSearchSpace</i> is set to zero and if SS/PBCH block and CORESET multiplexing pattern is 2 or 3 (as specified in TS 38.213 [13]):</p> <ul style="list-style-type: none"> <li>- for <i>ssb-periodicityServingCell</i> of 5 or 10 ms, N can be set to one of {<i>oneT</i>, <i>halfT</i>, <i>quarterT</i>, <i>oneEighthT</i>, <i>oneSixteenthT</i>}</li> <li>- for <i>ssb-periodicityServingCell</i> of 20 ms, N can be set to one of {<i>halfT</i>, <i>quarterT</i>, <i>oneEighthT</i>, <i>oneSixteenthT</i>}</li> <li>- for <i>ssb-periodicityServingCell</i> of 40 ms, N can be set to one of {<i>quarterT</i>, <i>oneEighthT</i>, <i>oneSixteenthT</i>}</li> <li>- for <i>ssb-periodicityServingCell</i> of 80 ms, N can be set to one of {<i>oneEighthT</i>, <i>oneSixteenthT</i>}</li> <li>- for <i>ssb-periodicityServingCell</i> of 160 ms, N can be set to <i>oneSixteenthT</i></li> </ul> <p>If <i>pagingSearchSpace</i> is set to zero and if SS/PBCH block and CORESET multiplexing pattern is 1 (as specified in TS 38.213 [13]), N can be set to one of {<i>halfT</i>, <i>quarterT</i>, <i>oneEighthT</i>, <i>oneSixteenthT</i>}</p> <p>If <i>pagingSearchSpace</i> is not set to zero, N can be configured to one of {<i>oneT</i>, <i>halfT</i>, <i>quarterT</i>, <i>oneEighthT</i>, <i>oneSixteenthT</i>}</p> |
| <p><b>ns</b><br/>Number of paging occasions per paging frame.</p>   |

## – DownlinkPreemption

The IE *DownlinkPreemption* is used to configure the UE to monitor PDCCH for the INT-RNTI (interruption).

### DownlinkPreemption information element

```
-- ASN1START
-- TAG-DOWNLINKPREEMPTION-START

DownlinkPreemption ::=
    int-RNTI                RNTI-Value,
    timeFrequencySet        ENUMERATED {set0, set1},
    dci-PayloadSize         INTEGER (0..maxINT-DCI-PayloadSize),
    int-ConfigurationPerServingCell SEQUENCE (SIZE (1..maxNrofServingCells)) OF INT-ConfigurationPerServingCell,
    ...
}

INT-ConfigurationPerServingCell ::= SEQUENCE {
    servingCellId           ServCellIndex,
    positionInDCI           INTEGER (0..maxINT-DCI-PayloadSize-1)
}

-- TAG-DOWNLINKPREEMPTION-STOP
-- ASN1STOP
```

| <b>DownlinkPreemption field descriptions</b>   |
|--|
| <b><i>dci-PayloadSize</i></b><br>Total length of the DCI payload scrambled with INT-RNTI (see TS 38.213 [13], clause 11.2).  |
| <b><i>int-ConfigurationPerServingCell</i></b><br>Indicates (per serving cell) the position of the 14 bit INT values inside the DCI payload (see TS 38.213 [13], clause 11.2).          |
| <b><i>int-RNTI</i></b><br>RNTI used for indication pre-emption in DL (see TS 38.213 [13], clause 10).  |
| <b><i>timeFrequencySet</i></b><br>Set selection for DL-preemption indication (see TS 38.213 [13], clause 11.2) The set determines how the UE interprets the DL preemption DCI payload. |

| <b>INT-ConfigurationPerServingCell field descriptions</b>  |
|--|
| <b><i>positionInDCI</i></b><br>Starting position (in number of bit) of the 14 bit INT value applicable for this serving cell ( <i>servingCellId</i> ) within the DCI payload (see TS 38.213 [13], clause 11.2). Must be multiples of 14 (bit). |

## – *DRB-Identity*

The IE *DRB-Identity* is used to identify a DRB used by a UE.

### ***DRB-Identity* information element**

```
-- ASN1START
-- TAG-DRB-IDENTITY-START

DRB-Identity ::=                INTEGER (1..32)

-- TAG-DRB-IDENTITY-STOP
-- ASN1STOP
```

## – *DRX-Config*

The IE *DRX-Config* is used to configure DRX related parameters.

### ***DRX-Config* information element**

```
-- ASN1START
-- TAG-DRX-CONFIG-START

DRX-Config ::=
    drx-onDurationTimer          SEQUENCE {
                                CHOICE {
                                    subMilliseconds INTEGER (1..31),
                                    milliseconds     ENUMERATED {
                                        ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60,
                                        ms80, ms100, ms200, ms300, ms400, ms500, ms600, ms800, ms1000, ms1200,

```

```

        ms1600, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 }
    },
drx-InactivityTimer      ENUMERATED {
    ms0, ms1, ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30, ms40, ms50, ms60, ms80,
    ms100, ms200, ms300, ms500, ms750, ms1280, ms1920, ms2560, spare9, spare8,
    spare7, spare6, spare5, spare4, spare3, spare2, spare1},
drx-HARQ-RTT-TimerDL    INTEGER (0..56),
drx-HARQ-RTT-TimerUL    INTEGER (0..56),
drx-RetransmissionTimerDL  ENUMERATED {
    s10, s11, s12, s14, s16, s18, s116, s124, s133, s140, s164, s180, s196, s1112, s1128,
    s1160, s1320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,
    spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},
drx-RetransmissionTimerUL  ENUMERATED {
    s10, s11, s12, s14, s16, s18, s116, s124, s133, s140, s164, s180, s196, s1112, s1128,
    s1160, s1320, spare15, spare14, spare13, spare12, spare11, spare10, spare9,
    spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
drx-LongCycleStartOffset CHOICE {
    ms10      INTEGER(0..9),
    ms20      INTEGER(0..19),
    ms32      INTEGER(0..31),
    ms40      INTEGER(0..39),
    ms60      INTEGER(0..59),
    ms64      INTEGER(0..63),
    ms70      INTEGER(0..69),
    ms80      INTEGER(0..79),
    ms128     INTEGER(0..127),
    ms160     INTEGER(0..159),
    ms256     INTEGER(0..255),
    ms320     INTEGER(0..319),
    ms512     INTEGER(0..511),
    ms640     INTEGER(0..639),
    ms1024    INTEGER(0..1023),
    ms1280    INTEGER(0..1279),
    ms2048    INTEGER(0..2047),
    ms2560    INTEGER(0..2559),
    ms5120    INTEGER(0..5119),
    ms10240   INTEGER(0..10239)
},
shortDRX
  drx-ShortCycle          SEQUENCE {
    ENUMERATED {
      ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,
      ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,
      spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
    drx-ShortCycleTimer   INTEGER (1..16)
  }
  drx-SlotOffset          INTEGER (0..31)
}
-- TAG-DRX-CONFIG-STOP
-- ASN1STOP

```

OPTIONAL, -- Need R

| <b>DRX-Config field descriptions</b>   |
|--|
| <b>drx-HARQ-RTT-TimerDL</b><br>Value in number of symbols of the BWP where the transport block was received.   |
| <b>drx-HARQ-RTT-TimerUL</b><br>Value in number of symbols of the BWP where the transport block was transmitted.  |
| <b>drx-InactivityTimer</b><br>Value in multiple integers of 1 ms. <i>ms0</i> corresponds to 0, <i>ms1</i> corresponds to 1 ms, <i>ms2</i> corresponds to 2 ms, and so on.  |
| <b>drx-LongCycleStartOffset</b><br><i>drx-LongCycle</i> in ms and <i>drx-StartOffset</i> in multiples of 1 ms. If <i>drx-ShortCycle</i> is configured, the value of <i>drx-LongCycle</i> shall be a multiple of the <i>drx-ShortCycle</i> value. |
| <b>drx-onDurationTimer</b><br>Value in multiples of 1/32 ms (subMilliSeconds) or in ms (milliSecond). For the latter, value <i>ms1</i> corresponds to 1 ms, value <i>ms2</i> corresponds to 2 ms, and so on.                                     |
| <b>drx-RetransmissionTimerDL</b><br>Value in number of slot lengths of the BWP where the transport block was received. value <i>s0</i> corresponds to 0 slots, <i>s1</i> corresponds to 1 slot, <i>s2</i> corresponds to 2 slots, and so on.     |
| <b>drx-RetransmissionTimerUL</b><br>Value in number of slot lengths of the BWP where the transport block was transmitted. <i>s0</i> corresponds to 0 slots, <i>s1</i> corresponds to 1 slot, <i>s2</i> corresponds to 2 slots, and so on.        |
| <b>drx-ShortCycleTimer</b><br>Value in multiples of <i>drx-ShortCycle</i> . A value of 1 corresponds to <i>drx-ShortCycle</i> , a value of 2 corresponds to 2 * <i>drx-ShortCycle</i> and so on.   |
| <b>drx-ShortCycle</b><br>Value in ms. <i>ms1</i> corresponds to 1 ms, <i>ms2</i> corresponds to 2 ms, and so on.   |
| <b>drx-SlotOffset</b><br>Value in 1/32 ms. Value 0 corresponds to 0 ms, value 1 corresponds to 1/32 ms, value 2 corresponds to 2/32 ms, and so on.   |

### – *FilterCoefficient*

The IE *FilterCoefficient* specifies the measurement filtering coefficient. Value *fc0* corresponds to  $k = 0$ , *fc1* corresponds to  $k = 1$ , and so on.

#### **FilterCoefficient information element**

```
-- ASN1START
-- TAG-FILTERCOEFFICIENT-START

FilterCoefficient ::=      ENUMERATED { fc0, fc1, fc2, fc3, fc4, fc5, fc6, fc7, fc8, fc9, fc11, fc13, fc15, fc17, fc19, spare1, ... }

-- TAG-FILTERCOEFFICIENT-STOP
-- ASN1STOP
```

### – *FreqBandIndicatorNR*

The IE *FreqBandIndicatorNR* is used to convey an NR frequency band number as defined in TS 38.101-1 [15] and TS 38.101-2 [39].

***FreqBandIndicatorNR* information element**

```
-- ASN1START
-- TAG-FREQBANDINDICATORNR-START

FreqBandIndicatorNR ::=                INTEGER (1..1024)

-- TAG-FREQBANDINDICATORNR-STOP
-- ASN1STOP
```

– ***FrequencyInfoDL***

The IE *FrequencyInfoDL* provides basic parameters of a downlink carrier and transmission thereon.

***FrequencyInfoDL* information element**

```
-- ASN1START
-- TAG-FREQUENCYINFODL-START

FrequencyInfoDL ::=                    SEQUENCE {
    absoluteFrequencySSB                ARFCN-ValueNR                                OPTIONAL,  -- Cond SpCellAdd
    frequencyBandList                   MultiFrequencyBandListNR,
    absoluteFrequencyPointA             ARFCN-ValueNR,
    scs-SpecificCarrierList             SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,
    ...
}

-- TAG-FREQUENCYINFODL-STOP
-- ASN1STOP
```

***FrequencyInfoDL* field descriptions*****absoluteFrequencyPointA***

Absolute frequency position of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A (see TS 38.211 [16], clause 4.4.4.2). Note that the lower edge of the actual carrier is not defined by this field but rather in the *scs-SpecificCarrierList*.

***absoluteFrequencySSB***

Frequency of the SSB to be used for this serving cell. SSB related parameters (e.g. SSB index) provided for a serving cell refer to this SSB frequency unless mentioned otherwise. The cell-defining SSB of the PCell is always on the sync raster. Frequencies are considered to be on the sync raster if they are also identifiable with a GSCN value (see TS 38.101-1 [15]). If the field is absent, the SSB related parameters should be absent, e.g. *ssb-PositionsInBurst*, *ssb-periodicityServingCell* and *subcarrierSpacing* in *ServingCellConfigCommon* IE. If the field is absent, the UE obtains timing reference from the SpCell. This is only supported in case the Scell is in the same frequency band as the SpCell.

***frequencyBandList***

List containing only one frequency band to which this carrier(s) belongs. Multiple values are not supported.

***scs-SpecificCarrierList***

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A. The network configures a *scs-SpecificCarrier* at least for each numerology (SCS) that is used e.g. in a BWP (see TS 38.211 [16], clause 5.3).

| Conditional Presence | Explanation   |
|----------------------|---|
| <i>SpCellAdd</i>     | The field is mandatory present if this <i>FrequencyInfoDL</i> is for SpCell. Otherwise the field is optionally present, Need S. |

## – *FrequencyInfoDL-SIB*

The IE *FrequencyInfoDL-SIB* provides basic parameters of a downlink carrier and transmission thereon.

### *FrequencyInfoDL-SIB* information element

```
-- ASN1START
-- TAG-FREQUENCYINFODL-SIB-START

FrequencyInfoDL-SIB ::=
    frequencyBandList      MultiFrequencyBandListNR-SIB,
    offsetToPointA         INTEGER (0..2199),
    scs-SpecificCarrierList SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier
}

-- TAG-FREQUENCYINFODL-SIB-STOP
-- ASN1STOP
```

### *FrequencyInfoDL-SIB* field descriptions

#### ***offsetToPointA***

Represents the offset to Point A as defined in TS 38.211 [16], clause 4.4.4.2.

#### ***frequencyBandList***

List of one or multiple frequency bands to which this carrier(s) belongs.

#### ***scs-SpecificCarrierList***

A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A (see TS 38.211 [16], clause 5.3). The network configures this for all SCSs that are used in DL BWPs in this serving cell.

## – *FrequencyInfoUL*

The IE *FrequencyInfoUL* provides basic parameters of an uplink carrier and transmission thereon.

### *FrequencyInfoUL* information element

```
-- ASN1START
-- TAG-FREQUENCYINFOUL-START

FrequencyInfoUL ::=
    frequencyBandList      MultiFrequencyBandListNR                OPTIONAL,  -- Cond FDD-OrSUL
    absoluteFrequencyPointA ARFCN-ValueNR                          OPTIONAL,  -- Cond FDD-OrSUL
    scs-SpecificCarrierList SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,
    additionalSpectrumEmission AdditionalSpectrumEmission          OPTIONAL,  -- Need S
    p-Max                   P-Max                                    OPTIONAL,  -- Need S
```



```

    frequencyShift7p5khz          ENUMERATED {true}                OPTIONAL,    -- Cond FDD-TDD-OrSUL-Optional
    ...
}
-- TAG-FREQUENCYINFOUL-STOP
-- ASN1STOP

```

| <b>FrequencyInfoUL field descriptions</b>   |
|---|
| <p><b>absoluteFrequencyPointA</b><br/>                     Absolute frequency of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A. Note that the lower edge of the actual carrier is not defined by this field but rather in the <i>scs-SpecificCarrierList</i> (see TS 38.211 [16], clause 4.4.4.2).</p>   |
| <p><b>additionalSpectrumEmission</b><br/>                     The additional spectrum emission requirements to be applied by the UE on this uplink. If the field is absent, the UE uses value 0 for the <i>additionalSpectrumEmission</i> (see TS 38.101-1 [15], table 6.2.3.1-1A, and TS 38.101-2 [39], table 6.2.3.1-2).</p>  |
| <p><b>frequencyBandList</b><br/>                     List containing only one frequency band to which this carrier(s) belongs. Multiple values are not supported.</p>   |
| <p><b>frequencyShift7p5khz</b><br/>                     Enable the NR UL transmission with a 7.5 kHz shift to the LTE raster. If the field is absent, the frequency shift is disabled.</p>  |
| <p><b>p-Max</b><br/>                     Maximum transmit power allowed in this serving cell. The maximum transmit power that the UE may use on this serving cell may be additionally limited by <i>p-NR-FR1</i> (configured for the cell group) and by <i>p-UE-FR1</i> (configured total for all serving cells operating on FR1). If absent, the UE applies the maximum power according to TS 38.101-1 [15]. Value in dBm.</p> |
| <p><b>scs-SpecificCarrierList</b><br/>                     A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A. The network configures a <i>scs-SpecificCarrier</i> at least for each numerology (SCS) that is used e.g. in a BWP (see TS 38.211 [16], clause 5.3).</p>  |

| <b>Conditional Presence</b>   | <b>Explanation</b>   |
|-------------------------------|--|
| <i>FDD-OrSUL</i>              | The field is mandatory present if this <i>FrequencyInfoUL</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL</i> ) or if this <i>FrequencyInfoUL</i> is for a supplementary uplink (SUL). It is absent otherwise (if this <i>FrequencyInfoUL</i> is for an unpaired UL (TDD)).   |
| <i>FDD-TDD-OrSUL-Optional</i> | The field is optionally present, Need R, if this <i>FrequencyInfoUL</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL</i> ), or if this <i>FrequencyInfoUL</i> is for an unpaired UL (TDD) in certain bands (as defined in clause 5.4.2.1 of TS 38.101-1 and in clause 5.4.2.1 of TS 38.104 [12]), or if this <i>FrequencyInfoUL</i> is for a supplementary uplink (SUL). It is absent otherwise. |

– **FrequencyInfoUL-SIB**

The IE *FrequencyInfoUL-SIB* provides basic parameters of an uplink carrier and transmission thereon.

**FrequencyInfoUL-SIB information element**

```

-- ASN1START
-- TAG-FREQUENCYINFOUL-SIB-START

```

```

FrequencyInfoUL-SIB ::= SEQUENCE {

```

```

frequencyBandList          MultiFrequencyBandListNR-SIB          OPTIONAL,  -- Cond FDD-OrSUL
absoluteFrequencyPointA   ARFCN-ValueNR                               OPTIONAL,  -- Cond FDD-OrSUL
scs-SpecificCarrierList    SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier,
p-Max                      P-Max                                         OPTIONAL,  -- Need S
frequencyShift7p5khz      ENUMERATED {true}                            OPTIONAL,  -- Cond FDD-TDD-OrSUL-Optional
...
}
-- TAG-FREQUENCYINFOUL-SIB-STOP
-- ASN1STOP

```

| <i>FrequencyInfoUL-SIB</i> field descriptions  |
|--|
| <p><b><i>absoluteFrequencyPointA</i></b><br/>                     Absolute frequency of the reference resource block (Common RB 0). Its lowest subcarrier is also known as Point A. Note that the lower edge of the actual carrier is not defined by this field but rather in the <i>scs-SpecificCarrierList</i> (see TS 38.211 [16], clause 4.4.4.2).</p>                       |
| <p><b><i>frequencyBandList</i></b><br/>                     Provides the frequency band indicator and a list of <i>additionalPmax</i> and <i>additionalSpectrumEmission</i> values as defined in TS 38.101-1 [15], table 6.2.3.1-1, and TS 38.101-2 [39], table 6.2.3.1-2. The UE shall apply the first listed band which it supports in the <i>frequencyBandList</i> field.</p> |
| <p><b><i>frequencyShift7p5khz</i></b><br/>                     Enable the NR UL transmission with a 7.5 kHz shift to the LTE raster. If the field is absent, the frequency shift is disabled.</p>  |
| <p><b><i>p-Max</i></b><br/>                     Value in dBm applicable for the cell. If absent the UE applies the maximum power according to TS 38.101-1 [15].</p>  |
| <p><b><i>scs-SpecificCarrierList</i></b><br/>                     A set of carriers for different subcarrier spacings (numerologies). Defined in relation to Point A (see TS 38.211 [16], clause 5.3). The network configures this for all SCSs that are used in UL BWPs configured in this serving cell.</p>  |

| Conditional Presence          | Explanation  |
|-------------------------------|--|
| <i>FDD-OrSUL</i>              | The field is mandatory present if this <i>FrequencyInfoUL-SIB</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL-SIB</i> ) or if this <i>FrequencyInfoUL-SIB</i> is for a supplementary uplink (SUL). It is absent otherwise (if this <i>FrequencyInfoUL-SIB</i> is for an unpaired UL (TDD)).   |
| <i>FDD-TDD-OrSUL-Optional</i> | The field is optionally present, Need R, if this <i>FrequencyInfoUL-SIB</i> is for the paired UL for a DL (defined in a <i>FrequencyInfoDL-SIB</i> ), or if this <i>FrequencyInfoUL-SIB</i> is for an unpaired UL (TDD) in certain bands (as defined in clause 5.4.2.1 of TS 38.101-1 and in clause 5.4.2.1 of TS 38.104 [12]), or if this <i>FrequencyInfoUL-SIB</i> is for a supplementary uplink (SUL). It is absent otherwise. |

– ***Hysteresis***

The IE *Hysteresis* is a parameter used within the entry and leave condition of an event triggered reporting condition. The actual value is field value \* 0.5 dB.

***Hysteresis* information element**

```

-- ASN1START
-- TAG-HYSTERESIS-START

```

```

Hysteresis ::=
                INTEGER (0..30)

```

```
-- TAG-HYSTERESIS-STOP
-- ASN1STOP
```

### – *I-RNTI-Value*

The IE *I-RNTI-Value* is used to identify the suspended UE context of a UE in RRC\_INACTIVE.

#### ***I-RNTI-Value* information element**

```
-- ASN1START
-- TAG-I-RNTI-VALUE-START

I-RNTI-Value ::=                BIT STRING (SIZE(40))

-- TAG-I-RNTI-VALUE-STOP
-- ASN1STOP
```

### – *LocationMeasurementInfo*

The IE *LocationMeasurementInfo* defines the information sent by the UE to the network to assist with the configuration of measurement gaps for location related measurements.

#### ***LocationMeasurementInfo* information element**

```
-- ASN1START
-- TAG-LOCATIONMEASUREMENTINFO-START

LocationMeasurementInfo ::=    CHOICE {
    eutra-RSTD                  EUTRA-RSTD-InfoList,
    ...
    eutra-FineTimingDetection    NULL
}

EUTRA-RSTD-InfoList ::= SEQUENCE (SIZE (1..maxInterRAT-RSTD-Freq)) OF EUTRA-RSTD-Info

EUTRA-RSTD-Info ::= SEQUENCE {
    carrierFreq                ARFCN-ValueEUTRA,
    measPRS-Offset             INTEGER (0..39),
    ...
}

-- TAG-LOCATIONMEASUREMENTINFO-STOP
-- ASN1STOP
```

**LocationMeasurementInfo field descriptions****carrierFreq**

The EARFCN value of the carrier received from upper layers for which the UE needs to perform the inter-RAT RSTD measurements.

**measPRS-Offset**

Indicates the requested gap offset for performing RSTD measurements towards E-UTRA. It is the smallest subframe offset from the beginning of subframe 0 of SFN=0 of the serving cell of the requested gap for measuring PRS positioning occasions in the carrier frequency *carrierFreq* for which the UE needs to perform the inter-RAT RSTD measurements. The PRS positioning occasion information is received from upper layers. The value of *measPRS-Offset* is obtained by mapping the starting subframe of the PRS positioning occasion in the measured cell onto the corresponding subframe in the serving cell and is calculated as the serving cell's number of subframes from SFN=0 mod 40.

The UE shall take into account any additional time required by the UE to start PRS measurements on the other carrier when it does this mapping for determining the *measPRS-Offset*.

NOTE: Figure 6.2.2-1 in TS 36.331[10] illustrates the *measPRS-Offset* field.

## – LogicalChannelConfig

The IE *LogicalChannelConfig* is used to configure the logical channel parameters.

**LogicalChannelConfig information element**

```

-- ASN1START
-- TAG-LOGICALCHANNELCONFIG-START

LogicalChannelConfig ::=
    SEQUENCE {
        ul-SpecificParameters
            SEQUENCE {
                priority
                    INTEGER (1..16),
                prioritisedBitRate
                    ENUMERATED {kBps0, kBps8, kBps16, kBps32, kBps64, kBps128, kBps256, kBps512,
                    kBps1024, kBps2048, kBps4096, kBps8192, kBps16384, kBps32768, kBps65536, infinity},
                bucketSizeDuration
                    ENUMERATED {ms5, ms10, ms20, ms50, ms100, ms150, ms300, ms500, ms1000,
                    spare7, spare6, spare5, spare4, spare3, spare2, spare1},
                allowedServingCells
                    SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF ServCellIndex
                    OPTIONAL, -- PDCP-CADuplication
                allowedSCS-List
                    SEQUENCE (SIZE (1..maxSCSs)) OF SubcarrierSpacing
                    OPTIONAL, -- Need R
                maxPUSCH-Duration
                    ENUMERATED {ms0p02, ms0p04, ms0p0625, ms0p125, ms0p25, ms0p5, spare2, spare1}
                    OPTIONAL, -- Need R
                configuredGrantType1Allowed
                    ENUMERATED {true}
                    OPTIONAL, -- Need R
                logicalChannelGroup
                    INTEGER (0..maxLCG-ID)
                    OPTIONAL, -- Need R
                schedulingRequestID
                    SchedulingRequestID
                    OPTIONAL, -- Need R
                logicalChannelSR-Mask
                    BOOLEAN,
                logicalChannelSR-DelayTimerApplied
                    BOOLEAN,
                ...
                bitrateQueryProhibitTimer
                    ENUMERATED {s0, s0dot4, s0dot8, s1dot6, s3, s6, s12,s30}
                    OPTIONAL -- Need R
            }
            OPTIONAL, -- Cond UL
        ...
    }

-- TAG-LOGICALCHANNELCONFIG-STOP
-- ASN1STOP

```

| <b>LogicalChannelConfig field descriptions</b> |  |
|--|--|
| <b>allowedSCS-List</b>                         | If present, UL MAC SDUs from this logical channel can only be mapped to the indicated numerology. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured numerology. Only the values 15/30/60 kHz (for FR1) and 60/120 kHz (for FR2) are applicable. Corresponds to 'allowedSCS-List' as specified in TS 38.321 [3].                               |
| <b>allowedServingCells</b>                     | If present, UL MAC SDUs from this logical channel can only be mapped to the serving cells indicated in this list. Otherwise, UL MAC SDUs from this logical channel can be mapped to any configured serving cell of this cell group. Corresponds to 'allowedServingCells' in TS 38.321 [3].   |
| <b>bitRateQueryProhibitTimer</b>               | The timer is used for bit rate recommendation query in TS 38.321 [3], in seconds. Value <i>s0</i> means 0 s, <i>s0dot4</i> means 0.4 s and so on.  |
| <b>bucketSizeDuration</b>                      | Value in ms. <i>ms5</i> corresponds to 5 ms, value <i>ms10</i> corresponds to 10 ms, and so on.  |
| <b>configuredGrantType1Allowed</b>             | If present, UL MAC SDUs from this logical channel can be transmitted on a configured grant type 1. Corresponds to 'configuredGrantType1Allowed' in TS 38.321 [3].  |
| <b>logicalChannelGroup</b>                     | ID of the logical channel group, as specified in TS 38.321 [3], which the logical channel belongs to.  |
| <b>logicalChannelSR-Mask</b>                   | Controls SR triggering when a configured uplink grant of <i>type1</i> or <i>type2</i> is configured. <i>true</i> indicates that SR masking is configured for this logical channel as specified in TS 38.321 [3].   |
| <b>logicalChannelSR-DelayTimerApplied</b>      | Indicates whether to apply the delay timer for SR transmission for this logical channel. Set to <i>false</i> if <i>logicalChannelSR-DelayTimer</i> is not included in <i>BSR-Config</i> .  |
| <b>maxPUSCH-Duration</b>                       | If present, UL MAC SDUs from this logical channel can only be transmitted using uplink grants that result in a PUSCH duration shorter than or equal to the duration indicated by this field. Otherwise, UL MAC SDUs from this logical channel can be transmitted using an uplink grant resulting in any PUSCH duration. Corresponds to "maxPUSCH-Duration" in TS 38.321 [3]. |
| <b>priority</b>                                | Logical channel priority, as specified in TS 38.321 [3].   |
| <b>prioritisedBitRate</b>                      | Value in kiloBytes/s. Value <i>kBps0</i> corresponds to 0 kiloBytes/s, value <i>kBps8</i> corresponds to 8 kiloBytes/s, value <i>kBps16</i> corresponds to 16 kiloBytes/s, and so on. For SRBs, the value can only be set to <i>infinity</i> .   |
| <b>schedulingRequestId</b>                     | If present, it indicates the scheduling request configuration applicable for this logical channel, as specified in TS 38.321 [3].  |

| Conditional Presence      | Explanation  |
|---------------------------|--|
| <i>PDCP-CADuplication</i> | The field is mandatory present if the DRB/SRB associated with this logical channel is configured with PDCP CA duplication in UL (i.e. the PDCP entity is associated with multiple RLC entities belonging to the same cell group). Otherwise the field is optionally present, need R. |
| <i>UL</i>                 | The field is mandatory present for a logical channel with uplink if it serves DRB. It is optionally present, Need R, for a logical channel with uplink if it serves an SRB. Otherwise it is absent.  |

– **LogicalChannelIdentity**

The IE *LogicalChannelIdentity* is used to identify one logical channel (*LogicalChannelConfig*) and the corresponding RLC bearer (*RLC-BearerConfig*).

**LogicalChannelIdentity** information element

```

-- ASN1START
-- TAG-LOGICALCHANNELIDENTITY-START

LogicalChannelIdentity ::=          INTEGER (1..maxLC-ID)

-- TAG-LOGICALCHANNELIDENTITY-STOP
-- ASN1STOP

```

— **MAC-CellGroupConfig**

The IE *MAC-CellGroupConfig* is used to configure MAC parameters for a cell group, including DRX.

**MAC-CellGroupConfig** information element

```

-- ASN1START
-- TAG-MAC-CELLGROUPCONFIG-START

MAC-CellGroupConfig ::=          SEQUENCE {
  drx-Config                      SetupRelease { DRX-Config }          OPTIONAL,  -- Need M
  schedulingRequestConfig         SchedulingRequestConfig        OPTIONAL,  -- Need M
  bsr-Config                      BSR-Config                       OPTIONAL,  -- Need M
  tag-Config                      TAG-Config                       OPTIONAL,  -- Need M
  phr-Config                      SetupRelease { PHR-Config }      OPTIONAL,  -- Need M
  skipUplinkTxDynamic            BOOLEAN,
  . . .
  [[
  csi-Mask                        BOOLEAN                          OPTIONAL,  -- Need M
  dataInactivityTimer            SetupRelease { DataInactivityTimer }  OPTIONAL  -- Cond MCG-Only
  ]]
}

DataInactivityTimer ::=          ENUMERATED {s1, s2, s3, s5, s7, s10, s15, s20, s40, s50, s60, s80, s100, s120, s150, s180}

-- TAG-MAC-CELLGROUPCONFIG-STOP
-- ASN1STOP

```

| <b>MAC-CellGroupConfig field descriptions</b>   |
|---|
| <b>csi-Mask</b><br>If set to true, the UE limits CSI reports to the on-duration period of the DRX cycle, see TS 38.321 [3].   |
| <b>dataInactivityTimer</b><br>Releases the RRC connection upon data inactivity as specified in clause 5.3.8.5 and in TS 38.321 [3]. Value s1 corresponds to 1 second, value s2 corresponds to 2 seconds, and so on. |
| <b>drx-Config</b><br>Used to configure DRX as specified in TS 38.321 [3].   |
| <b>skipUplinkTxDynamic</b><br>If set to true, the UE skips UL transmissions as described in TS 38.321 [3].  |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>MCG-Only</i>             | This field is optionally present, Need M, for the <i>MAC-CellGroupConfig</i> of the MCG. It is absent otherwise. |

## – *MeasConfig*

The IE *MeasConfig* specifies measurements to be performed by the UE, and covers intra-frequency, inter-frequency and inter-RAT mobility as well as configuration of measurement gaps.

### ***MeasConfig* information element**

```

-- ASN1START
-- TAG-MEASCONFIG-START

MeasConfig ::=
    SEQUENCE {
        measObjectToRemoveList      MeasObjectToRemoveList      OPTIONAL,  -- Need N
        measObjectToAddModList      MeasObjectToAddModList    OPTIONAL,  -- Need N
        reportConfigToRemoveList    ReportConfigToRemoveList  OPTIONAL,  -- Need N
        reportConfigToAddModList    ReportConfigToAddModList  OPTIONAL,  -- Need N
        measIdToRemoveList          MeasIdToRemoveList        OPTIONAL,  -- Need N
        measIdToAddModList          MeasIdToAddModList          OPTIONAL,  -- Need N
        s-MeasureConfig             CHOICE {
            ssb-RSRP                RSRP-Range,
            csi-RSRP                RSRP-Range
        }                                OPTIONAL,  -- Need M
        quantityConfig              QuantityConfig                OPTIONAL,  -- Need M
        measGapConfig               MeasGapConfig                 OPTIONAL,  -- Need M
        measGapSharingConfig        MeasGapSharingConfig        OPTIONAL,  -- Need M
        ...
    }

MeasObjectToRemoveList ::=
    SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectId

MeasIdToRemoveList ::=
    SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasId

ReportConfigToRemoveList ::=
    SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigId

```

```
-- TAG-MEASCONFIG-STOP
-- ASN1STOP
```

| <i>MeasConfig</i> field descriptions  |
|---|
| <b><i>measGapConfig</i></b><br>Used to setup and release measurement gaps in NR.  |
| <b><i>measIdToAddModList</i></b><br>List of measurement identities to add and/or modify.  |
| <b><i>measIdToRemoveList</i></b><br>List of measurement identities to remove.   |
| <b><i>measObjectToAddModList</i></b><br>List of measurement objects to add and/or modify.   |
| <b><i>measObjectToRemoveList</i></b><br>List of measurement objects to remove.  |
| <b><i>reportConfigToAddModList</i></b><br>List of measurement reporting configurations to add and/or modify.  |
| <b><i>reportConfigToRemoveList</i></b><br>List of measurement reporting configurations to remove.   |
| <b><i>s-MeasureConfig</i></b><br>Threshold for NR SpCell RSRP measurement controlling when the UE is required to perform measurements on non-serving cells. Choice of <i>ssb-RSRP</i> corresponds to cell RSRP based on SS/PBCH block and choice of <i>csi-RSRP</i> corresponds to cell RSRP of CSI-RS. |
| <b><i>measGapSharingConfig</i></b><br>Specifies the measurement gap sharing scheme and controls setup/ release of measurement gap sharing.  |

## – *MeasGapConfig*

The IE *MeasGapConfig* specifies the measurement gap configuration and controls setup/release of measurement gaps.

### *MeasGapConfig* information element

```
-- ASN1START
-- TAG-MEASGAPCONFIG-START

MeasGapConfig ::=
    SEQUENCE {
        gapFR2          SetupRelease { GapConfig }          OPTIONAL,  -- Need M
        ...
        [[
            gapFR1      SetupRelease { GapConfig }          OPTIONAL,  -- Need M
            gapUE        SetupRelease { GapConfig }          OPTIONAL,  -- Need M
        ]]
    }

GapConfig ::=
    SEQUENCE {
        gapOffset      INTEGER (0..159),
        mgl            ENUMERATED {ms1dot5, ms3, ms3dot5, ms4, ms5dot5, ms6},
```



```

    mgrp          ENUMERATED {ms20, ms40, ms80, ms160},
    mgta          ENUMERATED {ms0, ms0dot25, ms0dot5},
    ...
    [[
    refServCellIndicator          ENUMERATED {pCell, pSCell, mcg-FR2}          OPTIONAL    -- Cond NEDCorNRDC
    ]]
}

-- TAG-MEASGAPCONFIG-STOP
-- ASN1STOP

```

| <b>MeasGapConfig field descriptions</b> |  |
|---|--|
| <b>gapFR1</b>                           | Indicates measurement gap configuration that applies to FR1 only. In (NG)EN-DC, <i>gapFR1</i> cannot be set up by NR RRC (i.e. only LTE RRC can configure FR1 measurement gap). In NE-DC, <i>gapFR1</i> can only be set up by NR RRC (i.e. LTE RRC cannot configure FR1 gap). In NR-DC, <i>gapFR1</i> can only be set up in the <i>measConfig</i> associated with MCG. <i>gapFR1</i> can not be configured together with <i>gapUE</i> . The applicability of the FR1 measurement gap is according to Table 9.1.2-2 and Table 9.1.2-3 in TS 38.133 [14].  |
| <b>gapFR2</b>                           | Indicates measurement gap configuration applies to FR2 only. In (NG)EN-DC or NE-DC, <i>gapFR2</i> can only be set up by NR RRC (i.e. LTE RRC cannot configure FR2 gap). In NR-DC, <i>gapFR2</i> can only be set up in the <i>measConfig</i> associated with MCG. <i>gapFR2</i> cannot be configured together with <i>gapUE</i> . The applicability of the FR2 measurement gap is according to Table 9.1.2-2 and Table 9.1.2-3 in TS 38.133 [14].   |
| <b>gapUE</b>                            | Indicates measurement gap configuration that applies to all frequencies (FR1 and FR2). In (NG)EN-DC, <i>gapUE</i> cannot be set up by NR RRC (i.e. only LTE RRC can configure per UE measurement gap). In NE-DC, <i>gapUE</i> can only be set up by NR RRC (i.e. LTE RRC cannot configure per UE gap). In NR-DC, <i>gapUE</i> can only be set up in the <i>measConfig</i> associated with MCG. If <i>gapUE</i> is configured, then neither <i>gapFR1</i> nor <i>gapFR2</i> can be configured. The applicability of the per UE measurement gap is according to Table 9.1.2-2 and Table 9.1.2-3 in TS 38.133 [14]. |
| <b>gapOffset</b>                        | Value <i>gapOffset</i> is the gap offset of the gap pattern with MGRP indicated in the field <i>mgrp</i> . The value range is from 0 to <i>mgrp</i> -1.  |
| <b>mgl</b>                              | Value <i>mgl</i> is the measurement gap length in ms of the measurement gap. The measurement gap length is according to in Table 9.1.2-1 in TS 38.133 [14]. Value <i>ms1dot5</i> corresponds to 1.5 ms, <i>ms3</i> corresponds to 3 ms and so on.  |
| <b>mgrp</b>                             | Value <i>mgrp</i> is measurement gap repetition period in (ms) of the measurement gap. The measurement gap repetition period is according to Table 9.1.2-1 in TS 38.133 [14].  |
| <b>mgta</b>                             | Value <i>mgta</i> is the measurement gap timing advance in ms. The applicability of the measurement gap timing advance is according to clause 9.1.2 of TS 38.133 [14]. Value <i>ms0</i> corresponds to 0 ms, <i>ms0dot25</i> corresponds to 0.25 ms and <i>ms0dot5</i> corresponds to 0.5 ms. For FR2, the network only configures 0 ms and 0.25 ms.   |
| <b>refServCellIndicator</b>             | Indicates the serving cell whose SFN and subframe are used for gap calculation for this gap pattern. Value pCell corresponds to the PCell, pSCell corresponds to the PSCell, and mcg-FR2 corresponds to a serving cell on FR2 frequency in MCG.  |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>NEDCorNRDC</i>           | This field is mandatory present when configuring gap pattern to UE in NE-DC or NR-DC. In case the gap pattern to UE in NE-DC and NR-DC is already configured, then the field is absent, need M. Otherwise, it is absent. |

## – *MeasGapSharingConfig*

The IE *MeasGapSharingConfig* specifies the measurement gap sharing scheme and controls setup/ release of measurement gap sharing.

### ***MeasGapSharingConfig* information element**

```
-- ASN1START
-- TAG-MEASGAPSHARINGCONFIG-START

MeasGapSharingConfig ::=          SEQUENCE {
    gapSharingFR2                SetupRelease { MeasGapSharingScheme }      OPTIONAL,  -- Need M
    . . . ,
    [ [
        gapSharingFR1            SetupRelease { MeasGapSharingScheme }      OPTIONAL,  --Need M
        gapSharingUE              SetupRelease { MeasGapSharingScheme }      OPTIONAL,  --Need M
    ] ]
}

MeasGapSharingScheme ::=          ENUMERATED {scheme00, scheme01, scheme10, scheme11}

-- TAG-MEASGAPSHARINGCONFIG-STOP
-- ASN1STOP
```

#### ***MeasGapSharingConfig* field descriptions**

##### ***gapSharingFR1***

Indicates the measurement gap sharing scheme that applies to the gap set for FR1 only. In (NG)EN-DC, *gapSharingFR1* cannot be set up by NR RRC (i.e. only LTE RRC can configure FR1 gap sharing). In NE-DC, *gapSharingFR1* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR1 gap sharing). In NR-DC, *gapSharingFR1* can only be set up in the *measConfig* associated with MCG. *gapSharingFR1* can not be configured together with *gapSharingUE*. For the applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

##### ***gapSharingFR2***

Indicates the measurement gap sharing scheme that applies to the gap set for FR2 only. In (NG)EN-DC or NE-DC, *gapSharingFR2* can only be set up by NR RRC (i.e. LTE RRC cannot configure FR2 gap sharing). In NR-DC, *gapSharingFR2* can only be set up by MCG in the *measConfig* associated with MCG. *gapSharingFR2* cannot be configured together with *gapSharingUE*. For applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

##### ***gapSharingUE***

Indicates the measurement gap sharing scheme that applies to the gap set per UE. In (NG)EN-DC, *gapSharingUE* cannot be set up by NR RRC (i.e. only LTE RRC can configure per UE gap sharing). In NE-DC, *gapSharingUE* can only be set up by NR RRC (i.e. LTE RRC cannot configure per UE gap sharing). In NR-DC, *gapSharingUE* can only be set up in the *measConfig* associated with MCG. If *gapSharingUE* is configured, then neither *gapSharingFR1* nor *gapSharingFR2* can be configured. For the applicability of the different gap sharing schemes, see TS 38.133 [14]. Value *scheme00* corresponds to scheme "00", value *scheme01* corresponds to scheme "01", and so on.

## – *MeasId*

The IE *MeasId* is used to identify a measurement configuration, i.e., linking of a measurement object and a reporting configuration.

**MeasId** information element

```

-- ASN1START
-- TAG-MEASID-START

MeasId ::=
    INTEGER (1..maxNrofMeasId)

-- TAG-MEASID-STOP
-- ASN1STOP

```

— **MeasIdToAddModList**

The IE *MeasIdToAddModList* concerns a list of measurement identities to add or modify, with for each entry the *measId*, the associated *measObjectId* and the associated *reportConfigId*.

**MeasIdToAddModList** information element

```

-- ASN1START
-- TAG-MEASIDTOADDMODLIST-START

MeasIdToAddModList ::=
    SEQUENCE (SIZE (1..maxNrofMeasId)) OF MeasIdToAddMod

MeasIdToAddMod ::=
    SEQUENCE {
        measId
            MeasId,
        measObjectId
            MeasObjectId,
        reportConfigId
            ReportConfigId
    }

-- TAG-MEASIDTOADDMODLIST-STOP
-- ASN1STOP

```

— **MeasObjectEUTRA**

The IE *MeasObjectEUTRA* specifies information applicable for E-UTRA cells.

**MeasObjectEUTRA** information element

```

-- ASN1START
-- TAG-MEASOBJECTEUTRA-START

MeasObjectEUTRA ::=
    SEQUENCE {
        carrierFreq
            ARFCN-ValueEUTRA,
        allowedMeasBandwidth
            EUTRA-AllowedMeasBandwidth,
        cellsToRemoveListEUTRAN
            EUTRA-CellIndexList
            OPTIONAL, -- Need N
        cellsToAddModListEUTRAN
            SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-Cell
            OPTIONAL, -- Need N
        blackCellsToRemoveListEUTRAN
            EUTRA-CellIndexList
            OPTIONAL, -- Need N
        blackCellsToAddModListEUTRAN
            SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-BlackCell
            OPTIONAL, -- Need N
    }

```

```

    eutra-PresenceAntennaPort1      EUTRA-PresenceAntennaPort1,
    eutra-Q-OffsetRange             EUTRA-Q-OffsetRange
    widebandRSRQ-Meas               BOOLEAN,
    ...
}
EUTRA-CellIndexList ::=           SEQUENCE (SIZE (1..maxCellMeasEUTRA)) OF EUTRA-CellIndex
EUTRA-CellIndex ::=              INTEGER (1..maxCellMeasEUTRA)

EUTRA-Cell ::=                   SEQUENCE {
    cellIndexEUTRA                 EUTRA-CellIndex,
    physCellId                     EUTRA-PhysCellId,
    cellIndividualOffset           EUTRA-Q-OffsetRange
}

EUTRA-BlackCell ::=             SEQUENCE {
    cellIndexEUTRA                 EUTRA-CellIndex,
    physCellIdRange                EUTRA-PhysCellIdRange
}

-- TAG-MEASOBJECTEUTRA-STOP
-- ASN1STOP

```

| <i>EUTRAN-BlackCell</i> field descriptions  |
|---|
| <b><i>cellIndexEUTRA</i></b><br>Entry index in the cell list.                                       |
| <b><i>physicalCellIdRange</i></b><br>Physical cell identity or a range of physical cell identities. |

| <i>EUTRAN-Cell</i> field descriptions   |
|---|
| <b><i>physicalCellId</i></b><br>Physical cell identity of a cell in the cell list.  |
| <b><i>cellIndividualOffset</i></b><br>Cell individual offset applicable to a specific cell. Value <i>dB-24</i> corresponds to -24 dB, <i>dB-22</i> corresponds to -22 dB and so on. |

| <b>MeasObjectEUTRA field descriptions</b>   |
|---|
| <b>allowedMeasBandwidth</b><br>The maximum allowed measurement bandwidth on a carrier frequency as defined by the parameter Transmission Bandwidth Configuration "N <sub>RB</sub> " TS 36.104 [33].   |
| <b>blackCellsToAddModListEUTRAN</b><br>List of cells to add/ modify in the black list of cells.   |
| <b>blackCellsToRemoveListEUTRAN</b><br>List of cells to remove from the black list of cells.  |
| <b>carrierFreq</b><br>Identifies E-UTRA carrier frequency for which this configuration is valid. E-UTRAN does not configure more than one measurement object for the same physical frequency regardless of the E-ARFCN used to indicate this.   |
| <b>cellsToAddModListEUTRAN</b><br>List of cells to add/ modify in the cell list.  |
| <b>cellsToRemoveListEUTRAN</b><br>List of cells to remove from the cell list.   |
| <b>eutra-PresenceAntennaPort1</b><br>When set to <i>true</i> , the UE may assume that at least two cell-specific antenna ports are used in all neighbouring cells.  |
| <b>eutra-Q-OffsetRange</b><br>Used to indicate a cell, or frequency specific offset to be applied when evaluating candidates when evaluating triggering conditions for measurement reporting. The value is in dB. Value <i>dB-24</i> corresponds to -24 dB, value <i>dB-22</i> corresponds to -22 dB and so on.   |
| <b>widebandRSRQ-Meas</b><br>If set to <i>true</i> , the UE shall, when performing RSRQ measurements, use a wider bandwidth in accordance with TS 36.133 [40]. The network may set the field to <i>true</i> if the measurement bandwidth indicated by <i>allowedMeasBandwidth</i> is 50 resource blocks or larger; otherwise the network sets this field to <i>false</i> . |

– **MeasObjectId**

The IE *MeasObjectId* used to identify a measurement object configuration.

**MeasObjectId information element**

```
-- ASN1START
-- TAG-MEASOBJECTID-START

MeasObjectId ::=                INTEGER (1..maxNrofObjectId)

-- TAG-MEASOBJECTID-STOP
-- ASN1STOP
```

– **MeasObjectNR**

The IE *MeasObjectNR* specifies information applicable for SS/PBCH block(s) intra/inter-frequency measurements and/or CSI-RS intra/inter-frequency measurements.

**MeasObjectNR information element**

```
-- ASN1START
```

```

-- TAG-MEASOBJECTNR-START

MeasObjectNR ::=
    ssbFrequency                ARFCN-ValueNR                OPTIONAL, -- Cond SSBorAssociatedSSB
    ssbSubcarrierSpacing        SubcarrierSpacing            OPTIONAL, -- Cond SSBorAssociatedSSB
    smtc1                        SSB-MTC                    OPTIONAL, -- Cond SSBorAssociatedSSB
    smtc2                        SSB-MTC2                   OPTIONAL, -- Cond IntraFreqConnected
    refFreqCSI-RS               ARFCN-ValueNR                OPTIONAL, -- Cond CSI-RS
    referenceSignalConfig       ReferenceSignalConfig,
    absThreshSS-BlocksConsolidation ThresholdNR                OPTIONAL, -- Need R
    absThreshCSI-RS-Consolidation ThresholdNR                OPTIONAL, -- Need R
    nrofSS-BlocksToAverage      INTEGER (2..maxNrofSS-BlocksToAverage)    OPTIONAL, -- Need R
    nrofCSI-RS-ResourcesToAverage INTEGER (2..maxNrofCSI-RS-ResourcesToAverage)    OPTIONAL, -- Need R
    quantityConfigIndex        INTEGER (1..maxNrofQuantityConfig),
    offsetMO                     Q-OffsetRangeList,
    cellsToRemoveList           PCI-List                    OPTIONAL, -- Need N
    cellsToAddModList           CellsToAddModList            OPTIONAL, -- Need N
    blackCellsToRemoveList      PCI-RangeIndexList           OPTIONAL, -- Need N
    blackCellsToAddModList      SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement    OPTIONAL, -- Need N
    whiteCellsToRemoveList      PCI-RangeIndexList           OPTIONAL, -- Need N
    whiteCellsToAddModList      SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeElement    OPTIONAL, -- Need N
    ... ,
    [[
    freqBandIndicatorNR-v1530    FreqBandIndicatorNR                OPTIONAL, -- Need R
    measCycleSCell-v1530        ENUMERATED {sf160, sf256, sf320, sf512, sf640, sf1024, sf1280}    OPTIONAL, -- Need R
    ]]
}

ReferenceSignalConfig ::=
    ssb-ConfigMobility          SSB-ConfigMobility                OPTIONAL, -- Need M
    csi-rs-ResourceConfigMobility SetupRelease { CSI-RS-ResourceConfigMobility }    OPTIONAL, -- Need M
}

SSB-ConfigMobility ::=
    ssb-ToMeasure               SetupRelease { SSB-ToMeasure }                OPTIONAL, -- Need M
    deriveSSB-IndexFromCell     BOOLEAN,
    ss-RSSI-Measurement         SS-RSSI-Measurement                OPTIONAL, -- Need M
    ...
}

Q-OffsetRangeList ::=
    rsrpOffsetSSB               Q-OffsetRange                    DEFAULT dB0,
    rsrqOffsetSSB               Q-OffsetRange                    DEFAULT dB0,
    sinrOffsetSSB               Q-OffsetRange                    DEFAULT dB0,
    rsrpOffsetCSI-RS            Q-OffsetRange                    DEFAULT dB0,
    rsrqOffsetCSI-RS            Q-OffsetRange                    DEFAULT dB0,
    sinrOffsetCSI-RS            Q-OffsetRange                    DEFAULT dB0
}

ThresholdNR ::=
    thresholdRSRP               RSRP-Range                        OPTIONAL, -- Need R

```

```

    thresholdRSRQ          RSRQ-Range          OPTIONAL, -- Need R
    thresholdSINR         SINR-Range          OPTIONAL  -- Need R
}

CellsToAddModList ::=
    SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CellsToAddMod

CellsToAddMod ::=
    SEQUENCE {
        physCellId          PhysCellId,
        cellIndividualOffset Q-OffsetRangeList
    }

-- TAG-MEASOBJECTNR-STOP
-- ASN1STOP

```

| <i>CellsToAddMod</i> field descriptions  |
|--|
| <b><i>cellIndividualOffset</i></b><br>Cell individual offsets applicable to a specific cell. |
| <b><i>physCellId</i></b><br>Physical cell identity of a cell in the cell list.               |

| <b><i>MeasObjectNR</i> field descriptions</b>   |
|---|
| <p><b><i>absThreshCSI-RS-Consolidation</i></b><br/>           Absolute threshold for the consolidation of measurement results per CSI-RS resource(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per CSI-RS resource as described in 5.5.5.2.</p>   |
| <p><b><i>absThreshSS-BlocksConsolidation</i></b><br/>           Absolute threshold for the consolidation of measurement results per SS/PBCH block(s) from L1 filter(s). The field is used for the derivation of cell measurement results as described in 5.5.3.3 and the reporting of beam measurement information per SS/PBCH block index as described in 5.5.5.2.</p>   |
| <p><b><i>blackCellsToAddModList</i></b><br/>           List of cells to add/modify in the black list of cells. It applies only to SSB resources.</p>  |
| <p><b><i>blackCellsToRemoveList</i></b><br/>           List of cells to remove from the black list of cells.</p>  |
| <p><b><i>cellsToAddModList</i></b><br/>           List of cells to add/modify in the cell list.</p>   |
| <p><b><i>cellsToRemoveList</i></b><br/>           List of cells to remove from the cell list.</p>   |
| <p><b><i>freqBandIndicatorNR</i></b><br/>           The frequency band in which the SSB and/or CSI-RS indicated in this <i>MeasObjectNR</i> are located and according to which the UE shall perform the RRM measurements. This field is always provided when the network configures measurements with this <i>MeasObjectNR</i>.</p>   |
| <p><b><i>measCycleSCell</i></b><br/>           The parameter is used only when an SCell is configured on the frequency indicated by the <i>measObjectNR</i> and is in deactivated state, see TS 38.133 [14]. gNB configures the parameter whenever an SCell is configured on the frequency indicated by the <i>measObjectNR</i>, but the field may also be signalled when an SCell is not configured. Value <i>sf160</i> corresponds to 160 sub-frames, value <i>sf256</i> corresponds to 256 sub-frames and so on.</p>   |
| <p><b><i>nrofCSI-RS-ResourcesToAverage</i></b><br/>           Indicates the maximum number of measurement results per beam based on CSI-RS resources to be averaged. The same value applies for each detected cell associated with this <i>MeasObjectNR</i>.</p>  |
| <p><b><i>nrofSS-BlocksToAverage</i></b><br/>           Indicates the maximum number of measurement results per beam based on SS/PBCH blocks to be averaged. The same value applies for each detected cell associated with this <i>MeasObjectNR</i>.</p>   |
| <p><b><i>offsetMO</i></b><br/>           Offset values applicable to all measured cells with reference signal(s) indicated in this <i>MeasObjectNR</i>.</p>   |
| <p><b><i>quantityConfigIndex</i></b><br/>           Indicates the <i>n</i>-th element of <i>quantityConfigNR-List</i> provided in <i>MeasConfig</i>.</p>  |
| <p><b><i>referenceSignalConfig</i></b><br/>           RS configuration for SS/PBCH block and CSI-RS.</p>  |
| <p><b><i>refFreqCSI-RS</i></b><br/>           Point A which is used for mapping of CSI-RS to physical resources according to TS 38.211 [16] clause 7.4.1.5.3.</p>   |
| <p><b><i>smtc1</i></b><br/>           Primary measurement timing configuration. (see clause 5.5.2.10).</p>  |
| <p><b><i>smtc2</i></b><br/>           Secondary measurement timing configuration for SS corresponding to this <i>MeasObjectNR</i> with PCI listed in <i>pci-List</i>. For these SS, the periodicity is indicated by <i>periodicity</i> in <i>smtc2</i> and the timing offset is equal to the offset indicated in <i>periodicityAndOffset</i> modulo <i>periodicity</i>. <i>periodicity</i> in <i>smtc2</i> can only be set to a value strictly shorter than the periodicity indicated by <i>periodicityAndOffset</i> in <i>smtc1</i> (e.g. if <i>periodicityAndOffset</i> indicates <i>sf10</i>, <i>periodicity</i> can only be set of <i>sf5</i>, if <i>periodicityAndOffset</i> indicates <i>sf5</i>, <i>smtc2</i> cannot be configured).</p> |
| <p><b><i>ssbFrequency</i></b><br/>           Indicates the frequency of the SS associated to this <i>MeasObjectNR</i>.</p>  |



|  |
|--|
| <b>ssbSubcarrierSpacing</b><br>Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable. |
| <b>whiteCellsToAddModList</b><br>List of cells to add/modify in the white list of cells. It applies only to SSB resources.                     |
| <b>whiteCellsToRemoveList</b><br>List of cells to remove from the white list of cells.   |

| <b>ReferenceSignalConfig field descriptions</b>  |
|--|
| <b>csi-rs-ResourceConfigMobility</b><br>CSI-RS resources to be used for CSI-RS based RRM measurements. |
| <b>ssb-ConfigMobility</b><br>SSB configuration for mobility (nominal SSBs, timing configuration).      |

| <b>SSB-ConfigMobility field descriptions</b>  |
|---|
| <b>deriveSSB-IndexFromCell</b><br>If this field is set to <i>true</i> , UE assumes SFN and frame boundary alignment across cells on the same frequency carrier as specified in TS 38.133 [14]. Hence, if the UE is configured with a serving cell for which ( <i>absoluteFrequencySSB</i> , <i>subcarrierSpacing</i> ) in <i>ServingCellConfigCommon</i> is equal to ( <i>ssbFrequency</i> , <i>ssbSubcarrierSpacing</i> ) in this <i>MeasObjectNR</i> , this field indicates whether the UE can utilize the timing of this serving cell to derive the index of SS block transmitted by neighbour cell. Otherwise, this field indicates whether the UE may use the timing of any detected cell on that target frequency to derive the SSB index of all neighbour cells on that frequency. |
| <b>ssb-ToMeasure</b><br>The set of SS blocks to be measured within the SMTc measurement duration. The first/leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not to be measured while value 1 indicates that the corresponding SS/PBCH block is to be measured (see TS 38.215 [9]). When the field is not configured the UE measures on all SS blocks. Regardless of the value of this field, SS/PBCH blocks outside of the applicable <i>smtc</i> are not to be measured. See TS 38.215 [9] clause 5.1.1.  |

| Conditional Presence      | Explanation  |
|---------------------------|--|
| <i>CSI-RS</i>             | This field is mandatory present if <i>csi-rs-ResourceConfigMobility</i> is configured, otherwise, it is absent.  |
| <i>SSBorAssociatedSSB</i> | This field is mandatory present if <i>ssb-ConfigMobility</i> is configured or <i>associatedSSB</i> is configured in at least one cell. Otherwise, it is absent, Need R.  |
| <i>IntraFreqConnected</i> | This field is optionally present, Need R if the UE is configured with a serving cell for which ( <i>absoluteFrequencySSB</i> , <i>subcarrierSpacing</i> ) in <i>ServingCellConfigCommon</i> is equal to ( <i>ssbFrequency</i> , <i>ssbSubcarrierSpacing</i> ) in this <i>MeasObjectNR</i> , otherwise, it is absent. |

– **MeasObjectToAddModList**

The IE *MeasObjectToAddModList* concerns a list of measurement objects to add or modify.

**MeasObjectToAddModList information element**

```
-- ASN1START
-- TAG-MEASOBJECTTOADDMODLIST-START
```

```

MeasObjectToAddModList ::=
    SEQUENCE (SIZE (1..maxNrofObjectId)) OF MeasObjectToAddMod

MeasObjectToAddMod ::=
    SEQUENCE {
        measObjectId      MeasObjectId,
        measObject        CHOICE {
            measObjectNR   MeasObjectNR,
            ... ,
            measObjectEUTRA MeasObjectEUTRA
        }
    }

-- TAG-MEASOBJECTTOADDMODLIST-STOP
-- ASN1STOP

```

### – *MeasResultCellListSFTD-NR*

The IE *MeasResultCellListSFTD-NR* consists of SFN and radio frame boundary difference between the PCell and an NR cell as specified in TS 38.215 [9] and TS 38.133 [14].

#### ***MeasResultCellListSFTD-NR* information element**

```

-- ASN1START
-- TAG-MEASRESULTCELLLISTSFTD-NR-START

MeasResultCellListSFTD-NR ::=
    SEQUENCE (SIZE (1..maxCellSFTD)) OF MeasResultCellSFTD-NR

MeasResultCellSFTD-NR ::=
    SEQUENCE {
        physCellId      PhysCellId,
        sfn-OffsetResult INTEGER (0..1023),
        frameBoundaryOffsetResult INTEGER (-30720..30719),
        rsrp-Result      RSRP-Range OPTIONAL
    }

-- TAG-MEASRESULTCELLLISTSFTD-NR-STOP
-- ASN1STOP

```

#### ***MeasResultCellSFTD-NR* field descriptions**

##### ***sfn-OffsetResult***

Indicates the SFN difference between the PCell and the NR cell as an integer value according to TS 38.215 [9].

##### ***frameBoundaryOffsetResult***

Indicates the frame boundary difference between the PCell and the NR cell as an integer value according to TS 38.215 [9].

### – *MeasResultCellListSFTD-EUTRA*

The IE *MeasResultCellListSFTD-EUTRA* consists of SFN and radio frame boundary difference between the PCell and an E-UTRA PSCell.

**MeasResultCellListSFTD-EUTRA information element**

```

-- ASN1START
-- TAG-MEASRESULTCELLLISTSFTD-EUTRA-START

MeasResultCellListSFTD-EUTRA ::=
    SEQUENCE (SIZE (1..maxCellSFTD)) OF MeasResultSFTD-EUTRA

MeasResultSFTD-EUTRA ::=
    SEQUENCE {
        eutra-PhysCellId          EUTRA-PhysCellId,
        sfn-OffsetResult          INTEGER (0..1023),
        frameBoundaryOffsetResult INTEGER (-30720..30719),
        rsrp-Result               RSRP-Range
    }

-- TAG-MEASRESULTCELLLISTSFTD-EUTRA-STOP
-- ASN1STOP

```

**MeasResultSFTD-EUTRA field descriptions****eutra-PhysCellId**

Identifies the physical cell identity of the E-UTRA cell for which the reporting is being performed.

**sfn-OffsetResult**

Indicates the SFN difference between the PCell and the E-UTRA cell as an integer value according to TS 38.215 [9].

**frameBoundaryOffsetResult**

Indicates the frame boundary difference between the PCell and the E-UTRA cell as an integer value according to TS 38.215 [9].

– **MeasResults**

The IE *MeasResults* covers measured results for intra-frequency, inter-frequency, and inter-RAT mobility.

**MeasResults information element**

```

-- ASN1START
-- TAG-MEASRESULTS-START

MeasResults ::=
    SEQUENCE {
        measId                MeasId,
        measResultServingMOList MeasResultServingMOList,
        measResultNeighCells   CHOICE {
            measResultListNR,
            ...,
            measResultListEUTRA
        }
        ...,
        [
            measResultServFreqListEUTRA-SCG MeasResultServFreqListEUTRA-SCG OPTIONAL,
            measResultServFreqListNR-SCG    MeasResultServFreqListNR-SCG  OPTIONAL,
            measResultSFTD-EUTRA            MeasResultSFTD-EUTRA         OPTIONAL,
            measResultSFTD-NR               MeasResultCellSFTD-NR        OPTIONAL
        ]
    }

```

```

    ]]
  }
MeasResultServMOList ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResultServMO
MeasResultServMO ::= SEQUENCE {
  servCellId ServCellIndex,
  measResultServingCell MeasResultNR,
  measResultBestNeighCell MeasResultNR OPTIONAL,
  ...
}
MeasResultListNR ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultNR
MeasResultNR ::= SEQUENCE {
  physCellId PhysCellId OPTIONAL,
  measResult SEQUENCE {
    cellResults SEQUENCE{
      resultsSSB-Cell MeasQuantityResults OPTIONAL,
      resultsCSI-RS-Cell MeasQuantityResults OPTIONAL
    },
    rsIndexResults SEQUENCE{
      resultsSSB-Indexes ResultsPerSSB-IndexList OPTIONAL,
      resultsCSI-RS-Indexes ResultsPerCSI-RS-IndexList OPTIONAL
    }
  },
  ...,
  [[
  cgi-Info CGI-InfoNR OPTIONAL
  ]]
}
MeasResultListEUTRA ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultEUTRA
MeasResultEUTRA ::= SEQUENCE {
  eutra-PhysCellId PhysCellId,
  measResult MeasQuantityResultsEUTRA,
  cgi-Info CGI-InfoEUTRA OPTIONAL, ...
}
MultiBandInfoListEUTRA ::= SEQUENCE (SIZE (1..maxMultiBands)) OF FreqBandIndicatorEUTRA
MeasQuantityResults ::= SEQUENCE {
  rsrp RSRP-Range OPTIONAL,
  rsrq RSRQ-Range OPTIONAL,
  sinr SINR-Range OPTIONAL
}
MeasQuantityResultsEUTRA ::= SEQUENCE {
  rsrp RSRP-RangeEUTRA OPTIONAL,
  rsrq RSRQ-RangeEUTRA OPTIONAL,
}

```

```

    sinr                SINR-RangeEUTRA                OPTIONAL
}

ResultsPerSSB-IndexList ::= SEQUENCE (SIZE (1..maxNrofIndexesToReport2)) OF ResultsPerSSB-Index

ResultsPerSSB-Index ::= SEQUENCE {
    ssb-Index           SSB-Index,
    ssb-Results         MeasQuantityResults            OPTIONAL
}

ResultsPerCSI-RS-IndexList ::= SEQUENCE (SIZE (1..maxNrofIndexesToReport2)) OF ResultsPerCSI-RS-Index

ResultsPerCSI-RS-Index ::= SEQUENCE {
    csi-RS-Index       CSI-RS-Index,
    csi-RS-Results     MeasQuantityResults            OPTIONAL
}

MeasResultServFreqListEUTRA-SCG ::= SEQUENCE (SIZE (1..maxNrofServingCellsEUTRA)) OF MeasResult2EUTRA

MeasResultServFreqListNR-SCG ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF MeasResult2NR

-- TAG-MEASRESULTS-STOP
-- ASN1STOP

```

| <b>MeasResultEUTRA field descriptions</b>  |
|--|
| <p><b>eutra-PhysCellId</b><br/>Identifies the physical cell identity of the E-UTRA cell for which the reporting is being performed. The UE reports a value in the range 0..503, other values are reserved.</p> |

| <b>MeasResultNR field descriptions</b>   |
|--|
| <p><b>cellResults</b><br/>Cell level measurement results.</p>  |
| <p><b>physCellId</b><br/>The physical cell identity of the NR cell for which the reporting is being performed.</p> |
| <p><b>resultsSSB-Cell</b><br/>Cell level measurement results based on SS/PBCH related measurements.</p>            |
| <p><b>resultsSSB-Indexes</b><br/>Beam level measurement results based on SS/PBCH related measurements.</p>         |
| <p><b>resultsCSI-RS-Cell</b><br/>Cell level measurement results based on CSI-RS related measurements.</p>          |
| <p><b>resultsCSI-RS-Indexes</b><br/>Beam level measurement results based on CSI-RS related measurements.</p>       |
| <p><b>rsIndexResults</b><br/>Beam level measurement results.</p>   |

| <i>MeasResults</i> field descriptions   |
|---|
| <b><i>measId</i></b><br>Identifies the measurement identity for which the reporting is being performed.   |
| <b><i>measResultEUTRA</i></b><br>Measured results of an E-UTRA cell.  |
| <b><i>measResultListEUTRA</i></b><br>List of measured results for the maximum number of reported best cells for an E-UTRA measurement identity.   |
| <b><i>measResultListNR</i></b><br>List of measured results for the maximum number of reported best cells for an NR measurement identity.  |
| <b><i>measResultNR</i></b><br>Measured results of an NR cell.   |
| <b><i>measResultServFreqListEUTRA-SCG</i></b><br>Measured results of the E-UTRA SCG serving frequencies: the measurement result of PSCell and each SCell, if any, and of the best neighbouring cell on each E-UTRA SCG serving frequency.   |
| <b><i>measResultServFreqListNR-SCG</i></b><br>Measured results of the NR SCG serving frequencies: the measurement result of PSCell and each SCell, if any, and of the best neighbouring cell on each NR SCG serving frequency.  |
| <b><i>measResultServingMOList</i></b><br>Measured results of measured cells with reference signals indicated in the serving cell measurement objects including measurement results of SpCell, configured SCell(s) and best neighbouring cell within measured cells with reference signals indicated in on each serving cell measurement object. |
| <b><i>measResultSFTD-EUTRA</i></b><br>SFTD measurement results between the PCell and the E-UTRA PScell in NE-DC.  |
| <b><i>measResultSFTD-NR</i></b><br>SFTD measurement results between the PCell and the NR PScell in NR-DC.   |

– ***MeasResult2EUTRA***

The IE *MeasResult2EUTRA* contains measurements on E-UTRA frequencies.

***MeasResult2EUTRA* information element**

```

-- ASN1START
-- TAG-MEASRESULT2EUTRA-START

MeasResult2EUTRA ::= SEQUENCE {
    carrierFreq                ARFCN-ValueEUTRA,
    measResultServingCell     MeasResultEUTRA           OPTIONAL,
    measResultBestNeighCell   MeasResultEUTRA           OPTIONAL,
    ...
}

-- TAG-MEASRESULT2EUTRA-STOP
-- ASN1STOP

```

– *MeasResult2NR*

The IE *MeasResult2NR* contains measurements on NR frequencies.

***MeasResult2NR* information element**

```
-- ASN1START
-- TAG-MEASRESULT2NR-START

MeasResult2NR ::=
    ssbFrequency                SEQUENCE {
        ARFCN-ValueNR           OPTIONAL,
        refFreqCSI-RS           OPTIONAL,
        measResultServingCell    OPTIONAL,
        measResultNeighCellListNR  OPTIONAL,
        ...
    }

-- TAG-MEASRESULT2NR-STOP
-- ASN1STOP
```

– *MeasResultSCG-Failure*

The IE *MeasResultSCG-Failure* is used to provide information regarding failures detected by the UE in EN-DC.

***MeasResultSCG-Failure* information element**

```
-- ASN1START
-- TAG-MEASRESULTSCG-FAILURE-START

MeasResultSCG-Failure ::=
    measResultPerMOList         SEQUENCE {
        MeasResultList2NR,
        ...
    }

MeasResultList2NR ::=
    SEQUENCE (SIZE (1..maxFreq)) OF MeasResult2NR

-- TAG-MEASRESULTSCG-FAILURE-STOP
-- ASN1STOP
```

– *MobilityStateParameters*

The IE *MobilityStateParameters* contains parameters to determine UE mobility state.

***MobilityStateParameters* information element**

```
-- ASN1START
```

```

-- TAG-MOBILITYSTATEPARAMETERS-START
MobilityStateParameters ::= SEQUENCE {
    t-Evaluation      ENUMERATED {
                        s30, s60, s120, s180, s240, spare3, spare2, spare1},
    t-HystNormal      ENUMERATED {
                        s30, s60, s120, s180, s240, spare3, spare2, spare1},
    n-CellChangeMedium INTEGER (1..16),
    n-CellChangeHigh  INTEGER (1..16)
}
-- TAG-MOBILITYSTATEPARAMETERS-STOP
-- ASN1STOP

```

#### **MobilityStateParameters field descriptions**

##### ***n-CellChangeHigh***

The number of cell changes to enter high mobility state. Corresponds to  $N_{CR\_H}$  in TS 38.304 [20].

##### ***n-CellChangeMedium***

The number of cell changes to enter medium mobility state. Corresponds to  $N_{CR\_M}$  in TS 38.304 [20].

##### ***t-Evaluation***

The duration for evaluating criteria to enter mobility states. Corresponds to  $T_{CR\_max}$  in TS 38.304 [20]. Value in seconds, *s30* corresponds to 30 s and so on.

##### ***t-HystNormal***

The additional duration for evaluating criteria to enter normal mobility state. Corresponds to  $T_{CR\_maxHyst}$  in TS 38.304 [20]. Value in seconds, value *s30* corresponds to 30 seconds and so on.

## – ***MultiFrequencyBandListNR***

The IE *MultiFrequencyBandListNR* is used to configure a list of one or multiple NR frequency bands.

#### ***MultiFrequencyBandListNR* information element**

```

-- ASN1START
-- TAG-MULTIFREQUENCYBANDLISTNR-START
MultiFrequencyBandListNR ::= SEQUENCE (SIZE (1..maxNrofMultiBands)) OF FreqBandIndicatorNR
-- TAG-MULTIFREQUENCYBANDLISTNR-STOP
-- ASN1STOP

```

## – ***MultiFrequencyBandListNR-SIB***

The IE *MultiFrequencyBandListNR-SIB* indicates the list of frequency bands, for which cell (re-)selection parameters are common, and a list of *additionalPmax* and *additionalSpectrumEmission*.



**MultiFrequencyBandListNR-SIB information element**

```

-- ASN1START
-- TAG-MULTIFREQUENCYBANDLISTNR-SIB-START

MultiFrequencyBandListNR-SIB ::=
    SEQUENCE (SIZE (1.. maxNrofMultiBands)) OF NR-MultiBandInfo

NR-MultiBandInfo ::=
    SEQUENCE {
        freqBandIndicatorNR          FreqBandIndicatorNR          OPTIONAL,  -- Cond OptULNotSIB2
        nr-NS-PmaxList               NR-NS-PmaxList              OPTIONAL  -- Need S
    }

-- TAG-MULTIFREQUENCYBANDLISTNR-SIB-STOP
-- ASN1STOP

```

**NR-MultiBandInfo field descriptions****freqBandIndicatorNR**

Provides an NR frequency band number as defined in TS 38.101-1 [15] and TS 38.101-2 [39], table 5.2-1.

**nr-NS-PmaxList**

Provides a list of *additionalPmax* and *additionalSpectrumEmission* values. If the field is absent the UE uses value 0 for the *additionalSpectrumEmission* (see TS 38.101-1 [15] table 6.2.3.1-1A , and TS 38.101-2 [39], table 6.2.3.1-2).

| Conditional Presence | Explanation   |
|----------------------|---|
| <i>OptULNotSIB2</i>  | The field is absent for <i>SIB2</i> and is mandatory present in <i>SIB4</i> and <i>frequencyInfoDL-SIB</i> . Otherwise, if the field is absent in <i>frequencyInfoUL-SIB</i> in <i>UplinkConfigCommonSIB</i> , the UE will use the frequency band indicated in <i>frequencyInfoDL-SIB</i> in <i>DownlinkConfigCommonSIB</i> . |

– **NextHopChainingCount**

The IE *NextHopChainingCount* is used to update the  $K_{qNB}$  key and corresponds to parameter NCC: See TS 33.501 [11].

**NextHopChainingCount information element**

```

-- ASN1START
-- TAG-NEXTHOPCHAININGCOUNT-START

NextHopChainingCount ::=
    INTEGER (0..7)

-- TAG-NEXTHOPCHAININGCOUNT-STOP
-- ASN1STOP

```

– **NG-5G-S-TMSI**

The IE *NG-5G-S-TMSI* contains a 5G S-Temporary Mobile Subscription Identifier (5G-S-TMSI), a temporary UE identity provided by the 5GC which uniquely identifies the UE within the tracking area, see TS 23.003 [21].

**NG-5G-S-TMSI information element**

```

-- ASN1START
-- TAG-NG-5G-S-TMSI-START

NG-5G-S-TMSI ::=
    BIT STRING (SIZE (48))

-- TAG-NG-5G-S-TMSI-STOP
-- ASN1STOP

```

– **NR-NS-PmaxList**

The IE *NR-NS-PmaxList* is used to configure a list of *additionalPmax* and *additionalSpectrumEmission*, as defined in TS 38.101-1 [15], table 6.2.3.1-1A, and TS 38.101-2 [39], table 6.2.3.1-2, for a given frequency band.

**NR-NS-PmaxList information element**

```

-- ASN1START
-- TAG-NR-NS-PMAXLIST-START

NR-NS-PmaxList ::=
    SEQUENCE (SIZE (1..maxNR-NS-Pmax)) OF NR-NS-PmaxValue

NR-NS-PmaxValue ::=
    SEQUENCE {
        additionalPmax          P-Max          OPTIONAL, -- Need N
        additionalSpectrumEmission AdditionalSpectrumEmission
    }

-- TAG-NR-NS-PMAXLIST-STOP
-- ASN1STOP

```

– **NZP-CSI-RS-Resource**

The IE *NZP-CSI-RS-Resource* is used to configure Non-Zero-Power (NZP) CSI-RS transmitted in the cell where the IE is included, which the UE may be configured to measure on (see TS 38.214 [19], clause 5.2.2.3.1). A change of configuration between periodic, semi-persistent or aperiodic for an *NZP-CSI-RS-Resource* is not supported without a release and add.

**NZP-CSI-RS-Resource information element**

```

-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCE-START

NZP-CSI-RS-Resource ::=
    SEQUENCE {
        nzp-CSI-RS-ResourceId,
        resourceMapping,
        powerControlOffset,
        powerControlOffsetSS,
        scramblingID
        NZP-CSI-RS-ResourceId,
        CSI-RS-ResourceMapping,
        INTEGER (-8..15),
        ENUMERATED{db-3, db0, db3, db6}
        ScramblingId,
        OPTIONAL, -- Need R
    }

```

```

periodicityAndOffset          CSI-ResourcePeriodicityAndOffset    OPTIONAL,  -- Cond PeriodicOrSemiPersistent
qcl-InfoPeriodicCSI-RS       TCI-StateId                OPTIONAL,  -- Cond Periodic
...
}

-- TAG-NZP-CSI-RS-RESOURCE-STOP
-- ASN1STOP
    
```

| <b>NZP-CSI-RS-Resource field descriptions</b> |  |
|---|--|
| <b>periodicityAndOffset</b>                   | Periodicity and slot offset <i>s/1</i> corresponds to a periodicity of 1 slot, <i>s/2</i> to a periodicity of two slots, and so on. The corresponding offset is also given in number of slots (see TS 38.214 [19], clause 5.2.2.3.1). Network always configures the UE with a value for this field for periodic and semi-persistent NZP-CSI-RS-Resource (as indicated in <i>CSI-ResourceConfig</i> ).  |
| <b>powerControlOffset</b>                     | Power offset of PDSCH RE to NZP CSI-RS RE. Value in dB (see TS 38.214 [19], clauses 5.2.2.3.1 and 4.1).  |
| <b>powerControlOffsetSS</b>                   | Power offset of NZP CSI-RS RE to SSS RE. Value in dB (see TS 38.214 [19], clause 5.2.2.3.1).   |
| <b>qcl-InfoPeriodicCSI-RS</b>                 | For a target periodic CSI-RS, contains a reference to one <i>TCI-State</i> in <i>TCI-States</i> for providing the QCL source and QCL type. For periodic CSI-RS, the source can be SSB or another periodic-CSI-RS. Refers to the <i>TCI-State</i> which has this value for <i>tcI-StateId</i> and is defined in <i>tcI-StatesToAddModList</i> in the <i>PDSCH-Config</i> included in the <i>BWP-Downlink</i> corresponding to the serving cell and to the DL BWP to which the resource belongs to (see TS 38.214 [19], clause 5.2.2.3.1). |
| <b>resourceMapping</b>                        | OFDM symbol location(s) in a slot and subcarrier occupancy in a PRB of the CSI-RS resource.  |
| <b>scramblingID</b>                           | Scrambling ID (see TS 38.214 [19], clause 5.2.2.3.1).  |

| Conditional Presence            | Explanation  |
|---------------------------------|--|
| <i>Periodic</i>                 | The field is optionally present, Need M, for periodic <i>NZP-CSI-RS-Resources</i> (as indicated in <i>CSI-ResourceConfig</i> ). The field is absent otherwise.                     |
| <i>PeriodicOrSemiPersistent</i> | The field is optionally present, Need M, for periodic and semi-persistent <i>NZP-CSI-RS-Resources</i> (as indicated in <i>CSI-ResourceConfig</i> ). The field is absent otherwise. |

– **NZP-CSI-RS-ResourceId**

The IE *NZP-CSI-RS-ResourceId* is used to identify one NZP-CSI-RS-Resource.

**NZP-CSI-RS-ResourceId information element**

```

-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCEID-START

NZP-CSI-RS-ResourceId ::=
    INTEGER (0..maxNrofNZP-CSI-RS-Resources-1)

-- TAG-NZP-CSI-RS-RESOURCEID-STOP
-- ASN1STOP
    
```

– *NZP-CSI-RS-ResourceSet*

The IE *NZP-CSI-RS-ResourceSet* is a set of Non-Zero-Power (NZP) CSI-RS resources (their IDs) and set-specific parameters.

***NZP-CSI-RS-ResourceSet* information element**

```

-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESET-START
NZP-CSI-RS-ResourceSet ::= SEQUENCE {
    nzp-CSI-ResourceSetId      NZP-CSI-RS-ResourceSetId,
    nzp-CSI-RS-Resources      SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceId,
    repetition                 ENUMERATED { on, off } OPTIONAL, -- Need S
    aperiodicTriggeringOffset INTEGER(0..6) OPTIONAL, -- Need S
    trs-Info                   ENUMERATED {true} OPTIONAL, -- Need R
    ...
}
-- TAG-NZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP

```

***NZP-CSI-RS-ResourceSet* field descriptions**

***aperiodicTriggeringOffset***

Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the CSI-RS resource set is transmitted. The value 0 corresponds to 0 slots, value 1 corresponds to 1 slot, value 2 corresponds to 2 slots, value 3 corresponds to 3 slots, value 4 corresponds to 4 slots, value 5 corresponds to 16 slots, value 6 corresponds to 24 slots. When the field is absent the UE applies the value 0.

***nzp-CSI-RS-Resources***

NZP-CSI-RS-Resources associated with this NZP-CSI-RS resource set (see TS 38.214 [19], clause 5.2). For CSI, there are at most 8 NZP CSI RS resources per resource set.

***repetition***

Indicates whether repetition is on/off. If the field is set to *off* or if the field is absent, the UE may not assume that the NZP-CSI-RS resources within the resource set are transmitted with the same downlink spatial domain transmission filter and with same NrofPorts in every symbol (see TS 38.214 [19], clauses 5.2.2.3.1 and 5.1.6.1.2). Can only be configured for CSI-RS resource sets which are associated with *CSI-ReportConfig* with report of L1 RSRP or "no report".

***trs-Info***

Indicates that the antenna port for all NZP-CSI-RS resources in the CSI-RS resource set is same. If the field is absent or released the UE applies the value *false* (see TS 38.214 [19], clause 5.2.2.3.1).

– *NZP-CSI-RS-ResourceSetId*

The IE *NZP-CSI-RS-ResourceSetId* is used to identify one *NZP-CSI-RS-ResourceSet*.

***NZP-CSI-RS-ResourceSetId* information element**

```

-- ASN1START
-- TAG-NZP-CSI-RS-RESOURCESETID-START

```

```
NZP-CSI-RS-ResourceSetId ::=          INTEGER (0..maxNrofNZP-CSI-RS-ResourceSets-1)
```

```
-- TAG-NZP-CSI-RS-RESOURCESETID-STOP
-- ASN1STOP
```

### – *P-Max*

The IE *P-Max* is used to limit the UE's uplink transmission power on a carrier frequency, in TS 38.101-1 [15] and is used to calculate the parameter *Pcompensation* defined in TS 38.304 [20].

#### ***P-Max* information element**

```
-- ASN1START
-- TAG-P-MAX-START
```

```
P-Max ::=          INTEGER (-30..33)
```

```
-- TAG-P-MAX-STOP
-- ASN1STOP
```

### – *PCI-List*

The IE *PCI-List* concerns a list of physical cell identities, which may be used for different purposes.

#### ***PCI-List* information element**

```
-- ASN1START
-- TAG-PCI-LIST-START
```

```
PCI-List ::=          SEQUENCE (SIZE (1..maxNrofCellMeas)) OF PhysCellId
```

```
-- TAG-PCI-LIST-STOP
-- ASN1STOP
```

### – *PCI-Range*

The IE *PCI-Range* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *PCI-Range*, the Network may configure overlapping ranges of physical cell identities.

#### ***PCI-Range* information element**

```
-- ASN1START
```

```

-- TAG-PCI-RANGE-START

PCI-Range ::=
  start          SEQUENCE {
    range        PhysCellId,
                ENUMERATED {n4, n8, n12, n16, n24, n32, n48, n64, n84,
                             n96, n128, n168, n252, n504, n1008, spare1}
  }
-- TAG-PCI-RANGE-STOP
-- ASN1STOP
OPTIONAL -- Need S

```

#### **PCI-Range field descriptions**

**range**

Indicates the number of physical cell identities in the range (including *start*). Value *n4* corresponds with 4, value *n8* corresponds with 8 and so on. The UE shall apply value 1 in case the field is absent, in which case only the physical cell identity value indicated by *start* applies.

**start**

Indicates the lowest physical cell identity in the range.

### – *PCI-RangeElement*

The IE *PCI-RangeElement* is used to define a PCI-Range as part of a list (e.g. AddMod list).

#### **PCI-RangeElement information element**

```

-- ASN1START
-- TAG-PCI-RANGEELEMENT-START

PCI-RangeElement ::=
  pci-RangeIndex PCI-RangeIndex,
  pci-Range      PCI-Range
}
-- TAG-PCI-RANGEELEMENT-STOP
-- ASN1STOP

```

#### **PCI-RangeElement field descriptions**

**pci-Range**

Physical cell identity or a range of physical cell identities.

### – *PCI-RangeIndex*

The IE *PCI-RangeIndex* identifies a physical cell id range, which may be used for different purposes.

**PCI-RangeIndex information element**

```

-- ASN1START
-- TAG-PCI-RANGEINDEX-START

PCI-RangeIndex ::=
    INTEGER (1..maxNrofPCI-Ranges)

-- TAG-PCI-RANGEINDEX-STOP
-- ASN1STOP

```

– **PCI-RangeIndexList**

The IE *PCI-RangeIndexList* concerns a list of indexes of physical cell id ranges, which may be used for different purposes.

**PCI-RangeIndexList information element**

```

-- ASN1START
-- TAG-PCI-RANGEINDEXLIST-START

PCI-RangeIndexList ::=
    SEQUENCE (SIZE (1..maxNrofPCI-Ranges)) OF PCI-RangeIndex

-- TAG-PCI-RANGEINDEXLIST-STOP
-- ASN1STOP

```

– **PDCCH-Config**

The IE *PDCCH-Config* is used to configure UE specific PDCCH parameters such as control resource sets (CORESET), search spaces and additional parameters for acquiring the PDCCH. If this IE is used for the scheduled cell in case of cross carrier scheduling, the fields other than *searchSpacesToAddModList* and *searchSpaceToReleaseList* are absent.

**PDCCH-Config information element**

```

-- ASN1START
-- TAG-PDCCH-CONFIG-START

PDCCH-Config ::=
    SEQUENCE {
        controlResourceSetToAddModList
            SEQUENCE(SIZE (1..3)) OF ControlResourceSet
            OPTIONAL, -- Need N
        controlResourceSetToReleaseList
            SEQUENCE(SIZE (1..3)) OF ControlResourceSetId
            OPTIONAL, -- Need N
        searchSpacesToAddModList
            SEQUENCE(SIZE (1..10)) OF SearchSpace
            OPTIONAL, -- Need N
        searchSpacesToReleaseList
            SEQUENCE(SIZE (1..10)) OF SearchSpaceId
            OPTIONAL, -- Need N
        downlinkPreemption
            SetupRelease { DownlinkPreemption }
            OPTIONAL, -- Need M
        tpc-PUSCH
            SetupRelease { PUSCH-TPC-CommandConfig }
            OPTIONAL, -- Need M
        tpc-PUCCH
            SetupRelease { PUCCH-TPC-CommandConfig }
            OPTIONAL, -- Need M
        tpc-SRS
            SetupRelease { SRS-TPC-CommandConfig }
            OPTIONAL, -- Need M
        ...
    }

```

```
-- TAG-PDCCH-CONFIG-STOP
-- ASN1STOP
```

| <b>PDCCH-Config field descriptions</b>   |
|--|
| <p><b>controlResourceSetToAddModList</b><br/>List of UE specifically configured Control Resource Sets (CORESETs) to be used by the UE. The network configures at most 3 CORESETs per BWP per cell (including UE-specific and common CORESETs). In case network reconfigures control resource set with the same <i>ControlResourceSetId</i> as used for <i>commonControlResourceSet</i> configured via <i>PDCCH-ConfigCommon</i>, the configuration from <i>PDCCH-Config</i> always takes precedence and should not be updated by the UE based on <i>servingCellConfigCommon</i>.</p> |
| <p><b>downlinkPreemption</b><br/>Configuration of downlink preemption indications to be monitored in this cell (see TS 38.213 [13], clause 11.2).</p>  |
| <p><b>searchSpacesToAddModList</b><br/>List of UE specifically configured Search Spaces. The network configures at most 10 Search Spaces per BWP per cell (including UE-specific and common Search Spaces).</p>  |
| <p><b>tpc-PUCCH</b><br/>Enable and configure reception of group TPC commands for PUCCH.</p>  |
| <p><b>tpc-PUSCH</b><br/>Enable and configure reception of group TPC commands for PUSCH.</p>  |
| <p><b>tpc-SRS</b><br/>Enable and configure reception of group TPC commands for SRS.</p>  |

## – PDCCH-ConfigCommon

The IE *PDCCH-ConfigCommon* is used to configure cell specific PDCCH parameters provided in SIB as well as in dedicated signalling.

### PDCCH-ConfigCommon information element

```
-- ASN1START
-- TAG-PDCCH-CONFIGCOMMON-START
```

```
PDCCH-ConfigCommon ::=
SEQUENCE {
  controlResourceSetZero          ControlResourceSetZero          OPTIONAL,  -- Cond InitialBWP-Only
  commonControlResourceSet        ControlResourceSet              OPTIONAL,  -- Need R
  searchSpaceZero                 SearchSpaceZero                OPTIONAL,  -- Cond InitialBWP-Only
  commonSearchSpaceList           SEQUENCE (SIZE (1..4)) OF SearchSpace  OPTIONAL,  -- Need R
  searchSpaceSIB1                 SearchSpaceId                  OPTIONAL,  -- Need S
  searchSpaceOtherSystemInformation SearchSpaceId                  OPTIONAL,  -- Need S
  pagingSearchSpace               SearchSpaceId                  OPTIONAL,  -- Need S
  ra-SearchSpace                  SearchSpaceId                  OPTIONAL,  -- Need S
  ...
  [
    firstPDCCH-MonitoringOccasionOfPO CHOICE {
      sCS15KHzZoneT                   SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..139),
      sCS30KHzZoneT-SCS15KHzhalfT     SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..279),
      sCS60KHzZoneT-SCS30KHzhalfT-SCS15KHzquarterT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..559),
      sCS120KHzZoneT-SCS60KHzhalfT-SCS30KHzquarterT-SCS15KHzZoneEighthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..1119),
      sCS120KHzhalfT-SCS60KHzquarterT-SCS30KHzZoneEighthT-SCS15KHzZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..2239),
      sCS120KHzquarterT-SCS60KHzZoneEighthT-SCS30KHzZoneSixteenthT SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..4479),
```



```

        sCS120KHzZoneEighthT-SCS60KHzZoneSixteenthT
        sCS120KHzZoneSixteenthT
    }
    OtherBWP
    }
}

-- TAG-PDCCH-CONFIGCOMMON-STOP
-- ASN1STOP

```

```

SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..8959),
SEQUENCE (SIZE (1..maxPO-perPF)) OF INTEGER (0..17919)
OPTIONAL -- Cond

```

### **PDCCH-ConfigCommon field descriptions**

#### **commonControlResourceSet**

An additional common control resource set which may be configured and used for any common or UE-specific search space. If the network configures this field, it uses a *ControlResourceSetId* other than 0 for this *ControlResourceSet*. The network configures the *commonControlResourceSet* in *SIB1* so that it is contained in the bandwidth of *CORESET#0*.

#### **commonSearchSpaceList**

A list of additional common search spaces. If the network configures this field, it uses the *SearchSpaceIds* other than 0. If the field is included, it replaces any previous list, i.e. all the entries of the list are replaced and each of the *SearchSpace* entries is considered to be newly created and the conditions and Need codes for setup of the entry apply.

#### **controlResourceSetZero**

Parameters of the common *CORESET#0* which can be used in any common or UE-specific search spaces. The values are interpreted like the corresponding bits in *MIB pdccch-ConfigSIB1*. Even though this field is only configured in the initial BWP (BWP#0) *controlResourceSetZero* can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions defined in TS 38.213 [13], clause 10 are satisfied.

#### **firstPDCCH-MonitoringOccasionOfPO**

Indicates the first PDCCH monitoring occasion of each PO of the PF on this BWP, see TS 38.304 [20].

#### **pagingSearchSpace**

ID of the Search space for paging (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive paging in this BWP (see TS 38.213 [13], clause 10).

#### **ra-SearchSpace**

ID of the Search space for random access procedure (see TS 38.213 [13], clause 10.1). If the field is absent, the UE does not receive RAR in this BWP. This field is mandatory present in the DL BWP(s) if the conditions described in TS 38.321 [3], subclause 5.15 are met.

#### **searchSpaceOtherSystemInformation**

ID of the Search space for other system information, i.e., *SIB2* and beyond (see TS 38.213 [13], clause 10.1) If the field is absent, the UE does not receive other system information in this BWP.

#### **searchSpaceSIB1**

ID of the search space for *SIB1* message. In the initial DL BWP of the UE's PCell, the network sets this field to 0. If the field is absent, the UE does not receive *SIB1* in this BWP. (see TS 38.213 [13], clause 10)

#### **searchSpaceZero**

Parameters of the common *SearchSpace#0*. The values are interpreted like the corresponding bits in *MIB pdccch-ConfigSIB1*. Even though this field is only configured in the initial BWP (BWP#0), *searchSpaceZero* can be used in search spaces configured in other DL BWP(s) than the initial DL BWP if the conditions described in TS 38.213 [13], clause 10, are satisfied.

| Conditional Presence   | Explanation   |
|------------------------|---|
| <i>InitialBWP-Only</i> | If <i>SIB1</i> is broadcast the field is mandatory present in the <i>PDCCH-ConfigCommon</i> of the initial BWP (BWP#0) in <i>ServingCellConfigCommon</i> ; it is absent in other BWPs and when sent in system information. If <i>SIB1</i> is not broadcast and there is an SSB associated to the cell, the field is optionally present, Need M, in the <i>PDCCH-ConfigCommon</i> of the initial BWP (BWP#0) in <i>ServingCellConfigCommon</i> (still with the same setting for all UEs). In other cases, the field is absent. |
| <i>OtherBWP</i>        | This field is optionally present, Need R, if this BWP is not the initial DL BWP and <i>pagingSearchSpace</i> is configured in this BWP. Otherwise this field is absent.   |

## – *PDCCH-ConfigSIB1*

The IE *PDCCH-ConfigSIB1* is used to configure CORESET#0 and search space#0.

### ***PDCCH-ConfigSIB1* information element**

```
-- ASN1START
-- TAG-PDCCH-CONFIGSIB1-START

PDCCH-ConfigSIB1 ::=
    controlResourceSetZero      ControlResourceSetZero,
    searchSpaceZero             SearchSpaceZero
}

-- TAG-PDCCH-CONFIGSIB1-STOP
-- ASN1STOP
```

### ***PDCCH-ConfigSIB1* field descriptions**

|                                      |   |
|--------------------------------------|---|
| <b><i>controlResourceSetZero</i></b> | Determines a common ControlResourceSet (CORESET) with ID #0, see TS 38.213 [13], clause 13. |
| <b><i>searchSpaceZero</i></b>        | Determines a common search space with ID #0, see TS 38.213 [13], clause 13.                 |

## – *PDCCH-ServingCellConfig*

The IE *PDCCH-ServingCellConfig* is used to configure UE specific PDCCH parameters applicable across all bandwidth parts of a serving cell.

### ***PDCCH-ServingCellConfig* information element**

```
-- ASN1START
-- TAG-PDCCH-SERVINGCELLCONFIG-START

PDCCH-ServingCellConfig ::=
    slotFormatIndicator          SetupRelease { SlotFormatIndicator }          OPTIONAL, -- Need M
    ...
}

-- TAG-PDCCH-SERVINGCELLCONFIG-STOP
-- ASN1STOP
```

```
-- TAG-PDCCH-SERVINGCELLCONFIG-STOP
-- ASN1STOP
```

| <i>PDCCH-ServingCellConfig</i> field descriptions |
|---|
|---|

|                                   |
|-----------------------------------|
| <b><i>slotFormatIndicator</i></b> |
|-----------------------------------|

|  |
|--|
| Configuration of Slot-Format-Indicators to be monitored in the correspondingly configured PDCCHs of this serving cell. |
|--|

## – *PDCP-Config*

The IE *PDCP-Config* is used to set the configurable PDCP parameters for signalling and data radio bearers.

### *PDCP-Config* information element

```
-- ASN1START
-- TAG-PDCP-CONFIG-START
```

```
PDCP-Config ::= SEQUENCE {
  drb SEQUENCE {
    discardTimer ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200,
                             ms250, ms300, ms500, ms750, ms1500, infinity} OPTIONAL, -- Cond Setup
    pdcP-SN-SizeUL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2
    pdcP-SN-SizeDL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2
    headerCompression CHOICE {
      notUsed NULL,
      rohc SEQUENCE {
        maxCID INTEGER (1..16383) DEFAULT 15,
        profiles SEQUENCE {
          profile0x0001 BOOLEAN,
          profile0x0002 BOOLEAN,
          profile0x0003 BOOLEAN,
          profile0x0004 BOOLEAN,
          profile0x0006 BOOLEAN,
          profile0x0101 BOOLEAN,
          profile0x0102 BOOLEAN,
          profile0x0103 BOOLEAN,
          profile0x0104 BOOLEAN
        },
        drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N
      },
    },
    uplinkOnlyROHC SEQUENCE {
      maxCID INTEGER (1..16383) DEFAULT 15,
      profiles SEQUENCE {
        profile0x0006 BOOLEAN
      },
      drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N
    },
    ...
  },
}
```

```

    integrityProtection      ENUMERATED { enabled }
    statusReportRequired    ENUMERATED { true }
    outOfOrderDelivery      ENUMERATED { true }
}
moreThanOneRLC             SEQUENCE {
    primaryPath             SEQUENCE {
        cellGroup          CellGroupId
        logicalChannel      LogicalChannelIdentity
    },
    ul-DataSplitThreshold  UL-DataSplitThreshold
    pdcP-Duplication       BOOLEAN
}

t-Reordering               ENUMERATED {
    ms0, ms1, ms2, ms4, ms5, ms8, ms10, ms15, ms20, ms30, ms40,
    ms50, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,
    ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250,
    ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,
    ms3000, spare28, spare27, spare26, spare25, spare24,
    spare23, spare22, spare21, spare20,
    spare19, spare18, spare17, spare16, spare15, spare14,
    spare13, spare12, spare11, spare10, spare09,
    spare08, spare07, spare06, spare05, spare04, spare03,
    spare02, spare01 }
    OPTIONAL, -- Need S

...
[[
    cipheringDisabled      ENUMERATED {true}
]]
}

UL-DataSplitThreshold ::= ENUMERATED {
    b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,
    b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,
    b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}

-- TAG-PDCP-CONFIG-STOP
-- ASN1STOP

```

| <b>PDCP-Config field descriptions</b>   |
|---|
| <p><b><i>cipheringDisabled</i></b><br/>If included, ciphering is disabled for this DRB regardless of which ciphering algorithm is configured for the SRB/DRBs. The field may only be included if the UE is connected to 5GC. Otherwise the field is absent. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up.</p>  |
| <p><b><i>discardTimer</i></b><br/>Value in ms of <i>discardTimer</i> specified in TS 38.323 [5]. Value <i>ms50</i> corresponds to 50 ms, value <i>ms100</i> corresponds to 100 ms and so on.</p>  |
| <p><b><i>drb-ContinueROHC</i></b><br/>Indicates whether the PDCP entity continues or resets the ROHC header compression protocol during PDCP re-establishment, as specified in TS 38.323 [5]. This field is configured only in case of resuming an RRC connection or reconfiguration with sync, where the PDCP termination point is not changed and the <i>fullConfig</i> is not indicated.</p>   |
| <p><b><i>headerCompression</i></b><br/>If rohc is configured, the UE shall apply the configured ROHC profile(s) in both uplink and downlink. If <i>uplinkOnlyROHC</i> is configured, the UE shall apply the configured ROHC profile(s) in uplink (there is no header compression in downlink). ROHC can be configured for any bearer type. The network reconfigures <i>headerCompression</i> only upon reconfiguration involving PDCP re-establishment. Network configures <i>headerCompression</i> to <i>notUsed</i> when <i>outOfOrderDelivery</i> is configured.</p>                     |
| <p><b><i>integrityProtection</i></b><br/>Indicates whether or not integrity protection is configured for this radio bearer. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up.</p>  |
| <p><b><i>maxCID</i></b><br/>Indicates the value of the MAX_CID parameter as specified in TS 38.323 [5].<br/>The total value of MAX_CIDs across all bearers for the UE should be less than or equal to the value of <i>maxNumberROHC-ContextSessions</i> parameter as indicated by the UE.</p>   |
| <p><b><i>moreThanOneRLC</i></b><br/>This field configures UL data transmission when more than one RLC entity is associated with the PDCP entity.</p>  |
| <p><b><i>outOfOrderDelivery</i></b><br/>Indicates whether or not <i>outOfOrderDelivery</i> specified in TS 38.323 [5] is configured. This field should be either always present or always absent, after the radio bearer is established.</p>  |
| <p><b><i>pdcp-Duplication</i></b><br/>Indicates whether or not uplink duplication status at the time of receiving this IE is configured and activated as specified in TS 38.323 [5]. The presence of this field indicates whether duplication is configured. PDCP duplication is not configured for CA packet duplication of LTE RLC bearer. The value of this field, when the field is present, indicates the initial state of the duplication. If set to <i>true</i>, duplication is activated. The value of this field is always <i>true</i>, when configured for a SRB.</p>             |
| <p><b><i>pdcp-SN-SizeDL</i></b><br/>PDCP sequence number size for downlink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value <i>len12bits</i> is applicable.</p>   |
| <p><b><i>pdcp-SN-SizeUL</i></b><br/>PDCP sequence number size for uplink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value <i>len12bits</i> is applicable.</p>   |
| <p><b><i>primaryPath</i></b><br/>Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 [5], clause 5.2.1 for UL data transmission when more than one RLC entity is associated with the PDCP entity. In this version of the specification, only cell group ID corresponding to MCG is supported for SRBs. The NW indicates <i>cellGroup</i> for split bearers using logical channels in different cell groups. The NW indicates <i>logicalChannel</i> for CA based PDCP duplication, i.e., if both logical channels terminate in the same cell group.</p> |
| <p><b><i>statusReportRequired</i></b><br/>For AM DRBs, indicates whether the DRB is configured to send a PDCP status report in the uplink, as specified in TS 38.323 [5].</p>   |
| <p><b><i>t-Reordering</i></b><br/>Value in ms of t-Reordering specified in TS 38.323 [5]. Value <i>ms0</i> corresponds to 0 ms, value <i>ms20</i> corresponds to 20 ms, value <i>ms40</i> corresponds to 40 ms, and so on. When the field is absent the UE applies the value <i>infinity</i>.</p>   |

| <b>PDCP-Config field descriptions</b>   |  |
|---|--|
| <b>ul-DataSplitThreshold</b>  |  |
| Parameter specified in TS 38.323 [5]. Value <i>b0</i> corresponds to 0 bytes, value <i>b100</i> corresponds to 100 bytes, value <i>b200</i> corresponds to 200 bytes, and so on. The network sets this field to <i>infinity</i> for UEs not supporting <i>splitDRB-withUL-Both-MCG-SCG</i> . If the field is absent when the split bearer is configured for the radio bearer first time, then the default value <i>infinity</i> is applied. |  |

| Conditional presence   | Explanation  |
|------------------------|--|
| <i>DRB</i>             | This field is mandatory present when the corresponding DRB is being set up, absent for SRBs. Otherwise this field is optionally present, need M.   |
| <i>MoreThanOneRLC</i>  | This field is mandatory present upon RRC reconfiguration with setup of a PDCP entity for a radio bearer with more than one associated logical channel and upon RRC reconfiguration with the association of an additional logical channel to the PDCP entity. Upon RRC reconfiguration when a PDCP entity is associated with multiple logical channels, this field is optionally present need M. Otherwise, this field is absent. Need R. |
| <i>Rlc-AM</i>          | For RLC AM, the field is optionally present, need R. Otherwise, the field is absent.   |
| <i>Setup</i>           | The field is mandatory present in case of radio bearer setup. Otherwise the field is optionally present, need M.   |
| <i>SplitBearer</i>     | The field is absent for SRBs. Otherwise, the field is optional present, need M, in case of radio bearer with more than one associated RLC mapped to different cell groups.   |
| <i>ConnectedTo5GC</i>  | The field is optionally present, need R, if the UE is connected to 5GC. Otherwise the field is absent.   |
| <i>ConnectedTo5GC1</i> | The field is optionally present, need R, if the UE is connected to NR/5GC. Otherwise the field is absent.  |
| <i>Setup2</i>          | This field is mandatory present in case for radio bearer setup for RLC-AM and RLC-UM. Otherwise, this field is absent, Need M.   |

## – PDSCH-Config

The *PDSCH-Config* IE is used to configure the UE specific PDSCH parameters.

### PDSCH-Config information element

```

-- ASN1START
-- TAG-PDSCH-CONFIG-START

PDSCH-Config ::=
    dataScramblingIdentityPDSCH          INTEGER (0..1023)                OPTIONAL, -- Need S
    dmrs-DownlinkForPDSCH-MappingTypeA  SetupRelease { DMRS-DownlinkConfig }  OPTIONAL, -- Need M
    dmrs-DownlinkForPDSCH-MappingTypeB  SetupRelease { DMRS-DownlinkConfig }  OPTIONAL, -- Need M

    tci-StatesToAddModList               SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-State  OPTIONAL, -- Need N
    tci-StatesToReleaseList              SEQUENCE (SIZE(1..maxNrofTCI-States)) OF TCI-StateId  OPTIONAL, -- Need N
    vrb-ToPRB-Interleaver                ENUMERATED {n2, n4}                    OPTIONAL, -- Need S
    resourceAllocation                   ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch},
    pdsch-TimeDomainAllocationList       SetupRelease { PDSCH-TimeDomainResourceAllocationList }  OPTIONAL, -- Need M
    pdsch-AggregationFactor              ENUMERATED { n2, n4, n8 }                OPTIONAL, -- Need S
    rateMatchPatternToAddModList         SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern  OPTIONAL, -- Need N
    rateMatchPatternToReleaseList        SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId  OPTIONAL, -- Need N
    rateMatchPatternGroup1               RateMatchPatternGroup                OPTIONAL, -- Need R
    rateMatchPatternGroup2               RateMatchPatternGroup                OPTIONAL, -- Need R

```

```

rbg-Size          ENUMERATED {config1, config2},
mcs-Table         ENUMERATED {qam256, qam64LowSE}
maxNrofCodeWordsScheduledByDCI  ENUMERATED {n1, n2}
                                     OPTIONAL, -- Need S
                                     OPTIONAL, -- Need R

prb-BundlingType CHOICE {
  staticBundling SEQUENCE {
    bundleSize  ENUMERATED { n4, wideband }
  },
  dynamicBundling SEQUENCE {
    bundleSizeSet1  ENUMERATED { n4, wideband, n2-wideband, n4-wideband }
    bundleSizeSet2  ENUMERATED { n4, wideband }
  }
},
zp-CSI-RS-ResourceToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-Resource
                                     OPTIONAL, -- Need N
zp-CSI-RS-ResourceToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-Resources)) OF ZP-CSI-RS-ResourceId
                                     OPTIONAL, -- Need N
aperiodic-ZP-CSI-RS-ResourceSetsToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSet
                                     OPTIONAL, -- Need N
aperiodic-ZP-CSI-RS-ResourceSetsToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSetId
                                     OPTIONAL, -- Need N
sp-ZP-CSI-RS-ResourceSetsToAddModList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSet
                                     OPTIONAL, -- Need N
sp-ZP-CSI-RS-ResourceSetsToReleaseList SEQUENCE (SIZE (1..maxNrofZP-CSI-RS-ResourceSets)) OF ZP-CSI-RS-ResourceSetId
                                     OPTIONAL, -- Need N
p-ZP-CSI-RS-ResourceSet SetupRelease { ZP-CSI-RS-ResourceSet }
                                     OPTIONAL, -- Need M
...
}
RateMatchPatternGroup ::= SEQUENCE (SIZE (1..maxNrofRateMatchPatternsPerGroup)) OF CHOICE {
  cellLevel RateMatchPatternId,
  bwpLevel RateMatchPatternId
}

-- TAG-PDSCH-CONFIG-STOP
-- ASN1STOP

```

| <b>PDSCH-Config field descriptions</b>  |
|---|
| <p><b>aperiodic-ZP-CSI-RS-ResourceSetsToAddModList</b><br/>AddMod/Release lists for configuring aperiodically triggered zero-power CSI-RS resource sets. Each set contains a <i>ZP-CSI-RS-ResourceSetId</i> and the IDs of one or more <i>ZP-CSI-RS-Resources</i> (the actual resources are defined in the <i>zp-CSI-RS-ResourceToAddModList</i>). The network configures the UE with at most 3 aperiodic <i>ZP-CSI-RS-ResourceSets</i> and it uses only the <i>ZP-CSI-RS-ResourceSetId</i> 1 to 3. The network triggers a set by indicating its <i>ZP-CSI-RS-ResourceSetId</i> in the DCI payload. The DCI codepoint '01' triggers the resource set with <i>ZP-CSI-RS-ResourceSetId</i> 1, the DCI codepoint '10' triggers the resource set with <i>ZP-CSI-RS-ResourceSetId</i> 2, and the DCI codepoint '11' triggers the resource set with <i>ZP-CSI-RS-ResourceSetId</i> 3 (see TS 38.214 [19], clause 5.1.4.2)</p> |
| <p><b>dataScramblingIdentityPDSCH</b><br/>Identifier used to initialize data scrambling (<i>c_init</i>) for PDSCH. If the field is absent, the UE applies the physical cell ID. (see TS 38.211 [16], clause 7.3.1.1).</p>   |
| <p><b>dmrs-DownlinkForPDSCH-MappingTypeA</b><br/>DMRS configuration for PDSCH transmissions using PDSCH mapping type A (chosen dynamically via <i>PDSCH-TimeDomainResourceAllocation</i>). Only the fields <i>dmrs-Type</i>, <i>dmrs-AdditionalPosition</i> and <i>maxLength</i> may be set differently for mapping type A and B.</p>   |
| <p><b>dmrs-DownlinkForPDSCH-MappingTypeB</b><br/>DMRS configuration for PDSCH transmissions using PDSCH mapping type B (chosen dynamically via <i>PDSCH-TimeDomainResourceAllocation</i>). Only the fields <i>dmrs-Type</i>, <i>dmrs-AdditionalPosition</i> and <i>maxLength</i> may be set differently for mapping type A and B.</p>   |
| <p><b>maxNrofCodeWordsScheduledByDCI</b><br/>Maximum number of code words that a single DCI may schedule. This changes the number of MCS/RV/NDI bits in the DCI message from 1 to 2.</p>  |
| <p><b>mcs-Table</b><br/>Indicates which MCS table the UE shall use for PDSCH. (see TS 38.214 [19], clause 5.1.3.1). If the field is absent the UE applies the value 64QAM.</p>  |
| <p><b>pdsch-AggregationFactor</b><br/>Number of repetitions for data (see TS 38.214 [19], clause 5.1.2.1). When the field is absent the UE applies the value 1.</p>   |
| <p><b>pdsch-TimeDomainAllocationList</b><br/>List of time-domain configurations for timing of DL assignment to DL data (see table 5.1.2.1.1-1 in TS 38.214 [19]).</p>   |
| <p><b>prb-BundlingType</b><br/>Indicates the PRB bundle type and bundle size(s) (see TS 38.214 [19], clause 5.1.2.3). If <i>dynamic</i> is chosen, the actual <i>bundleSizeSet1</i> or <i>bundleSizeSet2</i> to use is indicated via DCI. Constraints on <i>bundleSize(Set)</i> setting depending on <i>vrb-ToPRB-Interleaver</i> and <i>rbg-Size</i> settings are described in TS 38.214 [19], clause 5.1.2.3. If a <i>bundleSize(Set)</i> value is absent, the UE applies the value <i>n2</i>.</p>  |
| <p><b>p-ZP-CSI-RS-ResourceSet</b><br/>A set of periodically occurring ZP-CSI-RS-Resources (the actual resources are defined in the <i>zp-CSI-RS-ResourceToAddModList</i>). The network uses the ZP-CSI-RS-ResourceSetId=0 for this set.</p>   |
| <p><b>rateMatchPatternGroup1</b><br/>The IDs of a first group of <i>RateMatchPatterns</i> defined in <i>PDSCH-Config-&gt;rateMatchPatternToAddModList</i> (BWP level) or in <i>ServingCellConfig-&gt;rateMatchPatternToAddModList</i> (cell level). These patterns can be activated dynamically by DCI (see TS 38.214 [19], clause 5.1.4.1).</p>  |
| <p><b>rateMatchPatternGroup2</b><br/>The IDs of a second group of <i>RateMatchPatterns</i> defined in <i>PDSCH-Config-&gt;rateMatchPatternToAddModList</i> (BWP level) or in <i>ServingCellConfig-&gt;rateMatchPatternToAddModList</i> (cell level). These patterns can be activated dynamically by DCI (see TS 38.214 [19], clause 5.1.4.1).</p>   |
| <p><b>rateMatchPatternToAddModList</b><br/>Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the nested bitmaps (see TS 38.214 [19], clause 5.1.4.1). FFS: RAN1 indicates that there should be a set of patterns per cell and one per BWP =&gt; Having both seems unnecessary.</p>   |
| <p><b>rbg-Size</b><br/>Selection between config 1 and config 2 for RBG size for PDSCH. The UE ignores this field if <i>resourceAllocation</i> is set to <i>resourceAllocationType1</i> (see TS 38.214 [19], clause 5.1.2.2.1).</p>  |
| <p><b>resourceAllocation</b><br/>Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI (see TS 38.214 [19], clause 5.1.2.2).</p>  |
| <p><b>sp-ZP-CSI-RS-ResourceSetsToAddModList</b><br/>AddMod/Release lists for configuring semi-persistent zero-power CSI-RS resource sets. Each set contains a <i>ZP-CSI-RS-ResourceSetId</i> and the IDs of one or more <i>ZP-CSI-RS-Resources</i> (the actual resources are defined in the <i>zp-CSI-RS-ResourceToAddModList</i>) (see TS 38.214 [19], clause 5.1.4.2).</p>  |



|   |
|---|
| <b><i>tci-StatesToAddModList</i></b><br>A list of Transmission Configuration Indicator (TCI) states indicating a transmission configuration which includes QCL-relationships between the DL RSs in one RS set and the PDSCH DMRS ports (see TS 38.214 [19], clause 5.1.5).    |
| <b><i>vrb-ToPRB-Interleaver</i></b><br>Interleaving unit configurable between 2 and 4 PRBs (see TS 38.211 [16], clause 7.3.1.6). When the field is absent, the UE performs non-interleaved VRB-to-PRB mapping.  |
| <b><i>zp-CSI-RS-ResourceToAddModList</i></b><br>A list of Zero-Power (ZP) CSI-RS resources used for PDSCH rate-matching. Each resource in this list may be referred to from only one type of resource set, i.e., aperiodic, semi-persistent or periodic (see TS 38.214 [19]). |

## – *PDSCH-ConfigCommon*

The IE *PDSCH-ConfigCommon* is used to configure cell specific PDSCH parameters.

### ***PDSCH-ConfigCommon* information element**

```
-- ASN1START
-- TAG-PDSCH-CONFIGCOMMON-START

PDSCH-ConfigCommon ::=
    pdsch-TimeDomainAllocationList          SEQUENCE {
        PDSCH-TimeDomainResourceAllocationList  OPTIONAL,  -- Need R
        ...
    }

-- TAG-PDSCH-CONFIGCOMMON-STOP
-- ASN1STOP
```

### ***PDSCH-ConfigCommon* field descriptions**

|  |
|--|
| <b><i>pdsch-TimeDomainAllocationList</i></b><br>List of time-domain configurations for timing of DL assignment to DL data (see table 5.1.2.1.1-1 in TS 38.214 [19]). |
|--|

## – *PDSCH-ServingCellConfig*

The IE *PDSCH-ServingCellConfig* is used to configure UE specific PDSCH parameters that are common across the UE's BWPs of one serving cell.

### ***PDSCH-ServingCellConfig* information element**

```
-- ASN1START
-- TAG-PDSCH-SERVINGCELLCONFIG-START

PDSCH-ServingCellConfig ::=
    codeBlockGroupTransmission          SEQUENCE {
        SetupRelease { PDSCH-CodeBlockGroupTransmission }  OPTIONAL,  -- Need M
        xOverhead          ENUMERATED { x0h6, x0h12, x0h18 }  OPTIONAL,  -- Need S
        nrofHARQ-ProcessesForPDSCH      ENUMERATED {n2, n4, n6, n10, n12, n16}  OPTIONAL,  -- Need S
        pucch-Cell          ServCellIndex          OPTIONAL,  -- Cond SCellAddOnly
    }
```

```

...
[[
maxMIMO-Layers                INTEGER (1..8)                OPTIONAL, -- Need M
processingType2Enabled         BOOLEAN                        OPTIONAL  -- Need M
]]
}

PDSCH-CodeBlockGroupTransmission ::= SEQUENCE {
maxCodeBlockGroupsPerTransportBlock  ENUMERATED {n2, n4, n6, n8},
codeBlockGroupFlushIndicator         BOOLEAN,
...
}

-- TAG-PDSCH-SERVINGCELLCONFIG-STOP
-- ASN1STOP

```

| <i>PDSCH-CodeBlockGroupTransmission</i> field descriptions |
|--|
|--|

|  |
|--|
| <b><i>codeBlockGroupFlushIndicator</i></b> |
|--|

|   |
|---|
| Indicates whether CBGFI for CBG based (re)transmission in DL is enabled (true). (see TS 38.212 [17], clause 7.3.1.2.2). |
|---|

|   |
|---|
| <b><i>maxCodeBlockGroupsPerTransportBlock</i></b> |
|---|

|   |
|---|
| Maximum number of code-block-groups (CBGs) per TB. In case of multiple CW, the maximum CBG is 4 (see TS 38.213 [13], clause 9.1.1). |
|---|

| <i>PDSCH-ServingCellConfig</i> field descriptions |
|---|
|---|

|  |
|--|
| <b><i>codeBlockGroupTransmission</i></b> |
|--|

|  |
|--|
| Enables and configures code-block-group (CBG) based transmission (see TS 38.213 [13], clause 9.1.1). |
|--|

|                              |
|------------------------------|
| <b><i>maxMIMO-Layers</i></b> |
|------------------------------|

|   |
|---|
| Indicates the maximum MIMO layer to be used for PDSCH in all BWPs of this serving cell. (see TS 38.212 [17], clause 5.4.2.1). |
|---|

|  |
|--|
| <b><i>nrofHARQ-ProcessesForPDSCH</i></b> |
|--|

|   |
|---|
| The number of HARQ processes to be used on the PDSCH of a serving cell. Value <i>n2</i> corresponds to 2 HARQ processes, value <i>n4</i> to 4 HARQ processes, and so on. If the field is absent, the UE uses 8 HARQ processes (see TS 38.214 [19], clause 5.1). |
|---|

|                                      |
|--------------------------------------|
| <b><i>processingType2Enabled</i></b> |
|--------------------------------------|

|   |
|---|
| Enables configuration of advanced processing time capability 2 for PDSCH (see 38.214 [19], clause 5.3). |
|---|

|                          |
|--------------------------|
| <b><i>pucch-Cell</i></b> |
|--------------------------|

|   |
|---|
| The ID of the serving cell (of the same cell group) to use for PUCCH. If the field is absent, the UE sends the HARQ feedback on the PUCCH of the SpCell of this cell group, or on this serving cell if it is a PUCCH SCell. |
|---|

|                         |
|-------------------------|
| <b><i>xOverhead</i></b> |
|-------------------------|

|  |
|--|
| Accounts for overhead from CSI-RS, CORESET, etc. If the field is absent, the UE applies value xOh0 (see TS 38.214 [19], clause 5.1.3.2). |
|--|

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>SCellAddOnly</i>  | It is optionally present, Need S, for (non-PUCCH) SCells when adding a new SCell. The field is absent, Need M, when reconfiguring SCells. The field is also absent for the SpCells as well as for a PUCCH SCell. |

## – *PDSCH-TimeDomainResourceAllocationList*

The IE *PDSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PDSCH. The *PDSCH-TimeDomainResourceAllocationList* contains one or more of such *PDSCH-TimeDomainResourceAllocations*. The network indicates in the DL assignment which of the configured time domain allocations the UE shall apply for that DL assignment. The UE determines the bit width of the DCI field based on the number of entries in the *PDSCH-TimeDomainResourceAllocationList*. Value 0 in the DCI field refers to the first element in this list, value 1 in the DCI field refers to the second element in this list, and so on.

### *PDSCH-TimeDomainResourceAllocationList* information element

```
-- ASN1START
-- TAG-PDSCH-TIMEDOMAINRESOURCEALLOCATIONLIST-START

PDSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofDL-Allocations)) OF PDSCH-TimeDomainResourceAllocation

PDSCH-TimeDomainResourceAllocation ::= SEQUENCE {
    k0                INTEGER(0..32)                OPTIONAL,    -- Need S
    mappingType       ENUMERATED {typeA, typeB},
    startSymbolAndLength  INTEGER (0..127)
}

-- TAG-PDSCH-TIMEDOMAINRESOURCEALLOCATIONLIST-STOP
-- ASN1STOP
```

### *PDSCH-TimeDomainResourceAllocation* field descriptions

|                                    |  |
|------------------------------------|--|
| <b><i>k0</i></b>                   | Slot offset between DCI and its scheduled PDSCH (see TS 38.214 [19], clause 5.1.2.1) When the field is absent the UE applies the value 0.  |
| <b><i>mappingType</i></b>          | PDSCH mapping type. (see TS 38.214 [19], clause 5.3).  |
| <b><i>startSymbolAndLength</i></b> | An index giving valid combinations of start symbol and length (jointly encoded) as start and length indicator (SLIV). The network configures the field so that the allocation does not cross the slot boundary (see TS 38.214 [19], clause 5.1.2.1). |

## – *PHR-Config*

The IE *PHR-Config* is used to configure parameters for power headroom reporting.

### *PHR-Config* information element

```
-- ASN1START
-- TAG-PHR-CONFIG-START

PHR-Config ::= SEQUENCE {
    phr-PeriodicTimer      ENUMERATED {sf10, sf20, sf50, sf100, sf200,sf500, sf1000, infinity},
    phr-ProhibitTimer      ENUMERATED {sf0, sf10, sf20, sf50, sf100,sf200, sf500, sf1000},
    phr-Tx-PowerFactorChange  ENUMERATED {dB1, dB3, dB6, infinity},
}
```

```

multiplePHR          BOOLEAN,
dummy                BOOLEAN,
phr-Type2OtherCell   BOOLEAN,
phr-ModeOtherCG      ENUMERATED {real, virtual},
...
}

-- TAG-PHR-CONFIG-STOP
-- ASN1STOP

```

#### **PHR-Config field descriptions**

|  |
|--|
| <p><b>dummy</b><br/>This field is not used in this version of the specification and the UE ignores the received value.</p>   |
| <p><b>multiplePHR</b><br/>Indicates if power headroom shall be reported using the Single Entry PHR MAC control element or Multiple Entry PHR MAC control element defined in TS 38.321 [3]. True means to use Multiple Entry PHR MAC control element and False means to use the Single Entry PHR MAC control element defined in TS 38.321 [3]. The network configures this field to <i>true</i> for MR-DC and UL CA for NR, and to <i>false</i> in all other cases.</p> |
| <p><b>phr-ModeOtherCG</b><br/>Indicates the mode (i.e. real or virtual) used for the PHR of the activated cells that are part of the other Cell Group (i.e. MCG or SCG), when DC is configured. If the UE is configured with only one cell group (no DC), it ignores the field.</p>  |
| <p><b>phr-PeriodicTimer</b><br/>Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. Value <i>sf10</i> corresponds to 10 subframes, value <i>sf20</i> corresponds to 20 subframes, and so on.</p>   |
| <p><b>phr-ProhibitTimer</b><br/>Value in number of subframes for PHR reporting as specified in TS 38.321 [3]. Value <i>sf0</i> corresponds to 0 subframe, value <i>sf10</i> corresponds to 10 subframes, value <i>sf20</i> corresponds to 20 subframes, and so on.</p>   |
| <p><b>phr-Tx-PowerFactorChange</b><br/>Value in dB for PHR reporting as specified in TS 38.321 [3]. Value <i>dB1</i> corresponds to 1 dB, <i>dB3</i> corresponds to 3 dB and so on. The same value applies for each serving cell (although the associated functionality is performed independently for each cell).</p>   |
| <p><b>phr-Type2OtherCell</b><br/>If set to true, the UE shall report a PHR type 2 for the SpCell of the other MAC entity. See TS 38.321 [3], clause 5.4.6. Network sets this field to <i>false</i> if the UE is not configured with an E-UTRA MAC entity.</p>  |

#### – **PhysCellId**

The *PhysCellId* identifies the physical cell identity (PCI).

#### **PhysCellId information element**

```

-- ASN1START
-- TAG-PHYSCELLID-START

PhysCellId ::=          INTEGER (0..1007)

-- TAG-PHYSCELLID-STOP
-- ASN1STOP

```

– *PhysicalCellGroupConfig*

The IE *PhysicalCellGroupConfig* is used to configure cell-group specific L1 parameters.

***PhysicalCellGroupConfig* information element**

```

-- ASN1START
-- TAG-PHYSICALCELLGROUPCONFIG-START

PhysicalCellGroupConfig ::=          SEQUENCE {
    harq-ACK-SpatialBundlingPUCCH    ENUMERATED {true}                OPTIONAL, -- Need S
    harq-ACK-SpatialBundlingPUSCH    ENUMERATED {true}                OPTIONAL, -- Need S
    p-NR-FR1                          P-Max                          OPTIONAL, -- Need R
    pdsch-HARQ-ACK-Codebook           ENUMERATED {semiStatic, dynamic},
    tpc-SRS-RNTI                      RNTI-Value                       OPTIONAL, -- Need R
    tpc-PUCCH-RNTI                   RNTI-Value                       OPTIONAL, -- Need R
    tpc-PUSCH-RNTI                   RNTI-Value                       OPTIONAL, -- Need R
    sp-CSI-RNTI                      RNTI-Value                       OPTIONAL, -- Need R
    cs-RNTI                          SetupRelease { RNTI-Value }    OPTIONAL, -- Need M
    ..,
    [[
    mcs-C-RNTI                        RNTI-Value                       OPTIONAL, -- Need R
    p-UE-FR1                          P-Max                          OPTIONAL, -- Cond MCG-Only
    ]],
    [[
    xScale                            ENUMERATED {dB0, dB6, spare2, spare1}
    ]],
    [[
    pdcch-BlindDetection              SetupRelease { PDCCH-BlindDetection }
    ]]
}

PDCCH-BlindDetection ::=            INTEGER (1..15)

-- TAG-PHYSICALCELLGROUPCONFIG-STOP
-- ASN1STOP

```

| <b>PhysicalCellGroupConfig field descriptions</b> |   |
|---|---|
| <b>cs-RNTI</b>                                    | RNTI value for downlink SPS (see <i>SPS-Config</i> ) and uplink configured grant (see <i>ConfiguredGrantConfig</i> ).   |
| <b>harq-ACK-SpatialBundlingPUCCH</b>              | Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUCCH reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule. When the field is absent, the spatial bundling is disabled (see TS 38.213 [13], clause 9.1.2.1).                       |
| <b>harq-ACK-SpatialBundlingPUSCH</b>              | Enables spatial bundling of HARQ ACKs. It is configured per cell group (i.e. for all the cells within the cell group) for PUSCH reporting of HARQ-ACK. It is only applicable when more than 4 layers are possible to schedule. When the field is absent, the spatial bundling is disabled (see TS 38.213 [13], clauses 9.1.2.2 and 9.1.3.2).          |
| <b>mcs-C-RNTI</b>                                 | RNTI to indicate use of <i>qam64LowSE</i> for grant-based transmissions. When the MCS-C-RNTI is configured, RNTI scrambling of DCI CRC is used to choose the corresponding MCS table.   |
| <b>pdccch-BlindDetection</b>                      | Indicates the reference number of cells for PDCCH blind detection for the CG. Network configures the field for each CG when the UE is in NR DC and sets the value in accordance with the constraints specified in TS 38.213 [13]. The network configures <i>pdccch-BlindDetection</i> only if the UE is in NR-DC.                                     |
| <b>p-NR-FR1</b>                                   | The maximum total transmit power to be used by the UE in this NR cell group across all serving cells in frequency range 1 (FR1). The maximum transmit power that the UE may use may be additionally limited by <i>p-Max</i> (configured in <i>FrequencyInfoUL</i> ) and by <i>p-UE-FR1</i> (configured total for all serving cells operating on FR1). |
| <b>p-UE-FR1</b>                                   | The maximum total transmit power to be used by the UE across all serving cells in frequency range 1 (FR1) across all cell groups. The maximum transmit power that the UE may use may be additionally limited by <i>p-Max</i> (configured in <i>FrequencyInfoUL</i> ) and by <i>p-NR-FR1</i> (configured for the cell group).                          |
| <b>pdsch-HARQ-ACK-Codebook</b>                    | The PDSCH HARQ-ACK codebook is either semi-static or dynamic. This is applicable to both CA and none CA operation (see TS 38.213 [13], clauses 9.1.2 and 9.1.3).  |
| <b>sp-CSI-RNTI</b>                                | RNTI for Semi-Persistent CSI reporting on PUSCH (see <i>CSI-ReportConfig</i> ) (see TS 38.214 [19], clause 5.2.1.5.2). Network always configures the UE with a value for this field when at least one <i>CSI-ReportConfig</i> with <i>reportConfigType</i> set to <i>semiPersistentOnPUSCH</i> is configured.   |
| <b>tpc-PUCCH-RNTI</b>                             | RNTI used for PUCCH TPC commands on DCI (see TS 38.213 [13], clause 10.1).  |
| <b>tpc-PUSCH-RNTI</b>                             | RNTI used for PUSCH TPC commands on DCI (see TS 38.213 [13], clause 10.1).  |
| <b>tpc-SRS-RNTI</b>                               | RNTI used for SRS TPC commands on DCI (see TS 38.213 [13], clause 10.1).  |
| <b>xScale</b>                                     | The UE is allowed to drop NR only if the power scaling applied to NR results in a difference between scaled and unscaled NR UL of more than <i>xScale</i> dB (see TS 38.101-3 [34]). If the value is not configured for dynamic power sharing, the UE assumes default value of 6 dB. This field is only used in EN-DC.                                |

| Conditional Presence | Explanation   |
|----------------------|---|
| <i>MCG-Only</i>      | This field is optionally present, Need R, in the <i>PhysicalCellGroupConfig</i> of the MCG. It is absent otherwise.   |
| <i>SCG-Only</i>      | This field is optionally present, Need S, in the <i>PhysicalCellGroupConfig</i> of the SCG in EN-DC as defined in TS 38.101-3 [34]. It is absent otherwise. |

– *PLMN-Identity*

The IE *PLMN-Identity* identifies a Public Land Mobile Network. Further information regarding how to set the IE is specified in TS 23.003 [21].

**PLMN-Identity information element**

```

-- ASN1START
-- TAG-PLMN-IDENTITY-START

PLMN-Identity ::=
    SEQUENCE {
        mcc          MCC          OPTIONAL,          -- Cond MCC
        mnc          MNC
    }

MCC ::=
    SEQUENCE (SIZE (3)) OF MCC-MNC-Digit

MNC ::=
    SEQUENCE (SIZE (2..3)) OF MCC-MNC-Digit

MCC-MNC-Digit ::=
    INTEGER (0..9)

-- TAG-PLMN-IDENTITY-STOP
-- ASN1STOP

```

**PLMN-Identity field descriptions**

|            |   |
|------------|---|
| <b>mcc</b> | The first element contains the first MCC digit, the second element the second MCC digit and so on. If the field is absent, it takes the same value as the <i>mcc</i> of the immediately preceding IE PLMN-Identity. See TS 23.003 [21]. |
| <b>mnc</b> | The first element contains the first MNC digit, the second element the second MNC digit and so on. See TS 23.003 [21].  |

| Conditional Presence | Explanation  |
|----------------------|--|
| MCC                  | This field is mandatory present when PLMN-Identity is not used in a list or if it is the first entry of PLMN-Identity in a list. Otherwise it is optionally present, Need S. |

– **PLMN-IdentityInfoList**

The IE *PLMN-IdentityInfoList* includes a list of PLMN identity information.

**PLMN-IdentityInfoList information element**

```

-- ASN1START
-- TAG-PLMN-IDENTITYINFOLIST-START

PLMN-IdentityInfoList ::=
    SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-IdentityInfo

PLMN-IdentityInfo ::=
    SEQUENCE {
        plmn-IdentityList  SEQUENCE (SIZE (1..maxPLMN)) OF PLMN-Identity,
        trackingAreaCode   TrackingAreaCode          OPTIONAL,          -- Need R
        ranac              RAN-AreaCode          OPTIONAL,          -- Need R
        cellIdentity       CellIdentity
    }

```

```

    cellReservedForOperatorUse      ENUMERATED {reserved, notReserved},
    ...
}
-- TAG-PLMN-IDENTITYINFOLIST-STOP
-- ASN1STOP

```

#### **PLMN-IdentityInfo field descriptions**

##### ***cellReservedForOperatorUse***

Indicates whether the cell is reserved for operator use (per PLMN), as defined in TS 38.304 [20].

##### ***trackingAreaCode***

Indicates Tracking Area Code to which the cell indicated by cellIdentity field belongs. The presence of the field indicates that the cell supports at least standalone operation (per PLMN); the absence of the field indicates that the cell only supports EN-DC functionality (per PLMN).

#### – ***PRB-Id***

The IE *PRB-Id* identifies a Physical Resource Block (PRB) position within a carrier.

#### ***PRB-Id* information element**

```

-- ASN1START
-- TAG-PRB-ID-START

PRB-Id ::=
    INTEGER (0..maxNrofPhysicalResourceBlocks-1)

-- TAG-PRB-ID-STOP
-- ASN1STOP

```

#### – ***PTRS-DownlinkConfig***

The IE *PTRS-DownlinkConfig* is used to configure downlink phase tracking reference signals (PTRS) (see TS 38.214 [19] clause 5.1.6.3)

#### ***PTRS-DownlinkConfig* information element**

```

-- ASN1START
-- TAG-PTRS-DOWNLINKCONFIG-START

PTRS-DownlinkConfig ::=
    SEQUENCE {
        frequencyDensity      SEQUENCE (SIZE (2)) OF INTEGER (1..276)           OPTIONAL, -- Need S
        timeDensity            SEQUENCE (SIZE (3)) OF INTEGER (0..29)           OPTIONAL, -- Need S
        epre-Ratio             INTEGER (0..3)                                    OPTIONAL, -- Need S
        resourceElementOffset  ENUMERATED { offset01, offset10, offset11 }      OPTIONAL, -- Need S
        ...
    }

-- TAG-PTRS-DOWNLINKCONFIG-STOP

```



```
-- ASN1STOP
```

| <i><b>PTRS-DownlinkConfig</b></i> field descriptions   |
|--|
| <p><b><i>epre-Ratio</i></b><br/>EPRE ratio between PTRS and PDSCH. Value 0 corresponds to the codepoint "00" in table 4.1-2. Value 1 corresponds to codepoint "01", and so on. If the field is not provided, the UE applies value 0 (see TS 38.214 [19], clause 4.1).</p>                        |
| <p><b><i>frequencyDensity</i></b><br/>Presence and frequency density of DL PT-RS as a function of Scheduled BW. If the field is absent, the UE uses <math>K_{PT-RS} = 2</math> (see TS 38.214 [19], clause 5.1.6.3, table 5.1.6.3-2).</p>  |
| <p><b><i>resourceElementOffset</i></b><br/>Indicates the subcarrier offset for DL PTRS. If the field is absent, the UE applies the value <code>offset00</code> (see TS 38.214 [19], clause 6.4.1.2.2.1).</p>   |
| <p><b><i>timeDensity</i></b><br/>Presence and time density of DL PT-RS as a function of MCS. The value 29 is only applicable for MCS Table 5.1.3.1-1 (TS 38.214 [19]). If the field is absent, the UE uses <math>L_{PT-RS} = 1</math> (see TS 38.214 [19], clause 5.1.6.3, table 5.1.6.3-1).</p> |

## – *PTRS-UplinkConfig*

The IE *PTRS-UplinkConfig* is used to configure uplink Phase-Tracking-Reference-Signals (PTRS).

### *PTRS-UplinkConfig* information element

```
-- ASN1START
-- TAG-PTRS-UPLINKCONFIG-START

PTRS-UplinkConfig ::=
    transformPrecoderDisabled          SEQUENCE {
        frequencyDensity              SEQUENCE (SIZE (2)) OF INTEGER (1..276)          OPTIONAL, -- Need S
        timeDensity                    SEQUENCE (SIZE (3)) OF INTEGER (0..29)          OPTIONAL, -- Need S
        maxNrofPorts                   ENUMERATED {n1, n2},
        resourceElementOffset          ENUMERATED {offset01, offset10, offset11 }        OPTIONAL, -- Need S
        ptrs-Power                     ENUMERATED {p00, p01, p10, p11}
    }
    transformPrecoderEnabled          SEQUENCE {
        sampleDensity                  SEQUENCE (SIZE (5)) OF INTEGER (1..276),
        timeDensityTransformPrecoding  ENUMERATED {d2}
    }
    ...
}

-- TAG-PTRS-UPLINKCONFIG-STOP
-- ASN1STOP
```

| <b><i>PTRS-UplinkConfig</i> field descriptions</b> |   |
|--|---|
| <b><i>frequencyDensity</i></b>                     | Presence and frequency density of UL PT-RS for CP-OFDM waveform as a function of scheduled BW. If the field is absent, the UE uses $K_{PT-RS} = 2$ (see TS 38.214 [19], clause 6.1).  |
| <b><i>maxNrofPorts</i></b>                         | The maximum number of UL PTRS ports for CP-OFDM (see TS 38.214 [19], clause 6.2.3.1).   |
| <b><i>ptrs-Power</i></b>                           | UL PTRS power boosting factor per PTRS port (see TS 38.214 [19], clause 6.1, table 6.2.3.1.3).  |
| <b><i>resourceElementOffset</i></b>                | Indicates the subcarrier offset for UL PTRS for CP-OFDM. If the field is absent, the UE applies the value <i>offset00</i> (see TS 38.211 [16], clause 6.4.1.2.2).   |
| <b><i>sampleDensity</i></b>                        | Sample density of PT-RS for DFT-s-OFDM, pre-DFT, indicating a set of thresholds $T = \{NRB_n, n=0,1,2,3,4\}$ , that indicates dependency between presence of PT-RS and scheduled BW and the values of X and K the UE should use depending on the scheduled BW, see TS 38.214 [19], clause 6.1, table 6.2.3.2-1. |
| <b><i>timeDensity</i></b>                          | Presence and time density of UL PT-RS for CP-OFDM waveform as a function of MCS. If the field is absent, the UE uses $L_{PT-RS} = 1$ (see TS 38.214 [19], clause 6.1).  |
| <b><i>timeDensityTransformPrecoding</i></b>        | Time density (OFDM symbol level) of PT-RS for DFT-s-OFDM. If the field is absent, the UE applies value <i>d1</i> (see TS 38.214 [19], clause 6.1).  |
| <b><i>transformPrecoderDisabled</i></b>            | Configuration of UL PTRS without transform precoder (with CP-OFDM).   |
| <b><i>transformPrecoderEnabled</i></b>             | Configuration of UL PTRS with transform precoder (DFT-S-OFDM).  |

## – *PUCCH-Config*

The IE *PUCCH-Config* is used to configure UE specific PUCCH parameters (per BWP).

### ***PUCCH-Config* information element**

```
-- ASN1START
-- TAG-PUCCH-CONFIG-START

PUCCH-Config ::=
    SEQUENCE {
        resourceSetToAddModList      SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSet      OPTIONAL, -- Need N
        resourceSetToReleaseList     SEQUENCE (SIZE (1..maxNrofPUCCH-ResourceSets)) OF PUCCH-ResourceSetId  OPTIONAL, -- Need N
        resourceToAddModList         SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-Resource        OPTIONAL, -- Need N
        resourceToReleaseList        SEQUENCE (SIZE (1..maxNrofPUCCH-Resources)) OF PUCCH-ResourceId       OPTIONAL, -- Need N
        format1                      SetupRelease { PUCCH-FormatConfig }                               OPTIONAL, -- Need M
        format2                      SetupRelease { PUCCH-FormatConfig }                               OPTIONAL, -- Need M
        format3                      SetupRelease { PUCCH-FormatConfig }                               OPTIONAL, -- Need M
        format4                      SetupRelease { PUCCH-FormatConfig }                               OPTIONAL, -- Need M

        schedulingRequestResourceToAddModList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceConfig
                                                                                                       OPTIONAL, -- Need N
        schedulingRequestResourceToReleaseList SEQUENCE (SIZE (1..maxNrofSR-Resources)) OF SchedulingRequestResourceId
                                                                                                       OPTIONAL, -- Need N

        multi-CSI-PUCCH-ResourceList SEQUENCE (SIZE (1..2)) OF PUCCH-ResourceId                               OPTIONAL, -- Need M
        dl-DataToUL-ACK               SEQUENCE (SIZE (1..8)) OF INTEGER (0..15)                               OPTIONAL, -- Need M
    }

```

```

    spatialRelationInfoToAddModList      SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfo
                                         OPTIONAL, -- Need N
    spatialRelationInfoToReleaseList     SEQUENCE (SIZE (1..maxNrofSpatialRelationInfos)) OF PUCCH-SpatialRelationInfoId
                                         OPTIONAL, -- Need N
    pucch-PowerControl                   PUCCH-PowerControl
                                         OPTIONAL, -- Need M
    ...
}

PUCCH-FormatConfig ::=
    interslotFrequencyHopping            ENUMERATED {enabled}                OPTIONAL, -- Need R
    additionalDMRS                        ENUMERATED {true}                OPTIONAL, -- Need R
    maxCodeRate                           PUCCH-MaxCodeRate                OPTIONAL, -- Need R
    nrofSlots                             ENUMERATED {n2,n4,n8}            OPTIONAL, -- Need S
    pi2BPSK                               ENUMERATED {enabled}            OPTIONAL, -- Need R
    simultaneousHARQ-ACK-CSI              ENUMERATED {true}                OPTIONAL, -- Need R
}

PUCCH-MaxCodeRate ::=
    ENUMERATED {zeroDot08, zeroDot15, zeroDot25, zeroDot35, zeroDot45, zeroDot60, zeroDot80}

-- A set with one or more PUCCH resources
PUCCH-ResourceSet ::=
    pucch-ResourceSetId                  PUCCH-ResourceSetId,
    resourceList                         SEQUENCE (SIZE (1..maxNrofPUCCH-ResourcesPerSet)) OF PUCCH-ResourceId,
    maxPayloadMinus1                     INTEGER (4..256)                    OPTIONAL, -- Need R
}

PUCCH-ResourceSetId ::=
    INTEGER (0..maxNrofPUCCH-ResourceSets-1)

PUCCH-Resource ::=
    pucch-ResourceId                     PUCCH-ResourceId,
    startingPRB                          PRB-Id,
    intraSlotFrequencyHopping            ENUMERATED { enabled }            OPTIONAL, -- Need R
    secondHopPRB                         PRB-Id                            OPTIONAL, -- Need R
    format                               CHOICE {
        format0                          PUCCH-format0,
        format1                          PUCCH-format1,
        format2                          PUCCH-format2,
        format3                          PUCCH-format3,
        format4                          PUCCH-format4
    }
}

PUCCH-ResourceId ::=
    INTEGER (0..maxNrofPUCCH-Resources-1)

PUCCH-format0 ::=
    initialCyclicShift                   SEQUENCE {
        INTEGER(0..11),
        nrofSymbols                       INTEGER (1..2),
        startingSymbolIndex               INTEGER(0..13)
    }
}

PUCCH-format1 ::=
    initialCyclicShift                   SEQUENCE {
        INTEGER(0..11),

```

```

    nrofSymbols                INTEGER (4..14),
    startingSymbolIndex        INTEGER(0..10),
    timeDomainOCC              INTEGER(0..6)
}

PUCCH-format2 ::=
    nrofPRBs                   INTEGER (1..16),
    nrofSymbols                INTEGER (1..2),
    startingSymbolIndex        INTEGER(0..13)
}

PUCCH-format3 ::=
    nrofPRBs                   INTEGER (1..16),
    nrofSymbols                INTEGER (4..14),
    startingSymbolIndex        INTEGER(0..10)
}

PUCCH-format4 ::=
    nrofSymbols                INTEGER (4..14),
    occ-Length                 ENUMERATED {n2,n4},
    occ-Index                  ENUMERATED {n0,n1,n2,n3},
    startingSymbolIndex        INTEGER(0..10)
}

-- TAG-PUCCH-CONFIG-STOP
-- ASN1STOP

```

| <b><i>PUCCH-Config</i> field descriptions</b>   |
|---|
| <b><i>dl-DataToUL-ACK</i></b><br>List of timing for given PDSCH to the DL ACK (see TS 38.213 [13], clause 9.1.2).   |
| <b><i>format1</i></b><br>Parameters that are common for all PUCCH resources of format 1.  |
| <b><i>format2</i></b><br>Parameters that are common for all PUCCH resources of format 2.  |
| <b><i>format3</i></b><br>Parameters that are common for all PUCCH resources of format 3.  |
| <b><i>format4</i></b><br>Parameters that are common for all PUCCH resources of format 4   |
| <b><i>resourceSetToAddModList, resourceSetToReleaseList</i></b><br>Lists for adding and releasing PUCCH resource sets (see TS 38.213 [13], clause 9.2).   |
| <b><i>resourceToAddModList, resourceToReleaseList</i></b><br>Lists for adding and releasing PUCCH resources applicable for the UL BWP and serving cell in which the <i>PUCCH-Config</i> is defined. The resources defined herein are referred to from other parts of the configuration to determine which resource the UE shall use for which report. |
| <b><i>spatialRelationInfoToAddModList</i></b><br>Configuration of the spatial relation between a reference RS and PUCCH. Reference RS can be SSB/CSI-RS/SRS. If the list has more than one element, MAC-CE selects a single element (see TS 38.321 [3], clause 5.18.8 and TS 38.213 [13], clause 9.2.2).  |

| <b>PUCCH-format3 field descriptions</b>      |   |
|--|---|
| <b>nrofPRBs</b>                              | The supported values are 1,2,3,4,5,6,8,9,10,12,15 and 16.   |
| <b>PUCCH-FormatConfig field descriptions</b> |   |
| <b>additionalDMRS</b>                        | If the field is present, the UE enables 2 DMRS symbols per hop of a PUCCH Format 3 or 4 if both hops are more than X symbols when FH is enabled (X=4). And it enables 4 DMRS symbols for a PUCCH Format 3 or 4 with more than 2X+1 symbols when FH is disabled (X=4). The field is not applicable for format 1 and 2. See TS 38.213 [13], clause 9.2.2. |
| <b>interslotFrequencyHopping</b>             | If the field is present, the UE enables inter-slot frequency hopping when PUCCH Format 1, 3 or 4 is repeated over multiple slots. For long PUCCH over multiple slots, the intra and inter slot frequency hopping cannot be enabled at the same time for a UE. The field is not applicable for format 2. See TS 38.213 [13], clause 9.2.6.               |
| <b>maxCodeRate</b>                           | Max coding rate to determine how to feedback UCI on PUCCH for format 2, 3 or 4. The field is not applicable for format 1. See TS 38.213 [13], clause 9.2.5.   |
| <b>nrofSlots</b>                             | Number of slots with the same PUCCH F1, F3 or F4. When the field is absent the UE applies the value <i>n1</i> . The field is not applicable for format 2. See TS 38.213 [13], clause 9.2.6.   |
| <b>pi2BPSK</b>                               | If the field is present, the UE uses pi/2 BPSK for UCI symbols instead of QPSK for PUCCH. The field is not applicable for format 1 and 2. See TS 38.213 [13], clause 9.2.5.   |
| <b>simultaneousHARQ-ACK-CSI</b>              | If the field is present, the UE uses simultaneous transmission of CSI and HARQ-ACK feedback with or without SR with PUCCH Format 2, 3 or 4. See TS 38.213 [13], clause 9.2.5. When the field is absent the UE applies the value <i>off</i> . The field is not applicable for format 1.  |
| <b>PUCCH-Resource field descriptions</b>     |   |
| <b>format</b>                                | Selection of the PUCCH format (format 0 – 4) and format-specific parameters, see TS 38.213 [13], clause 9.2. <i>format0</i> and <i>format1</i> are only allowed for a resource in a first PUCCH resource set. <i>format2</i> , <i>format3</i> and <i>format4</i> are only allowed for a resource in non-first PUCCH resource set.                       |
| <b>intraSlotFrequencyHopping</b>             | Enabling intra-slot frequency hopping, applicable for all types of PUCCH formats. For long PUCCH over multiple slots, the intra and inter slot frequency hopping cannot be enabled at the same time for a UE. See TS 38.213 [13], clause 9.2.1.   |
| <b>pucch-ResourceId</b>                      | Identifier of the PUCCH resource.   |
| <b>secondHopPRB</b>                          | Index of first PRB after frequency hopping (for second hop) of PUCCH. This value is applicable for intra-slot frequency hopping. See TS 38.213 [13], clause 9.2.1.  |

**PUCCH-ResourceSet field descriptions****maxPayloadMinus1**

Maximum number of payload bits minus 1 that the UE may transmit using this PUCCH resource set. In a PUCCH occurrence, the UE chooses the first of its *PUCCH-ResourceSet* which supports the number of bits that the UE wants to transmit. The field is absent in the first set (Set0) since the maximum Size of Set0 is specified to be 3 bits. The field is absent in the last configured set since the UE derives its maximum payload size as specified in TS 38.213 [13]. This field can take integer values that are multiples of 4 (see TS 38.213 [13], clause 9.2).

**resourceList**

PUCCH resources of *format0* and *format1* are only allowed in the first PUCCH resource set, i.e., in a PUCCH-ResourceSet with *pucch-ResourceSetId* = 0. This set may contain between 1 and 32 resources. PUCCH resources of *format2*, *format3* and *format4* are only allowed in a *PUCCH-ResourceSet* with *pucch-ResourceSetId* > 0. If present, these sets contain between 1 and 8 resources each. The UE chooses a *PUCCH-Resource* from this list as specified in TS 38.213 [13], clause 9.2.3. Note that this list contains only a list of resource IDs. The actual resources are configured in *PUCCH-Config*.

– **PUCCH-ConfigCommon**

The IE *PUCCH-ConfigCommon* is used to configure the cell specific PUCCH parameters.

**PUCCH-ConfigCommon information element**

```
-- ASN1START
-- TAG-PUCCH-CONFIGCOMMON-START

PUCCH-ConfigCommon ::=
    SEQUENCE {
        pucch-ResourceCommon          INTEGER (0..15)                OPTIONAL, -- Cond InitialBWP-Only
        pucch-GroupHopping            ENUMERATED { neither, enable, disable },
        hoppingId                     INTEGER (0..1023)                OPTIONAL, -- Need R
        p0-nominal                    INTEGER (-202..24)              OPTIONAL, -- Need R
        ...
    }

-- TAG-PUCCH-CONFIGCOMMON-STOP
-- ASN1STOP
```

**PUCCH-ConfigCommon field descriptions****hoppingId**

Cell-specific scrambling ID for group hopping and sequence hopping if enabled, see TS 38.211 [16], clause 6.3.2.2.

**p0-nominal**

Power control parameter P0 for PUCCH transmissions. Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.2).

**pucch-GroupHopping**

Configuration of group- and sequence hopping for all the PUCCH formats 0, 1, 3 and 4. Value *neither* implies neither group or sequence hopping is enabled. Value *enable* enables group hopping and disables sequence hopping. Value *disable* disables group hopping and enables sequence hopping (see TS 38.211 [16], clause 6.3.2.2).

**pucch-ResourceCommon**

An entry into a 16-row table where each row configures a set of cell-specific PUCCH resources/parameters. The UE uses those PUCCH resources until it is provided with a dedicated *PUCCH-Config* (e.g. during initial access) on the initial uplink BWP. Once the network provides a dedicated *PUCCH-Config* for that bandwidth part the UE applies that one instead of the one provided in this field (see TS 38.213 [13], clause 9.2).

| Conditional Presence   | Explanation   |
|------------------------|---|
| <i>InitialBWP-Only</i> | The field is mandatory present in the <i>PUCCH-ConfigCommon</i> of the initial BWP (BWP#0) in SIB1. It is absent in other BWPs. |

### – *PUCCH-PathlossReferenceRS-Id*

The IE *PUCCH-PathlossReferenceRS-Id* is an ID for a reference signal (RS) configured as PUCCH pathloss reference (see TS 38.213 [13], clause 7.2).

#### ***PUCCH-PathlossReferenceRS-Id* information element**

```
-- ASN1START
-- TAG-PUCCH-PATHLOSSREFERENCERS-ID-START

PUCCH-PathlossReferenceRS-Id ::=          INTEGER (0..maxNrofPUCCH-PathlossReferenceRSs-1)

-- TAG-PUCCH-PATHLOSSREFERENCERS-ID-STOP
-- ASN1STOP
```

### – *PUCCH-PowerControl*

The IE *PUCCH-PowerControl* is used to configure UE-specific parameters for the power control of PUCCH.

#### ***PUCCH-PowerControl* information element**

```
-- ASN1START
-- TAG-PUCCH-POWERCONTROL-START
PUCCH-PowerControl ::=
    SEQUENCE {
        deltaF-PUCCH-f0          INTEGER (-16..15)                OPTIONAL, -- Need R
        deltaF-PUCCH-f1          INTEGER (-16..15)                OPTIONAL, -- Need R
        deltaF-PUCCH-f2          INTEGER (-16..15)                OPTIONAL, -- Need R
        deltaF-PUCCH-f3          INTEGER (-16..15)                OPTIONAL, -- Need R
        deltaF-PUCCH-f4          INTEGER (-16..15)                OPTIONAL, -- Need R
        p0-Set                    SEQUENCE (SIZE (1..maxNrofPUCCH-P0-PerSet)) OF P0-PUCCH    OPTIONAL, -- Need M
        pathlossReferenceRSs      SEQUENCE (SIZE (1..maxNrofPUCCH-PathlossReferenceRSs)) OF PUCCH-PathlossReferenceRS    OPTIONAL, -- Need M
        twoPUCCH-PC-AdjustmentStates  ENUMERATED {twoStates}    OPTIONAL, -- Need S
        ...
    }

P0-PUCCH ::=
    SEQUENCE {
        p0-PUCCH-Id              P0-PUCCH-Id,
        p0-PUCCH-Value           INTEGER (-16..15)
    }

P0-PUCCH-Id ::=
    INTEGER (1..8)

PUCCH-PathlossReferenceRS ::=
    SEQUENCE {
        pucch-PathlossReferenceRS-Id
```

```

referenceSignal
  ssb-Index
  csi-RS-Index
}
CHOICE {
  SSB-Index,
  NZP-CSI-RS-ResourceId
}
-- TAG-PUCCH-POWERCONTROL-STOP
-- ASN1STOP

```

| <i>P0-PUCCH</i> field descriptions |
|------------------------------------|
|------------------------------------|

|                              |
|------------------------------|
| <b><i>p0-PUCCH-Value</i></b> |
|------------------------------|

|  |
|--|
| P0 value for PUCCH with 1dB step size. |
|--|

| <i>PUCCH-PowerControl</i> field descriptions |
|--|
|--|

|                               |
|-------------------------------|
| <b><i>deltaF-PUCCH-f0</i></b> |
|-------------------------------|

|  |
|--|
| deltaF for PUCCH format 0 with 1dB step size (see TS 38.213 [13], clause 7.2). |
|--|

|                               |
|-------------------------------|
| <b><i>deltaF-PUCCH-f1</i></b> |
|-------------------------------|

|  |
|--|
| deltaF for PUCCH format 1 with 1dB step size (see TS 38.213 [13], clause 7.2). |
|--|

|                               |
|-------------------------------|
| <b><i>deltaF-PUCCH-f2</i></b> |
|-------------------------------|

|  |
|--|
| deltaF for PUCCH format 2 with 1dB step size (see TS 38.213 [13], clause 7.2). |
|--|

|                               |
|-------------------------------|
| <b><i>deltaF-PUCCH-f3</i></b> |
|-------------------------------|

|  |
|--|
| deltaF for PUCCH format 3 with 1dB step size (see TS 38.213 [13], clause 7.2). |
|--|

|                               |
|-------------------------------|
| <b><i>deltaF-PUCCH-f4</i></b> |
|-------------------------------|

|  |
|--|
| deltaF for PUCCH format 4 with 1dB step size (see TS 38.213 [13], clause 7.2). |
|--|

|                      |
|----------------------|
| <b><i>p0-Set</i></b> |
|----------------------|

|  |
|--|
| A set with dedicated P0 values for PUCCH, i.e., {P01, P02,...} (see TS 38.213 [13], clause 7.2). |
|--|

|                                    |
|------------------------------------|
| <b><i>pathlossReferenceRSs</i></b> |
|------------------------------------|

|  |
|--|
| A set of Reference Signals (e.g. a CSI-RS config or a SS block) to be used for PUCCH pathloss estimation. Up to <i>maxNrofPUCCH-PathlossReference-RSs</i> may be configured. When the field is absent, the UE uses the SSB as reference signal (see TS 38.213 [13], clause 7.2). |
|--|

|  |
|--|
| <b><i>twoPUCCH-PC-AdjustmentStates</i></b> |
|--|

|  |
|--|
| Number of PUCCH power control adjustment states maintained by the UE (i.e., <i>g(i)</i> ). If the field is present ( <i>n2</i> ) the UE maintains two power control states (i.e., <i>g(i,0)</i> and <i>g(i,1)</i> ). If the field is absent, it maintains one power control state (i.e., <i>g(i,0)</i> ) (see TS 38.213 [13], clause 7.2). |
|--|

– *PUCCH-SpatialRelationInfo*

The IE *PUCCH-SpatialRelationInfo* is used to configure the spatial setting for PUCCH transmission and the parameters for PUCCH power control, see TS 38.213, [13], clause 9.2.2.

***PUCCH-SpatialRelationInfo* information element**

```

-- ASN1START
-- TAG-PUCCH-SPATIALRELATIONINFO-START

```



```

PUCCH-SpatialRelationInfo ::=
  pucch-SpatialRelationInfoId
  servingCellId
  referenceSignal
    ssb-Index
    csi-RS-Index
    srs
  },
  pucch-PathlossReferenceRS-Id
  p0-PUCCH-Id
  closedLoopIndex
}

SEQUENCE {
  PUCCH-SpatialRelationInfoId,
  ServCellIndex
  CHOICE {
    SSB-Index,
    NZP-CSI-RS-ResourceId,
    SEQUENCE {
      resource
      uplinkBWP
    }
  }
  PUCCH-PathlossReferenceRS-Id,
  P0-PUCCH-Id,
  ENUMERATED { i0, i1 }
}

PUCCH-SpatialRelationInfoId ::=
  INTEGER (1..maxNrofSpatialRelationInfos)

-- TAG-PUCCH-SPATIALRELATIONINFO-STOP
-- ASN1STOP

```

#### ***PUCCH-SpatialRelationInfo* field descriptions**

##### ***servingCellId***

If the field is absent, the UE applies the *ServCellId* of the serving cell in which this *PUCCH-SpatialRelationInfo* is configured

#### – ***PUCCH-TPC-CommandConfig***

The IE *PUCCH-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for PUCCH from a group-TPC messages on DCI.

#### ***PUCCH-TPC-CommandConfig* information element**

```

-- ASN1START
-- TAG-PUCCH-TPC-COMMANDCONFIG-START

PUCCH-TPC-CommandConfig ::=
  tpc-IndexPCell
  tpc-IndexPUCCH-SCell
  ...
}

SEQUENCE {
  INTEGER (1..15)
  INTEGER (1..15)
}

OPTIONAL, -- Cond PDCCH-OfSpCell
OPTIONAL, -- Cond PDCCH-ofSpCellOrPUCCH-SCell

-- TAG-PUCCH-TPC-COMMANDCONFIG-STOP
-- ASN1STOP

```

| <b>PUCCH-TPC-CommandConfig field descriptions</b> |  |
|---|--|
| <b><i>tpc-IndexPCell</i></b>                      | An index determining the position of the first bit of TPC command (applicable to the SpCell) inside the DCI format 2-2 payload.      |
| <b><i>tpc-IndexPUCCH-SCell</i></b>                | An index determining the position of the first bit of TPC command (applicable to the PUCCH SCell) inside the DCI format 2-2 payload. |

| <b>Conditional Presence</b>        | <b>Explanation</b>   |
|------------------------------------|--|
| <i>PDCCH-OfSpCell</i>              | The field is mandatory present if the <i>PUCCH-TPC-CommandConfig</i> is provided in the <i>PDCCH-Config</i> for the SpCell. Otherwise, the field is absent, Need R.  |
| <i>PDCCH-ofSpCellOrPUCCH-Scell</i> | The field is mandatory present if the <i>PUCCH-TPC-CommandConfig</i> is provided in the <i>PDCCH-Config</i> for the PUCCH-SCell. The field is optionally present, need R, if the UE is configured with a PUCCH SCell in this cell group and if the <i>PUCCH-TPC-CommandConfig</i> is provided in the <i>PDCCH-Config</i> for the SpCell. Otherwise, the field is absent, Need R. |

## – *PUSCH-Config*

The IE *PUSCH-Config* is used to configure the UE specific PUSCH parameters applicable to a particular BWP.

### ***PUSCH-Config* information element**

```

-- ASN1START
-- TAG-PUSCH-CONFIG-START

PUSCH-Config ::=
    dataScramblingIdentityPUSCH          INTEGER (0..1023)                OPTIONAL, -- Need S
    txConfig                             ENUMERATED {codebook, nonCodebook}  OPTIONAL, -- Need S
    dmrs-UplinkForPUSCH-MappingTypeA     SetupRelease { DMRS-UplinkConfig }  OPTIONAL, -- Need M
    dmrs-UplinkForPUSCH-MappingTypeB     SetupRelease { DMRS-UplinkConfig }  OPTIONAL, -- Need M

    pusch-PowerControl                   PUSCH-PowerControl                OPTIONAL, -- Need M
    frequencyHopping                     ENUMERATED {intraSlot, interSlot}    OPTIONAL, -- Need S
    frequencyHoppingOffsetLists           SEQUENCE (SIZE (1..4)) OF INTEGER (1.. maxNrofPhysicalResourceBlocks-1)  OPTIONAL, -- Need M

    resourceAllocation                    ENUMERATED { resourceAllocationType0, resourceAllocationType1, dynamicSwitch},
    pusch-TimeDomainAllocationList        SetupRelease { PUSCH-TimeDomainResourceAllocationList }  OPTIONAL, -- Need M
    pusch-AggregationFactor               ENUMERATED { n2, n4, n8 }           OPTIONAL, -- Need S
    mcs-Table                             ENUMERATED {qam256, qam64LowSE}     OPTIONAL, -- Need S
    mcs-TableTransformPrecoder            ENUMERATED {qam256, qam64LowSE}     OPTIONAL, -- Need S
    transformPrecoder                     ENUMERATED {enabled, disabled}      OPTIONAL, -- Need S
    codebookSubset                        ENUMERATED {fullyAndPartialAndNonCoherent, partialAndNonCoherent, nonCoherent}  OPTIONAL, -- Cond codebookBased

    maxRank                               INTEGER (1..4)                     OPTIONAL, -- Cond codebookBased
    rbg-Size                              ENUMERATED { config2}              OPTIONAL, -- Need S
    uci-OnPUSCH                           SetupRelease { UCI-OnPUSCH}        OPTIONAL, -- Need M
    tp-pi2BPSK                            ENUMERATED {enabled}               OPTIONAL, -- Need S
    ...
}

```

```
UCI-OnPUSCH ::=
  betaOffsets
    dynamic
    semiStatic
  }
  scaling
}

SEQUENCE {
  CHOICE {
    SEQUENCE (SIZE (4)) OF BetaOffsets,
    BetaOffsets
  }
  ENUMERATED { f0p5, f0p65, f0p8, f1 }
}

OPTIONAL, -- Need M

-- TAG-PUSCH-CONFIG-STOP
-- ASN1STOP
```

| <b>PUSCH-Config field descriptions</b>  |  |
|---|--|
| <b>codebookSubset</b>                   | Subset of PMIs addressed by TPMI, where PMIs are those supported by UEs with maximum coherence capabilities (see TS 38.214 [19], clause 6.1.1.1).  |
| <b>dataScramblingIdentityPUSCH</b>      | Identifier used to initialize data scrambling ( <i>c_init</i> ) for PUSCH. If the field is absent, the UE applies the physical cell ID. (see TS 38.211 [16], clause 6.3.1.1).  |
| <b>dmrs-UplinkForPUSCH-MappingTypeA</b> | DMRS configuration for PUSCH transmissions using PUSCH mapping type A (chosen dynamically via PUSCH-TimeDomainResourceAllocation). Only the fields <i>dmrs-Type</i> , <i>dmrs-AdditionalPosition</i> and <i>maxLength</i> may be set differently for mapping type A and B.                                 |
| <b>dmrs-UplinkForPUSCH-MappingTypeB</b> | DMRS configuration for PUSCH transmissions using PUSCH mapping type B (chosen dynamically via PUSCH-TimeDomainResourceAllocation). Only the fields <i>dmrs-Type</i> , <i>dmrs-AdditionalPosition</i> and <i>maxLength</i> may be set differently for mapping type A and B.                                 |
| <b>frequencyHopping</b>                 | The value <i>intraSlot</i> enables 'Intra-slot frequency hopping' and the value <i>interSlot</i> enables 'Inter-slot frequency hopping'. If the field is absent, frequency hopping is not configured (see TS 38.214 [19], clause 6.3).   |
| <b>frequencyHoppingOffsetLists</b>      | Set of frequency hopping offsets used when frequency hopping is enabled for granted transmission (not msg3) and type 2 (see TS 38.214 [19], clause 6.3).   |
| <b>maxRank</b>                          | Subset of PMIs addressed by TRIs from 1 to ULmaxRank (see TS 38.214 [19], clause 6.1.1.1).   |
| <b>mcs-Table</b>                        | Indicates which MCS table the UE shall use for PUSCH without transform precoder (see TS 38.214 [19], clause 6.1.4.1). If the field is absent the UE applies the value 64QAM  |
| <b>mcs-TableTransformPrecoder</b>       | Indicates which MCS table the UE shall use for PUSCH with transform precoding (see TS 38.214 [19], clause 6.1.4.1). If the field is absent the UE applies the value 64QAM  |
| <b>pusch-AggregationFactor</b>          | Number of repetitions for data (see TS 38.214 [19], clause 6.1.2.1). If the field is absent the UE applies the value 1.  |
| <b>pusch-TimeDomainAllocationList</b>   | List of time domain allocations for timing of UL assignment to UL data (see TS 38.214 [19], table 6.1.2.1.1-1).  |
| <b>rbg-Size</b>                         | Selection between configuration 1 and configuration 2 for RBG size for PUSCH. The UE does not apply this field if <i>resourceAllocation</i> is set to <i>resourceAllocationType1</i> . Otherwise, the UE applies the value <i>config1</i> when the field is absent (see TS 38.214 [19], clause 6.1.2.2.1). |
| <b>resourceAllocation</b>               | Configuration of resource allocation type 0 and resource allocation type 1 for non-fallback DCI (see TS 38.214 [19], clause 6.1.2).  |
| <b>tp-pi2BPSK</b>                       | Enables pi/2-BPSK modulation with transform precoding if the field is present and disables it otherwise.   |
| <b>transformPrecoder</b>                | The UE specific selection of transformer precoder for PUSCH (see TS 38.214 [19], clause 6.1.3). When the field is absent the UE applies the value of the field <i>msg3-transformPrecoder</i> .   |
| <b>txConfig</b>                         | Whether UE uses codebook based or non-codebook based transmission (see TS 38.214 [19], clause 6.1.1). If the field is absent, the UE transmits PUSCH on one antenna port, see TS 38.214 [19], clause 6.1.1.  |

| <b>UCI-OnPUSCH field descriptions</b>  |
|--|
| <b>betaOffsets</b><br>Selection between and configuration of dynamic and semi-static beta-offset. If the field is not configured, the UE applies the value 'semiStatic' (see TS 38.213 [13], clause 9.3).  |
| <b>scaling</b><br>Indicates a scaling factor to limit the number of resource elements assigned to UCI on PUSCH. Value <i>f0p5</i> corresponds to 0.5, value <i>f0p65</i> corresponds to 0.65, and so on. The value configured herein is applicable for PUSCH with configured grant (see TS 38.212 [17], clause 6.3). |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>codebookBased</i>        | The field is mandatory present if <i>txConfig</i> is set to codebook and absent otherwise. |

## – PUSCH-ConfigCommon

The IE *PUSCH-ConfigCommon* is used to configure the cell specific PUSCH parameters.

### **PUSCH-ConfigCommon information element**

```
-- ASN1START
-- TAG-PUSCH-CONFIGCOMMON-START

PUSCH-ConfigCommon ::=
    SEQUENCE {
        groupHoppingEnabledTransformPrecoding  ENUMERATED {enabled}           OPTIONAL, -- Need R
        pusch-TimeDomainAllocationList          PUSCH-TimeDomainResourceAllocationList OPTIONAL, -- Need R
        msg3-DeltaPreamble                      INTEGER (-1..6)                   OPTIONAL, -- Need R
        p0-NominalWithGrant                    INTEGER (-202..24)                OPTIONAL, -- Need R
        ...
    }

-- TAG-PUSCH-CONFIGCOMMON-STOP
-- ASN1STOP
```

| <b>PUSCH-ConfigCommon field descriptions</b>   |
|--|
| <b>groupHoppingEnabledTransformPrecoding</b><br>For DMRS transmission with transform precoder, the NW may configure group hopping by this cell-specific parameter, see TS 38.211 [16], clause 6.4.1.1.1.2. |
| <b>msg3-DeltaPreamble</b><br>Power offset between msg3 and RACH preamble transmission. Actual value = field value * 2 [dB] (see TS 38.213 [13], clause 7.1)  |
| <b>p0-NominalWithGrant</b><br>P0 value for PUSCH with grant (except msg3). Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.1) This field is cell specific               |
| <b>pusch-TimeDomainAllocationList</b><br>List of time domain allocations for timing of UL assignment to UL data (see TS 38.214 [19], table 6.1.2.1.1-1).   |

## – PUSCH-PowerControl

The IE *PUSCH-PowerControl* is used to configure UE specific power control parameter for PUSCH.

**PUSCH-PowerControl** information element

```

-- ASN1START
-- TAG-PUSCH-POWERCONTROL-START

PUSCH-PowerControl ::=
    SEQUENCE {
        tpc-Accumulation          ENUMERATED { disabled }          OPTIONAL, -- Need S
        msg3-Alpha                Alpha                          OPTIONAL, -- Need S
        p0-NominalWithoutGrant    INTEGER (-202..24)              OPTIONAL, -- Need M
        p0-AlphaSets              SEQUENCE (SIZE (1..maxNrofP0-PUSCH-AlphaSets)) OF P0-PUSCH-AlphaSet  OPTIONAL, -- Need M
        pathlossReferenceRSToAddModList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS  OPTIONAL, -- Need N
        pathlossReferenceRSToReleaseList SEQUENCE (SIZE (1..maxNrofPUSCH-PathlossReferenceRSs)) OF PUSCH-PathlossReferenceRS-Id  OPTIONAL, -- Need N
        twoPUSCH-PC-AdjustmentStates ENUMERATED { twoStates }          OPTIONAL, -- Need S
        deltaMCS                  ENUMERATED { enabled }          OPTIONAL, -- Need S
        sri-PUSCH-MappingToAddModList SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControl  OPTIONAL, -- Need N
        sri-PUSCH-MappingToReleaseList SEQUENCE (SIZE (1..maxNrofSRI-PUSCH-Mappings)) OF SRI-PUSCH-PowerControlId  OPTIONAL -- Need N
    }

P0-PUSCH-AlphaSet ::=
    SEQUENCE {
        p0-PUSCH-AlphaSetId      P0-PUSCH-AlphaSetId,
        p0                        INTEGER (-16..15)              OPTIONAL, -- Need S
        alpha                    Alpha                          OPTIONAL -- Need S
    }

P0-PUSCH-AlphaSetId ::=
    INTEGER (0..maxNrofP0-PUSCH-AlphaSets-1)

PUSCH-PathlossReferenceRS ::=
    SEQUENCE {
        pusch-PathlossReferenceRS-Id PUSCH-PathlossReferenceRS-Id,
        referenceSignal              CHOICE {
            ssb-Index                SSB-Index,
            csi-RS-Index              NZP-CSI-RS-ResourceId
        }
    }

PUSCH-PathlossReferenceRS-Id ::=
    INTEGER (0..maxNrofPUSCH-PathlossReferenceRSs-1)

SRI-PUSCH-PowerControl ::=
    SEQUENCE {
        sri-PUSCH-PowerControlId     SRI-PUSCH-PowerControlId,
        sri-PUSCH-PathlossReferenceRS-Id PUSCH-PathlossReferenceRS-Id,
        sri-P0-PUSCH-AlphaSetId      P0-PUSCH-AlphaSetId,
        sri-PUSCH-ClosedLoopIndex    ENUMERATED { i0, i1 }
    }

SRI-PUSCH-PowerControlId ::=
    INTEGER (0..maxNrofSRI-PUSCH-Mappings-1)

BetaOffsets ::=
    SEQUENCE {
        betaOffsetACK-Index1        INTEGER(0..31)          OPTIONAL, -- Need S
        betaOffsetACK-Index2        INTEGER(0..31)          OPTIONAL, -- Need S
        betaOffsetACK-Index3        INTEGER(0..31)          OPTIONAL, -- Need S
    }

```

```

betaOffsetCSI-Part1-Index1    INTEGER(0..31)
betaOffsetCSI-Part1-Index2    INTEGER(0..31)
betaOffsetCSI-Part2-Index1    INTEGER(0..31)
betaOffsetCSI-Part2-Index2    INTEGER(0..31)
}
-- TAG-PUSCH-POWERCONTROL-STOP
-- ASN1STOP
OPTIONAL, -- Need S
OPTIONAL, -- Need S
OPTIONAL, -- Need S
OPTIONAL, -- Need S

```

| <b>BetaOffsets field descriptions</b>   |
|---|
| <b>betaOffsetACK-Index1</b><br>Up to 2 bits HARQ-ACK (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 11                  |
| <b>betaOffsetACK-Index2</b><br>Up to 11 bits HARQ-ACK (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 11                 |
| <b>betaOffsetACK-Index3</b><br>Above 11 bits HARQ-ACK (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 11                 |
| <b>betaOffsetCSI-Part1-Index1</b><br>Up to 11 bits of CSI part 1 bits (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 13 |
| <b>betaOffsetCSI-Part1-Index2</b><br>Above 11 bits of CSI part 1 bits (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 13 |
| <b>betaOffsetCSI-Part2-Index1</b><br>Up to 11 bits of CSI part 2 bits (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 13 |
| <b>betaOffsetCSI-Part2-Index2</b><br>Above 11 bits of CSI part 2 bits (see TS 38.213 [13], clause 9.3) When the field is absent the UE applies the value 13 |

| <b>P0-PUSCH-AlphaSet field descriptions</b>   |
|---|
| <b>alpha</b><br>alpha value for PUSCH with grant (except msg3) (see TS 38.213 [13], clause 7.1) When the field is absent the UE applies the value 1 |
| <b>p0</b><br>P0 value for PUSCH with grant (except msg3) in steps of 1dB (see TS 38.213 [13], clause 7.1)   |

| <b>PUSCH-PowerControl field descriptions</b> |  |
|--|--|
| <b>deltaMCS</b>                              | Indicates whether to apply delta MCS. When the field is absent, the UE applies $K_s = 0$ in $\text{delta\_TFC}$ formula for PUSCH (see TS 38.213 [13], clause 7.1)   |
| <b>msg3-Alpha</b>                            | Dedicated alpha value for msg3 PUSCH (see TS 38.213 [13], clause 7.1). When the field is absent the UE applies the value 1.  |
| <b>p0-AlphaSets</b>                          | configuration {p0-pusch, alpha} sets for PUSCH (except msg3), i.e., { {p0,alpha,index1}, {p0,alpha,index2},...} (see TS 38.213 [13], clause 7.1). When no set is configured, the UE uses the P0-nominal for msg3 PUSCH, P0-UE is set to 0 and alpha is set according to msg3-Alpha configured for msg3 PUSCH.        |
| <b>p0-NominalWithoutGrant</b>                | P0 value for UL grant-free/SPS based PUSCH. Value in dBm. Only even values (step size 2) allowed (see TS 38.213 [13], clause 7.1)  |
| <b>pathlossReferenceRSToAddModList</b>       | A set of Reference Signals (e.g. a CSI-RS config or a SS block) to be used for PUSCH path loss estimation. Up to $\text{maxNrofPUSCH-PathlossReferenceRSs}$ may be configured (see TS 38.213 [13], clause 7.1)   |
| <b>sri-PUSCH-MappingToAddModList</b>         | A list of <i>SRI-PUSCH-PowerControl</i> elements among which one is selected by the SRI field in DCI (see TS 38.213 [13], clause 7.1)  |
| <b>tpc-Accumulation</b>                      | If enabled, UE applies TPC commands via accumulation. If not enabled, UE applies the TPC command without accumulation. If the field is absent, TPC accumulation is enabled (see TS 38.213 [13], clause 7.1)  |
| <b>twoPUSCH-PC-AdjustmentStates</b>          | Number of PUSCH power control adjustment states maintained by the UE (i.e., $fc(i)$ ). If the field is present ( $n2$ ) the UE maintains two power control states (i.e., $fc(i,0)$ and $fc(i,1)$ ). If the field is absent, it maintains one power control state (i.e., $fc(i,0)$ ) (see TS 38.213 [13], clause 7.1) |

| <b>SRI-PUSCH-PowerControl field descriptions</b> |   |
|--|---|
| <b>sri-P0-PUSCH-AlphaSetId</b>                   | The ID of a <i>P0-PUSCH-AlphaSet</i> as configured in <i>p0-AlphaSets</i> in <i>PUSCH-PowerControl</i> .                              |
| <b>sri-PUSCH-ClosedLoopIndex</b>                 | The index of the closed power control loop associated with this <i>SRI-PUSCH-PowerControl</i> .                                       |
| <b>sri-PUSCH-PathlossReferenceRS-Id</b>          | The ID of <i>PUSCH-PathlossReferenceRS</i> as configured in the <i>pathlossReferenceRSToAddModList</i> in <i>PUSCH-PowerControl</i> . |
| <b>sri-PUSCH-PowerControlId</b>                  | The ID of this <i>SRI-PUSCH-PowerControl</i> configuration. It is used as the codepoint (payload) in the SRI DCI field.               |

## – PUSCH-ServingCellConfig

The IE *PUSCH-ServingCellConfig* is used to configure UE specific PUSCH parameters that are common across the UE's BWPs of one serving cell.

### **PUSCH-ServingCellConfig** information element

```
-- ASN1START
-- TAG-PUSCH-SERVINGCELLCONFIG-START

PUSCH-ServingCellConfig ::=
    SEQUENCE {
        codeBlockGroupTransmission          SetupRelease { PUSCH-CodeBlockGroupTransmission }    OPTIONAL,  -- Need M
        rateMatching                       ENUMERATED {limitedBufferRM}                               OPTIONAL,  -- Need S
        xOverhead                           ENUMERATED {xoh6, xoh12, xoh18}                               OPTIONAL,  -- Need S
    }
-- ASN1END
```



```

    ...
    [[
    maxMIMO-Layers                INTEGER (1..4)                OPTIONAL,  -- Need M
    processingType2Enabled         BOOLEAN                    OPTIONAL  -- Need M
    ]]
}

PUSCH-CodeBlockGroupTransmission ::= SEQUENCE {
    maxCodeBlockGroupsPerTransportBlock  ENUMERATED {n2, n4, n6, n8},
    ...
}

-- TAG-PUSCH-SERVINGCELLCONFIG-STOP
-- ASN1STOP

```

| <i>PUSCH-CodeBlockGroupTransmission</i> field descriptions |
|--|
|--|

|   |
|---|
| <b><i>maxCodeBlockGroupsPerTransportBlock</i></b> |
|---|

|  |
|--|
| Maximum number of code-block-groups (CBGs) per TB (see TS 38.213 [13], section 9.1). |
|--|

| <i>PUSCH-ServingCellConfig</i> field descriptions |
|---|
|---|

|  |
|--|
| <b><i>codeBlockGroupTransmission</i></b> |
|--|

|  |
|--|
| Enables and configures code-block-group (CBG) based transmission (see TS 38.214 [19], clause 5.1.5). |
|--|

|                              |
|------------------------------|
| <b><i>maxMIMO-Layers</i></b> |
|------------------------------|

|   |
|---|
| Indicates the maximum MIMO layer to be used for PUSCH in all BWPs of this serving cell (see TS 38.212 [17], clause 5.4.2.1). If present, the network sets <i>maxRank</i> to the same value. |
|---|

|                                      |
|--------------------------------------|
| <b><i>processingType2Enabled</i></b> |
|--------------------------------------|

|   |
|---|
| Enables configuration of advanced processing time capability 2 for PUSCH (see 38.214 [19], clause 6.4). |
|---|

|                            |
|----------------------------|
| <b><i>rateMatching</i></b> |
|----------------------------|

|   |
|---|
| Enables LBRM (Limited buffer rate-matching). When the field is absent the UE applies FBRM (Full buffer rate-matchingLBRM) (see TS 38.212 [17], clause 5.4.2). |
|---|

|                         |
|-------------------------|
| <b><i>xOverhead</i></b> |
|-------------------------|

|  |
|--|
| Accounts for overhead from CSI-RS, CORESET, etc. If the field is absent, the UE applies the value 'xoh0' (see TS 38.214 [19], clause 5.1.3.2). |
|--|

– *PUSCH-TimeDomainResourceAllocationList*

The IE *PUSCH-TimeDomainResourceAllocation* is used to configure a time domain relation between PDCCH and PUSCH. *PUSCH-TimeDomainResourceAllocationList* contains one or more of such *PUSCH-TimeDomainResourceAllocations*. The network indicates in the UL grant which of the configured time domain allocations the UE shall apply for that UL grant. The UE determines the bit width of the DCI field based on the number of entries in the *PUSCH-TimeDomainResourceAllocationList*. Value 0 in the DCI field refers to the first element in this list, value 1 in the DCI field refers to the second element in this list, and so on.

***PUSCH-TimeDomainResourceAllocation* information element**

```

-- ASN1START
-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATIONLIST-START

```

```

PUSCH-TimeDomainResourceAllocationList ::= SEQUENCE (SIZE(1..maxNrofUL-Allocations)) OF PUSCH-TimeDomainResourceAllocation

```

```

PUSCH-TimeDomainResourceAllocation ::= SEQUENCE {
    k2                               INTEGER(0..32)           OPTIONAL,    -- Need S
    mappingType                      ENUMERATED {typeA, typeB},
    startSymbolAndLength             INTEGER (0..127)
}

-- TAG-PUSCH-TIMEDOMAINRESOURCEALLOCATIONLIST-STOP
-- ASN1STOP

```

#### ***PUSCH-TimeDomainResourceAllocationList* field descriptions**

|   |
|---|
| <b><i>k2</i></b>  |
| Corresponds to L1 parameter 'K2' (see TS 38.214 [19], clause 6.1.2.1) When the field is absent the UE applies the value 1 when PUSCH SCS is 15/30 kHz; the value 2 when PUSCH SCS is 60 kHz, and the value 3 when PUSCH SCS is 120KHz.                |
| <b><i>mappingType</i></b>   |
| Mapping type (see TS 38.214 [19], clause 6.1.2.1).  |
| <b><i>startSymbolAndLength</i></b>  |
| An index giving valid combinations of start symbol and length (jointly encoded) as start and length indicator (SLIV). The network configures the field so that the allocation does not cross the slot boundary. (see TS 38.214 [19], clause 6.1.2.1). |

#### – ***PUSCH-TPC-CommandConfig***

The IE *PUSCH-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for PUSCH from a group-TPC messages on DCI.

#### ***PUSCH-TPC-CommandConfig* information element**

```

-- ASN1START
-- TAG-PUSCH-TPC-COMMANDCONFIG-START

PUSCH-TPC-CommandConfig ::= SEQUENCE {
    tpc-Index                      INTEGER (1..15)           OPTIONAL,    -- Cond SUL
    tpc-IndexSUL                   INTEGER (1..15)           OPTIONAL,    -- Cond SUL-Only
    targetCell                     ServCellIndex             OPTIONAL,    -- Need S
    ...
}

-- TAG-PUSCH-TPC-COMMANDCONFIG-STOP
-- ASN1STOP

```

| <b>PUSCH-TPC-CommandConfig field descriptions</b> |   |
|---|---|
| <b>targetCell</b>                                 | The serving cell to which the acquired power control commands are applicable. If the value is absent, the UE applies the TPC commands to the serving cell on which the command has been received. |
| <b>tpc-Index</b>                                  | An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.  |
| <b>tpc-IndexSUL</b>                               | An index determining the position of the first bit of TPC command inside the DCI format 2-2 payload.  |

| <b>Conditional Presence</b> | <b>Explanation</b>  |
|-----------------------------|---|
| <i>SUL-Only</i>             | The field is optionally present, Need R, if this serving cell is configured with a supplementary uplink (SUL). It is absent otherwise.            |
| <i>SUL</i>                  | The field is optionally present, Need R, if this serving cell is configured with a supplementary uplink (SUL). It is mandatory present otherwise. |

### – *Q-OffsetRange*

The IE *Q-OffsetRange* is used to indicate a cell, beam or measurement object specific offset to be applied when evaluating candidates for cell re-selection or when evaluating triggering conditions for measurement reporting. The value is in dB. Value *dB-24* corresponds to -24 dB, *dB-22* corresponds to -22 dB and so on.

#### **Q-OffsetRange information element**

```
-- ASN1START
-- TAG-Q-OFFSETRANGE-START

Q-OffsetRange ::=
    ENUMERATED {
        dB-24, dB-22, dB-20, dB-18, dB-16, dB-14,
        dB-12, dB-10, dB-8, dB-6, dB-5, dB-4, dB-3,
        dB-2, dB-1, dB0, dB1, dB2, dB3, dB4, dB5,
        dB6, dB8, dB10, dB12, dB14, dB16, dB18,
        dB20, dB22, dB24}

-- TAG-Q-OFFSETRANGE-STOP
-- ASN1STOP
```

### – *Q-QualMin*

The IE *Q-QualMin* is used to indicate for cell selection/ re-selection the required minimum received RSRQ level in the (NR) cell. Corresponds to parameter  $Q_{\text{qualmin}}$  in TS 38.304 [20]. Actual value  $Q_{\text{qualmin}} = \text{field value [dB]}$ .

#### **Q-QualMin information element**

```
-- ASN1START
-- TAG-Q-QUALMIN-START
```

```

Q-QualMin ::=                               INTEGER (-43..-12)

-- TAG-Q-QUALMIN-STOP
-- ASN1STOP

```

### – *Q-RxLevMin*

The IE *Q-RxLevMin* is used to indicate for cell selection/ re-selection the required minimum received RSRP level in the (NR) cell. Corresponds to parameter  $Q_{rxlevmin}$  in TS 38.304 [20]. Actual value  $Q_{rxlevmin} = \text{field value} * 2$  [dBm].

#### **Q-RxLevMin information element**

```

-- ASN1START
-- TAG-Q-RXLEVMIN-START

Q-RxLevMin ::=                               INTEGER (-70..-22)

-- TAG-Q-RXLEVMIN-STOP
-- ASN1STOP

```

### – *QuantityConfig*

The IE *QuantityConfig* specifies the measurement quantities and layer 3 filtering coefficients for NR and inter-RAT measurements.

#### **QuantityConfig information element**

```

-- ASN1START
-- TAG-QUANTITYCONFIG-START

QuantityConfig ::=
  SEQUENCE {
    quantityConfigNR-List      SEQUENCE (SIZE (1..maxNrofQuantityConfig)) OF QuantityConfigNR      OPTIONAL,  -- Need M
    ...,
    [[
      quantityConfigEUTRA      FilterConfig                                                         OPTIONAL  -- Need M
    ]]
  }

QuantityConfigNR ::=
  SEQUENCE {
    quantityConfigCell          QuantityConfigRS,
    quantityConfigRS-Index      QuantityConfigRS                                                         OPTIONAL  -- Need M
  }

QuantityConfigRS ::=
  SEQUENCE {
    ssb-FilterConfig           FilterConfig,
    csi-RS-FilterConfig         FilterConfig
  }

```

```

}
FilterConfig ::=
    filterCoefficientRSRP          FilterCoefficient          DEFAULT fc4,
    filterCoefficientRSRQ          FilterCoefficient          DEFAULT fc4,
    filterCoefficientRS-SINR       FilterCoefficient          DEFAULT fc4
}
-- TAG-QUANTITYCONFIG-STOP
-- ASN1STOP

```

#### **QuantityConfigNR field descriptions**

##### **quantityConfigCell**

Specifies L3 filter configurations for cell measurement results for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).

##### **quantityConfigRS-Index**

Specifies L3 filter configurations for measurement results per RS index for the configurable RS Types (e.g. SS/PBCH block and CSI-RS) and the configurable measurement quantities (e.g. RSRP, RSRQ and SINR).

#### **QuantityConfigRS field descriptions**

##### **csi-RS-FilterConfig**

CSI-RS based L3 filter configurations:

Specifies L3 filter configurations for CSI-RSRP, CSI-RSRQ and CSI-SINR measurement results from the L1 filter(s), as defined in TS 38.215 [9].

##### **ssb-FilterConfig**

SS Block based L3 filter configurations:

Specifies L3 filter configurations for SS-RSRP, SS-RSRQ and SS-SINR measurement results from the L1 filter(s), as defined in TS 38.215 [9].

## – RACH-ConfigCommon

The IE *RACH-ConfigCommon* is used to specify the cell specific random-access parameters.

#### **RACH-ConfigCommon information element**

```

-- ASN1START
-- TAG-RACH-CONFIGCOMMON-START

RACH-ConfigCommon ::=
    rach-ConfigGeneric          RACH-ConfigGeneric,
    totalNumberOfRA-Preambles  INTEGER (1..63)                                OPTIONAL, -- Need S
    ssb-perRACH-OccasionAndCB-PreamblesPerSSB CHOICE {
        oneEighth              ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
        oneFourth              ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
        oneHalf                ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
        one                    ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},
        two                    ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32},
        four                   INTEGER (1..16),
    }

```

```

    eight                INTEGER (1..8),
    sixteen              INTEGER (1..4)
  }
                                                                    OPTIONAL, -- Need M
groupBconfigured        SEQUENCE {
  ra-Msg3SizeGroupA     ENUMERATED {b56, b144, b208, b256, b282, b480, b640,
                                b800, b1000, b72, spare6, spare5, spare4, spare3, spare2, spare1},
  messagePowerOffsetGroupB
  numberOfRA-PreamblesGroupA
  INTEGER (1..64)
  ra-ContentionResolutionTimer
  ENUMERATED { sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64},
  rsrp-ThresholdSSB     RSRP-Range
  rsrp-ThresholdSSB-SUL RSRP-Range
  prach-RootSequenceIndex
  CHOICE {
    1839                INTEGER (0..837),
    1139                INTEGER (0..137)
  },
  msg1-SubcarrierSpacing
  SubcarrierSpacing
  restrictedSetConfig    ENUMERATED {unrestrictedSet, restrictedSetTypeA, restrictedSetTypeB},
  msg3-transformPrecoder
  ENUMERATED {enabled}
  ...
}
                                                                    OPTIONAL, -- Cond L139
                                                                    OPTIONAL, -- Need R
                                                                    OPTIONAL, -- Cond SUL
                                                                    OPTIONAL, -- Need R
                                                                    OPTIONAL, -- Need R
                                                                    OPTIONAL, -- Need R
-- TAG-RACH-CONFIGCOMMON-STOP
-- ASN1STOP

```

| <b>RACH-ConfigCommon field descriptions</b>   |
|---|
| <p><b>messagePowerOffsetGroupB</b><br/>Threshold for preamble selection. Value is in dB. Value <i>minusinfinity</i> corresponds to <math>-\infty</math>. Value <i>dB0</i> corresponds to 0 dB, <i>dB5</i> corresponds to 5 dB and so on. (see TS 38.321 [3], clause 5.1.2)</p>  |
| <p><b>msg1-SubcarrierSpacing</b><br/>Subcarrier spacing of PRACH (see TS 38.211 [16], clause 5.3.2). Only the values 15 or 30 kHz (FR1), and 60 or 120 kHz (FR2) are applicable. If absent, the UE applies the SCS as derived from the <i>prach-ConfigurationIndex</i> in <i>RACH-ConfigGeneric</i> (see tables Table 6.3.3.1-1 and Table 6.3.3.2-2, TS 38.211 [16]). The value also applies to contention free random access (<i>RACH-ConfigDedicated</i>), to SI-request and to contention-based beam failure recovery (CB-BFR). But it does not apply for contention free beam failure recovery (CF-BFR) (see <i>BeamFailureRecoveryConfig</i>).</p>   |
| <p><b>msg3-transformPrecoder</b><br/>Enables the transform precoder for Msg3 transmission according to clause 6.1.3 of TS 38.214 [19]. If the field is absent, the UE disables the transformer precoder (see TS 38.213 [13], clause 8.3).</p>   |
| <p><b>numberOfRA-PreamblesGroupA</b><br/>The number of CB preambles per SSB in group A. This determines implicitly the number of CB preambles per SSB available in group B. (see TS 38.321 [3], clause 5.1.1). The setting should be consistent with the setting of <i>ssb-perRACH-OccasionAndCB-PreamblesPerSSB</i>.</p>   |
| <p><b>prach-RootSequenceIndex</b><br/>PRACH root sequence index (see TS 38.211 [16], clause 6.3.3.1). The value range depends on whether <math>L=839</math> or <math>L=139</math>. The short/long preamble format indicated in this IE should be consistent with the one indicated in <i>prach-ConfigurationIndex</i> in the <i>RACH-ConfigDedicated</i> (if configured).</p>   |
| <p><b>ra-ContentionResolutionTimer</b><br/>The initial value for the contention resolution timer (see TS 38.321 [3], clause 5.1.5). Value <i>sf8</i> corresponds to 8 subframes, value <i>sf16</i> corresponds to 16 subframes, and so on.</p>  |
| <p><b>ra-Msg3SizeGroupA</b><br/>Transport Blocks size threshold in bits below which the UE shall use a contention-based RA preamble of group A. (see TS 38.321 [3], clause 5.1.2).</p>  |
| <p><b>rach-ConfigGeneric</b><br/>RACH parameters for both regular random access and beam failure recovery.</p>  |
| <p><b>restrictedSetConfig</b><br/>Configuration of an unrestricted set or one of two types of restricted sets, see TS 38.211 [16], clause 6.3.3.1.</p>  |
| <p><b>rsrp-ThresholdSSB</b><br/>UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission based on SS blocks that satisfy the threshold (see TS 38.213 [13]).</p>   |
| <p><b>rsrp-ThresholdSSB-SUL</b><br/>The UE selects SUL carrier to perform random access based on this threshold (see TS 38.321 [3], clause 5.1.1). The value applies to all the BWPs.</p>   |
| <p><b>ssb-perRACH-OccasionAndCB-PreamblesPerSSB</b><br/>The meaning of this field is twofold: the CHOICE conveys the information about the number of SSBs per RACH occasion. Value <i>oneEight</i> corresponds to one SSB associated with 8 RACH occasions, value <i>oneFourth</i> corresponds to one SSB associated with 4 RACH occasions, and so on. The ENUMERATED part indicates the number of Contention Based preambles per SSB. Value <i>n4</i> corresponds to 4 Contention Based preambles per SSB, value <i>n8</i> corresponds to 8 Contention Based preambles per SSB, and so on. The total number of CB preambles in a RACH occasion is given by <math>CB\text{-preambles-per-SSB} * \max(1, SSB\text{-per-rach-occasion})</math>. See TS 38.213 [13].</p> |
| <p><b>totalNumberOfRA-Preambles</b><br/>Total number of preambles used for contention based and contention free random access in the RACH resources defined in <i>RACH-ConfigCommon</i>, excluding preambles used for other purposes (e.g. for SI request). If the field is absent, all 64 preambles are available for RA. The setting should be consistent with the setting of <i>ssb-perRACH-OccasionAndCB-PreamblesPerSSB</i>, i.e. it should be a multiple of the number of SSBs per RACH occasion.</p>   |

| Conditional Presence | Explanation   |
|----------------------|---|
| L139                 | The field is mandatory present if <i>prach-RootSequenceIndex</i> L=139, otherwise the field is absent.                    |
| SUL                  | The field is mandatory present in <i>initialUplinkBWP</i> in <i>supplementaryUplink</i> ; otherwise, the field is absent. |

## – RACH-ConfigDedicated

The IE *RACH-ConfigDedicated* is used to specify the dedicated random access parameters.

### RACH-ConfigDedicated information element

```

-- ASN1START
-- TAG-RACH-CONFIGDEDICATED-START

RACH-ConfigDedicated ::=          SEQUENCE {
    cfra                            CFRA                            OPTIONAL, -- Need S
    ra-Prioritization                RA-Prioritization              OPTIONAL, -- Need N
    ...
}

CFRA ::=                          SEQUENCE {
    occasions                        SEQUENCE {
        rach-ConfigGeneric          RACH-ConfigGeneric,
        ssb-perRACH-Occasion        ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}
    }                                OPTIONAL -- Cond SSB-CFRA
    resources                        CHOICE {
        ssb                          SEQUENCE {
            ssb-ResourceList         SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,
            ra-ssb-OccasionMaskIndex INTEGER (0..15)
        },
        csirs                         SEQUENCE {
            csirs-ResourceList       SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,
            rsrp-ThresholdCSI-RS     RSRP-Range
        }
    },
    ...
    [[
    totalNumberOfRA-Preambles-v1530 INTEGER (1..63)                                OPTIONAL -- Cond Occasions
    ]]
}

CFRA-SSB-Resource ::=             SEQUENCE {
    ssb                              SSB-Index,
    ra-PreambleIndex                 INTEGER (0..63),
    ...
}

CFRA-CSIRS-Resource ::=          SEQUENCE {
    csi-RS                           CSI-RS-Index,

```



```

    ra-OccasionList          SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1),
    ra-PreambleIndex        INTEGER (0..63),
    ...
}

-- TAG-RACH-CONFIGDEDICATED-STOP
-- ASN1STOP

```

#### **CFRA-CSIRS-Resource field descriptions**

##### **csi-RS**

The ID of a CSI-RS resource defined in the measurement object associated with this serving cell.

##### **ra-OccasionList**

RA occasions that the UE shall use when performing CF-RA upon selecting the candidate beam identified by this CSI-RS. The network ensures that the RA occasion indexes provided herein are also configured by prach-ConfigurationIndex and msg1-FDM. Each RACH occasion is sequentially numbered, first, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions; second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot and Third, in increasing order of indexes for PRACH slots.

##### **ra-PreambleIndex**

The RA preamble index to use in the RA occasions associated with this CSI-RS.

#### **CFRA field descriptions**

##### **occasions**

RA occasions for contention free random access. If the field is absent, the UE uses the RA occasions configured in *RACH-ConfigCommon* in the first active UL BWP.

##### **ra-ssb-OccasionMaskIndex**

Explicitly signalled PRACH Mask Index for RA Resource selection in TS 36.321. The mask is valid for all SSB resources signalled in *ssb-ResourceList*.

##### **rach-ConfigGeneric**

Configuration of contention free random access occasions for CFRA. The UE shall ignore *preambleReceivedTargetPower*, *preambleTransMax*, *powerRampingStep*, *ra-ResponseWindow* signaled within this field and use the corresponding values provided in *RACH-ConfigCommon*.

##### **ssb-perRACH-Occasion**

Number of SSBs per RACH occasion.

##### **totalNumberOfRA-Preambles**

Total number of preambles used for contention free random access in the RACH resources defined in CFRA, excluding preambles used for other purposes (e.g. for SI request). If the field is absent but the field *occasions* is present, the UE may assume all the 64 preambles are for RA. The setting should be consistent with the setting of *ssb-perRACH-Occasion*, if present, i.e. it should be a multiple of the number of SSBs per RACH occasion.

#### **CFRA-SSB-Resource field descriptions**

##### **ra-PreambleIndex**

The preamble index that the UE shall use when performing CF-RA upon selecting the candidate beams identified by this SSB.

##### **ssb**

The ID of an SSB transmitted by this serving cell.

| <i>RACH-ConfigDedicated</i> field descriptions |  |
|--|--|
| <b>cfra</b>                                    | Parameters for contention free random access to a given target cell. If the field is absent, the UE performs contention based random access. |
| <b>ra-prioritization</b>                       | Parameters which apply for prioritized random access procedure to a given target cell (see TS 38.321 [3], clause 5.1.1).                     |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>SSB-CFRA</i>      | The field is mandatory present if the field resources in CFRA is set to <i>ssb</i> ; otherwise it is absent. |
| <i>Occasions</i>     | The field is optionally present, Need S, if the field <i>occasions</i> is present, otherwise it is absent.   |

## – *RACH-ConfigGeneric*

The IE *RACH-ConfigGeneric* is used to specify the random-access parameters both for regular random access as well as for beam failure recovery.

### *RACH-ConfigGeneric* information element

```
-- ASN1START
-- TAG-RACH-CONFIGGENERIC-START

RACH-ConfigGeneric ::=
    prach-ConfigurationIndex          INTEGER (0..255),
    msg1-FDM                          ENUMERATED {one, two, four, eight},
    msg1-FrequencyStart               INTEGER (0..maxNrofPhysicalResourceBlocks-1),
    zeroCorrelationZoneConfig         INTEGER(0..15),
    preambleReceivedTargetPower       INTEGER (-202..-60),
    preambleTransMax                   ENUMERATED {n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200},
    powerRampingStep                  ENUMERATED {dB0, dB2, dB4, dB6},
    ra-ResponseWindow                 ENUMERATED {s11, s12, s14, s18, s110, s120, s140, s180},
    ...
}

-- TAG-RACH-CONFIGGENERIC-STOP
-- ASN1STOP
```

| <b>RACH-ConfigGeneric field descriptions</b>   |
|--|
| <b>msg1-FDM</b><br>The number of PRACH transmission occasions FDMed in one time instance. (see TS 38.211 [16], clause 6.3.3.2).  |
| <b>msg1-FrequencyStart</b><br>Offset of lowest PRACH transmission occasion in frequency domain with respect to PRB 0. The value is configured so that the corresponding RACH resource is entirely within the bandwidth of the UL BWP. (see TS 38.211 [16], clause 6.3.3.2).        |
| <b>powerRampingStep</b><br>Power ramping steps for PRACH (see TS 38.321 [3], 5.1.3).   |
| <b>prach-ConfigurationIndex</b><br>PRACH configuration index. For <i>prach-ConfigurationIndex</i> configured under <i>beamFailureRecovery-Config</i> , the <i>prach-ConfigurationIndex</i> can only correspond to the short preamble format, (see TS 38.211 [16], clause 6.3.3.2). |
| <b>preambleReceivedTargetPower</b><br>The target power level at the network receiver side (see TS 38.213 [13], clause 7.4, TS 38.321 [3], clauses 5.1.2, 5.1.3). Only multiples of 2 dBm may be chosen (e.g. -202, -200, -198, ...).   |
| <b>preambleTransMax</b><br>Max number of RA preamble transmission performed before declaring a failure (see TS 38.321 [3], clauses 5.1.4, 5.1.5).  |
| <b>ra-ResponseWindow</b><br>Msg2 (RAR) window length in number of slots. The network configures a value lower than or equal to 10 ms (see TS 38.321 [3], clause 5.1.4). UE ignores the field if included in <i>SCellConfig</i> .   |
| <b>zeroCorrelationZoneConfig</b><br>N-CS configuration, see Table 6.3.3.1-5 in TS 38.211 [16].   |

## – RA-Prioritization

The IE *RA-Prioritization* is used to configure prioritized random access.

### **RA-Prioritization information element**

```
-- ASN1START
-- TAG-RA-PRIORITIZATION-START

RA-Prioritization ::= SEQUENCE {
    powerRampingStepHighPriority  ENUMERATED {dB0, dB2, dB4, dB6},
    scalingFactorBI              ENUMERATED {zero, dot25, dot5, dot75}
    ...
}

-- TAG-RA-PRIORITIZATION-STOP
-- ASN1STOP
```

**RA-Prioritization field descriptions****powerRampingStepHighPriority**

Power ramping step applied for prioritized random access procedure.

**scalingFactorBI**

Scaling factor for the backoff indicator (BI) for the prioritized random access procedure. (see TS 38.321 [3], clause 5.1.4). Value *zero* corresponds to 0, value *dot25* corresponds to 0.25 and so on.

– **RadioBearerConfig**

The IE *RadioBearerConfig* is used to add, modify and release signalling and/or data radio bearers. Specifically, this IE carries the parameters for PDCP and, if applicable, SDAP entities for the radio bearers.

**RadioBearerConfig information element**

```

-- ASN1START
-- TAG-RADIOBEARERCONFIG-START

RadioBearerConfig ::=
    SEQUENCE {
        srb-ToAddModList          SRB-ToAddModList          OPTIONAL, -- Cond HO-Conn
        srb3-ToRelease            ENUMERATED{true}           OPTIONAL, -- Need N
        drb-ToAddModList          DRB-ToAddModList          OPTIONAL, -- Cond HO-toNR
        drb-ToReleaseList        DRB-ToReleaseList         OPTIONAL, -- Need N
        securityConfig            SecurityConfig            OPTIONAL, -- Need M
        ...
    }

SRB-ToAddModList ::=
    SEQUENCE (SIZE (1..2)) OF SRB-ToAddMod
SRB-ToAddMod ::=
    SEQUENCE {
        srb-Identity              SRB-Identity,
        reestablishPDCP           ENUMERATED{true}           OPTIONAL, -- Need N
        discardOnPDCP            ENUMERATED{true}           OPTIONAL, -- Need N
        pdcp-Config              PDCP-Config                OPTIONAL, -- Cond PDCP
        ...
    }

DRB-ToAddModList ::=
    SEQUENCE (SIZE (1..maxDRB)) OF DRB-ToAddMod
DRB-ToAddMod ::=
    SEQUENCE {
        cnAssociation            CHOICE {
            eps-BearerIdentity   INTEGER (0..15),           -- EPS-DRB-Setup
            sdap-Config          SDAP-Config                -- 5GC
        }
        drb-Identity            DRB-Identity,
        reestablishPDCP         ENUMERATED{true}           OPTIONAL, -- Need N
        recoverPDCP            ENUMERATED{true}           OPTIONAL, -- Need N
        pdcp-Config            PDCP-Config                OPTIONAL, -- Cond PDCP
        ...
    }
DRB-ToReleaseList ::=
    SEQUENCE (SIZE (1..maxDRB)) OF DRB-Identity

```

```

SecurityConfig ::=
  SecurityAlgorithmConfig      SEQUENCE {
    keyToUse                   SecurityAlgorithmConfig      OPTIONAL,  -- Cond RBTermChange
    ENUMERATED{master, secondary}
    ...
  }

-- TAG-RADIOBEARERCONFIG-STOP
-- ASN1STOP

```

#### **DRB-ToAddMod field descriptions**

|                           |  |
|---------------------------|--|
| <b>cnAssociation</b>      | Indicates if the bearer is associated with the <i>eps-bearerIdentity</i> (when connected to EPC) or <i>sdap-Config</i> (when connected to 5GC).  |
| <b>drb-Identity</b>       | In case of DC, the DRB identity is unique within the scope of the UE, i.e. an MCG DRB cannot use the same value as a split DRB. For a split DRB the same identity is used for the MCG and SCG parts of the configuration.  |
| <b>eps-BearerIdentity</b> | The EPS bearer ID determines the EPS bearer.   |
| <b>reestablishPDCP</b>    | Indicates that PDCP should be re-established. Network sets this to <i>true</i> whenever the security key used for this radio bearer changes. Key change could for example be due to termination point change for the bearer, reconfiguration with sync, resuming an RRC connection, or the first reconfiguration after reestablishment. It is also applicable for LTE procedures when NR PDCP is configured. |
| <b>recoverPDCP</b>        | Indicates that PDCP should perform recovery according to TS 38.323 [5].  |
| <b>sdap-Config</b>        | The SDAP configuration determines how to map QoS flows to DRBs when NR or E-UTRA connects to the 5GC and presence/absence of UL/DL SDAP headers.   |

#### **RadioBearerConfig field descriptions**

|                       |   |
|-----------------------|---|
| <b>securityConfig</b> | Indicates the security algorithm and key to use for the signalling and data radio bearers configured with the list in this IE <i>RadioBearerConfig</i> . When the field is not included after AS security has been activated, the UE shall continue to use the currently configured <i>keyToUse</i> and security algorithm for the radio bearers reconfigured with the lists in this IE <i>RadioBearerConfig</i> . The field is not included when configuring SRB1 before AS security is activated. |
| <b>srb3-ToRelease</b> | Release SRB3. SRB3 release can only be done over SRB1 and only at SCG release and reconfiguration with sync.  |

#### **SecurityConfig field descriptions**

|                                |   |
|--------------------------------|---|
| <b>keyToUse</b>                | Indicates if the bearers configured with the list in this IE <i>RadioBearerConfig</i> are using the master key or the secondary key for deriving ciphering and/or integrity protection keys. For MR-DC, network should not configure SRB1 and SRB2 with secondary key and SRB3 with the master key. When the field is not included, the UE shall continue to use the currently configured <i>keyToUse</i> for the radio bearers reconfigured with the lists in this IE <i>RadioBearerConfig</i> . |
| <b>securityAlgorithmConfig</b> | Indicates the security algorithm for the signalling and data radio bearers configured with the list in this IE <i>RadioBearerConfig</i> . When the field is not included, the UE shall continue to use the currently configured security algorithm for the radio bearers reconfigured with the lists in this IE <i>RadioBearerConfig</i> .  |

| <b>SRB-ToAddMod field descriptions</b>   |
|--|
| <b>discardOnPDCP</b><br>Indicates that PDCP should discard stored SDU and PDU according to TS 38.323 [5].  |
| <b>reestablishPDCP</b><br>Indicates that PDCP should be re-established. Network sets this to <i>true</i> whenever the security key used for this radio bearer changes. Key change could for example be due to reconfiguration with sync, for SRB2 when resuming an RRC connection, or at the first reconfiguration after RRC connection reestablishment in NR. For LTE SRBs using NR PDCP, it could be for handover, RRC connection reestablishment or resume. |
| <b>srb-Identity</b><br>Value 1 is applicable for SRB1 only. Value 2 is applicable for SRB2 only. Value 3 is applicable for SRB3 only.  |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>RBTermChange</i>         | The field is mandatory present in case of set up of signalling and data radio bearer and change of termination point for the radio bearer between MN and SN. It is optionally present otherwise, Need S.   |
| <i>PDCP</i>                 | The field is mandatory present if the corresponding DRB is being setup or corresponding DRB is reconfigured with NR PDCP or corresponding split SRB is being setup or if the number of RLC bearers associated with the DRB or SRB is changed. The field is optionally present, Need S, if the corresponding SRB is being setup or corresponding SRB is reconfigured with NR PDCP; otherwise the field is optionally present, need M. |
| <i>DRBSetup</i>             | The field is mandatory present if the corresponding DRB is being setup; otherwise the field is optionally present, need M.   |
| <i>HO-Conn</i>              | The field is mandatory present in case of inter-system handover from E-UTRA (connected to EPC) to E-UTRA (connected to 5GC) or NR, or when the <i>fullConfig</i> is included in the <i>RRCReconfiguration</i> message, or in case of <i>RRCSetup</i> ; otherwise the field is optionally present, need N. Upon <i>RRCSetup</i> , only SRB1 can be present.   |
| <i>HO-toNR</i>              | The field is mandatory present in case of inter-system handover from E-UTRA (connected to EPC) to E-UTRA (connected to 5GC) or NR, or when the <i>fullConfig</i> is included in the <i>RRCReconfiguration</i> message. In case of <i>RRCSetup</i> , the field is absent; otherwise the field is optionally present, need N.  |

## – *RadioLinkMonitoringConfig*

The IE *RadioLinkMonitoringConfig* is used to configure radio link monitoring for detection of beam- and/or cell radio link failure. See also TS 38.321 [3], clause 5.1.1.

### ***RadioLinkMonitoringConfig* information element**

```
-- ASN1START
-- TAG-RADIOLINKMONITORINGCONFIG-START

RadioLinkMonitoringConfig ::= SEQUENCE {
    failureDetectionResourcesToAddModList SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS
                                          OPTIONAL, -- Need N
    failureDetectionResourcesToReleaseList SEQUENCE (SIZE(1..maxNrofFailureDetectionResources)) OF RadioLinkMonitoringRS-Id
                                          OPTIONAL, -- Need N
    beamFailureInstanceMaxCount          ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10}
                                          OPTIONAL, -- Need R
    beamFailureDetectionTimer             ENUMERATED {pbfd1, pbfd2, pbfd3, pbfd4, pbfd5, pbfd6, pbfd8, pbfd10}
                                          OPTIONAL, -- Need R
    ...
}

RadioLinkMonitoringRS ::= SEQUENCE {
    radioLinkMonitoringRS-Id
}
```

```

    purpose                ENUMERATED {beamFailure, rlf, both},
    detectionResource      CHOICE {
        ssb-Index          SSB-Index,
        csi-RS-Index       NZP-CSI-RS-ResourceId
    },
    ...
}
-- TAG-RADIOLINKMONITORINGCONFIG-STOP
-- ASN1STOP

```

#### **RadioLinkMonitoringConfig field descriptions**

##### **beamFailureDetectionTimer**

Timer for beam failure detection (see TS 38.321 [3], clause 5.17). See also the *BeamFailureRecoveryConfig* IE. Value in number of "Q<sub>out,LR</sub> reporting periods of Beam Failure Detection" Reference Signal (see TS 38.213 [13], clause 6). Value *pbfd1* corresponds to 1 Q<sub>out,LR</sub> reporting period of Beam Failure Detection Reference Signal, value *pbfd2* corresponds to 2 Q<sub>out,LR</sub> reporting periods of Beam Failure Detection Reference Signal and so on.

##### **beamFailureInstanceMaxCount**

This field determines after how many beam failure events the UE triggers beam failure recovery (see TS 38.321 [3], clause 5.17). Value n1 corresponds to 1 beam failure instance, value n2 corresponds to 2 beam failure instances and so on.

##### **failureDetectionResourcesToAddModList**

A list of reference signals for detecting beam failure and/or cell level radio link failure (RLF). The limits of the reference signals that the network can configure are specified in TS 38.213 [13], table 5-1. The network configures at most two detectionResources per BWP for the purpose *beamFailure* or *both*. If no RSs are provided for the purpose of beam failure detection, the UE performs beam monitoring based on the activated *TCI-State* for PDCCH as described in TS 38.213 [13], clause 6. If no RSs are provided in this list for the purpose of RLF detection, the UE performs Cell-RLM based on the activated *TCI-State* of PDCCH as described in TS 38.213 [13], clause 5. The network ensures that the UE has a suitable set of reference signals for performing cell-RLM.

#### **RadioLinkMonitoringRS field descriptions**

##### **detectionResource**

A reference signal that the UE shall use for radio link monitoring or beam failure detection (depending on the indicated *purpose*).

##### **purpose**

Determines whether the UE shall monitor the associated reference signal for the purpose of cell- and/or beam failure detection.

#### – *RadioLinkMonitoringRS-Id*

The IE *RadioLinkMonitoringRS-Id* is used to identify one *RadioLinkMonitoringRS*.

#### **RadioLinkMonitoringRS-Id information element**

```

-- ASN1START
-- TAG-RADIOLINKMONITORINGRS-ID-START

RadioLinkMonitoringRS-Id ::=          INTEGER (0..maxNrofFailureDetectionResources-1)

-- TAG-RADIOLINKMONITORINGRS-ID-STOP
-- ASN1STOP

```

– *RAN-AreaCode*

The IE *RAN-AreaCode* is used to identify a RAN area within the scope of a tracking area.

***RAN-AreaCode* information element**

```
-- ASN1START
-- TAG-RAN-AREACODE-START

RAN-AreaCode ::=
    INTEGER (0..255)

-- TAG-RAN-AREACODE-STOP
-- ASN1STOP
```

– *RateMatchPattern*

The IE *RateMatchPattern* is used to configure one rate matching pattern for PDSCH, see TS 38.214 [19], clause 5.1.4.1.

***RateMatchPattern* information element**

```
-- ASN1START
-- TAG-RATEMATCHPATTERN-START

RateMatchPattern ::=
    SEQUENCE {
        rateMatchPatternId
            RateMatchPatternId,

        patternType
            CHOICE {
                bitmaps
                    SEQUENCE {
                        resourceBlocks
                            BIT STRING (SIZE (275)),
                        symbolsInResourceBlock
                            CHOICE {
                                oneSlot
                                    BIT STRING (SIZE (14)),
                                twoSlots
                                    BIT STRING (SIZE (28))
                            },
                        periodicityAndPattern
                            CHOICE {
                                n2
                                    BIT STRING (SIZE (2)),
                                n4
                                    BIT STRING (SIZE (4)),
                                n5
                                    BIT STRING (SIZE (5)),
                                n8
                                    BIT STRING (SIZE (8)),
                                n10
                                    BIT STRING (SIZE (10)),
                                n20
                                    BIT STRING (SIZE (20)),
                                n40
                                    BIT STRING (SIZE (40))
                            }
                    },
                ...
            },
        controlResourceSet
            ControlResourceSetId,
        subcarrierSpacing
            SubcarrierSpacing
    }
    OPTIONAL, -- Need S
    OPTIONAL, -- Cond CellLevel
```



```

    dummy          ENUMERATED { dynamic, semiStatic },
    ...
}

-- TAG-RATEMATCHPATTERN-STOP
-- ASN1STOP

```

| <b>RateMatchPattern field descriptions</b>  |
|---|
| <p><b>bitmaps</b><br/>Indicates rate matching pattern by a pair of bitmaps <i>resourceBlocks</i> and <i>symbolsInResourceBlock</i> to define the rate match pattern within one or two slots, and a third bitmap <i>periodicityAndPattern</i> to define the repetition pattern with which the pattern defined by the above bitmap pair occurs.</p>   |
| <p><b>controlResourceSet</b><br/>This ControlResourceSet is used as a PDSCH rate matching pattern, i.e., PDSCH reception rate matches around it. In frequency domain, the resource is determined by the frequency domain resource of the CORESET with the corresponding CORESET ID. Time domain resource is determined by the parameters of the associated search space of the CORESET.</p>   |
| <p><b>periodicityAndPattern</b><br/>A time domain repetition pattern at which the pattern defined by <i>symbolsInResourceBlock</i> and <i>resourceBlocks</i> recurs. This slot pattern repeats itself continuously. Absence of this field indicates the value <i>n1</i>, i.e., the <i>symbolsInResourceBlock</i> recurs every 14 symbols (see TS 38.214 [19], clause 5.1.4.1).</p>  |
| <p><b>resourceBlocks</b><br/>A resource block level bitmap in the frequency domain. A bit in the bitmap set to 1 indicates that the UE shall apply rate matching in the corresponding resource block in accordance with the <i>symbolsInResourceBlock</i> bitmap. If used as cell-level rate matching pattern, the bitmap identifies "common resource blocks (CRB)". If used as BWP-level rate matching pattern, the bitmap identifies "physical resource blocks" inside the BWP. The first/ leftmost bit corresponds to resource block 0, and so on (see TS 38.214 [19], clause 5.1.4.1).</p>  |
| <p><b>subcarrierSpacing</b><br/>The SubcarrierSpacing for this resource pattern. If the field is absent, the UE applies the SCS of the associated BWP. The value <i>kHz15</i> corresponds to <math>\mu=0</math>, the value <i>kHz30</i> corresponds to <math>\mu=1</math>, and so on. Only the values 15 kHz, 30 kHz or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable (see TS 38.214 [19], clause 5.1.4.1).</p>  |
| <p><b>symbolsInResourceBlock</b><br/>A symbol level bitmap in time domain. It indicates with a bit set to true that the UE shall rate match around the corresponding symbol. This pattern recurs (in time domain) with the configured <i>periodicityAndPattern</i> (see TS 38.214 [19], clause 5.1.4.1).<br/>For <i>oneSlot</i>, if ECP is configured, the first 12 bits represent the symbols within the slot and the last two bits within the bitstring are ignored by the UE; Otherwise, the 14 bits represent the symbols within the slot.<br/>For <i>twoSlots</i>, if ECP is configured, the first 12 bits represent the symbols within the first slot and the next 12 bits represent the symbols in the second slot and the last four bits within the bit string are ignored by the UE; Otherwise, the first 14 bits represent the symbols within the first slot and the next 14 bits represent the symbols in the second slot.<br/>For the bits representing symbols in a slot, the most significant bit of the bit string represents the first symbol in the slot and the second most significant bit represents the second symbol in the slot and so on.</p> |

| Conditional Presence | Explanation   |
|----------------------|---|
| <i>CellLevel</i>     | The field is mandatory present if the RateMatchPattern is defined on cell level. The field is absent when the RateMatchPattern is defined on BWP level. If the RateMatchPattern is defined on BWP level, the UE applies the SCS of the BWP. |

– **RateMatchPatternId**

The IE *RateMatchPatternId* identifies one RateMatchPattern (see TS 38.214 [19], clause 5.1.4.2).

**RateMatchPatternId** information element

```

-- ASN1START
-- TAG-RATEMATCHPATTERNID-START

RateMatchPatternId ::=                INTEGER (0..maxNrofRateMatchPatterns-1)

-- TAG-RATEMATCHPATTERNID-STOP
-- ASN1STOP

```

– **RateMatchPatternLTE-CRS**

The IE *RateMatchPatternLTE-CRS* is used to configure a pattern to rate match around LTE CRS. See TS 38.214 [19], clause 5.1.4.2.

**RateMatchPatternLTE-CRS** information element

```

-- ASN1START
-- TAG-RATEMATCHPATTERNLTE-CRS-START

RateMatchPatternLTE-CRS ::=          SEQUENCE {
  carrierFreqDL                       INTEGER (0..16383),
  carrierBandwidthDL                  ENUMERATED {n6, n15, n25, n50, n75, n100, spare2, spare1},
  mbsfn-SubframeConfigList            EUTRA-MBSFN-SubframeConfigList                OPTIONAL, -- Need M
  nrofCRS-Ports                       ENUMERATED {n1, n2, n4},
  v-Shift                             ENUMERATED {n0, n1, n2, n3, n4, n5}
}

-- TAG-RATEMATCHPATTERNLTE-CRS-STOP
-- ASN1STOP

```

**RateMatchPatternLTE-CRS** field descriptions

|  |
|--|
| <b>carrierBandwidthDL</b>  |
| BW of the LTE carrier in number of PRBs (see TS 38.214 [19], clause 5.1.4.2).                    |
| <b>carrierFreqDL</b>   |
| Center of the LTE carrier (see TS 38.214 [19], clause 5.1.4.2).                                  |
| <b>mbsfn-SubframeConfigList</b>  |
| LTE MBSFN subframe configuration (see TS 38.214 [19], clause 5.1.4.2).                           |
| <b>nrofCRS-Ports</b>   |
| Number of LTE CRS antenna port to rate-match around (see TS 38.214 [19], clause 5.1.4.2).        |
| <b>v-Shift</b>   |
| Shifting value v-shift in LTE to rate match around LTE CRS (see TS 38.214 [19], clause 5.1.4.2). |

– *RejectWaitTime*

The IE *RejectWaitTime* is used to provide the value in seconds for timer T302.

***RejectWaitTime* information element**

```
-- ASN1START
-- TAG-REJECTWAITTIME-START

RejectWaitTime ::=                INTEGER (1..16)

-- TAG-REJECTWAITTIME-STOP
-- ASN1STOP
```

– *ReportConfigId*

The IE *ReportConfigId* is used to identify a measurement reporting configuration.

***ReportConfigId* information element**

```
-- ASN1START
-- TAG-REPORTCONFIGID-START

ReportConfigId ::=                INTEGER (1..maxReportConfigId)

-- TAG-REPORTCONFIGID-STOP
-- ASN1STOP
```

– *ReportConfigInterRAT*

The IE *ReportConfigInterRAT* specifies criteria for triggering of an inter-RAT measurement reporting event. The inter-RAT measurement reporting events for E-UTRA are labelled BN with *N* equal to 1, 2 and so on.

Event B1: Neighbour becomes better than absolute threshold;

Event B2: PCell becomes worse than absolute threshold1 AND Neighbour becomes better than another absolute threshold2;

***ReportConfigInterRAT* information element**

```
-- ASN1START
-- TAG-REPORTCONFIGINTERRAT-START

ReportConfigInterRAT ::=          SEQUENCE {
    reportType                      CHOICE {
        periodical                    PeriodicalReportConfigInterRAT,
```

```

        eventTriggered          EventTriggerConfigInterRAT,
        reportCGI               ReportCGI-EUTRA,
        ...,
        reportSFTD              ReportSFTD-EUTRA
    }
}

ReportCGI-EUTRA ::=
    cellForWhichToReportCGI    SEQUENCE {
                                EUTRA-PhysCellId,
                                ...
    }

ReportSFTD-EUTRA ::=
    reportSFTD-Meas            BOOLEAN,
    reportRSRP                 BOOLEAN,
    ...
}

EventTriggerConfigInterRAT ::=
    eventId                    SEQUENCE {
                                CHOICE {
                                    eventB1
                                        SEQUENCE {
                                            b1-ThresholdEUTRA
                                            reportOnLeave
                                            hysteresis
                                            timeToTrigger
                                            ...
                                        },
                                    eventB2
                                        SEQUENCE {
                                            b2-Threshold1
                                            b2-Threshold2EUTRA
                                            reportOnLeave
                                            hysteresis
                                            timeToTrigger
                                            ...
                                        },
                                    ...
                                },
                                ...,
                                rsType
                                NR-RS-Type,

                                reportInterval
                                ReportInterval,
                                reportAmount
                                ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
                                reportQuantity
                                MeasReportQuantity,
                                maxReportCells
                                INTEGER (1..maxCellReport),
                                ...
    }

PeriodicalReportConfigInterRAT ::=
    reportInterval             ReportInterval,
    reportAmount               ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},
    reportQuantity             MeasReportQuantity,
    maxReportCells            INTEGER (1..maxCellReport),
    ...
}

```

```

MeasTriggerQuantityEUTRA ::=
    CHOICE {
        rsrp
        rsrq
        sinr
    }

RSRP-RangeEUTRA ::= INTEGER (0..97)
RSRQ-RangeEUTRA ::= INTEGER (0..34)
SINR-RangeEUTRA ::= INTEGER (0..127)

-- TAG-REPORTCONFIGINTERRAT-STOP
-- ASN1STOP

```

#### **ReportConfigInterRAT field descriptions**

**reportType**

Type of the configured measurement report. In EN-DC, network does not configure report of type *ReportCGI-EUTRA*.

#### **EventTriggerConfigInterRAT field descriptions**

**b2-Threshold1**

NR threshold to be used in inter RAT measurement report triggering condition for event B2.

**bN-ThresholdEUTRA**

E-UTRA threshold value associated with the selected trigger quantity (RSRP, RSRQ, SINR) to be used in inter RAT measurement report triggering condition for event number bN. In the same *eventB2*, the network configures the same CHOICE name (*rsrp*, *rsrq* or *sinr*) for the *MeasTriggerQuantity* of the *b2-Threshold1* and for the *MeasTriggerQuantityEUTRA* of the *b2-Threshold2EUTRA*.

**eventId**

Choice of inter RAT event triggered reporting criteria.

**maxReportCells**

Max number of non-serving cells to include in the measurement report.

**reportAmount**

Number of measurement reports applicable for *eventTriggered* as well as for *periodical* report types

**reportOnLeave**

Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in *cellsTriggeredList*, as specified in 5.5.4.1.

**reportQuantity**

The cell measurement quantities to be included in the measurement report.

**timeToTrigger**

Time during which specific criteria for the event needs to be met in order to trigger a measurement report.

| <i>MeasTriggerQuantityEUTRA</i> field descriptions                          |
|---|
| <b>EUTRA-RSRP</b><br>Corresponds to <i>RSRP-Range</i> in TS 36.331 [10].    |
| <b>EUTRA-RSRQ</b><br>Corresponds to <i>RSRQ-Range</i> in TS 36.331 [10].    |
| <b>EUTRA-SINR</b><br>Corresponds to <i>RS-SINR-Range</i> in TS 36.331 [10]. |

| <i>PeriodicalReportConfigInterRAT</i> field descriptions  |
|---|
| <b>maxReportCells</b><br>Max number of non-serving cells to include in the measurement report.  |
| <b>reportAmount</b><br>Number of measurement reports applicable for <i>eventTriggered</i> as well as for <i>periodical</i> report types |
| <b>reportQuantityCell</b><br>The cell measurement quantities to be included in the measurement report.                                  |

## – *ReportConfigNR*

The IE *ReportConfigNR* specifies criteria for triggering of an NR measurement reporting event. Measurement reporting events are based on cell measurement results, which can either be derived based on SS/PBCH block or CSI-RS. These events are labelled AN with N equal to 1, 2 and so on.

Event A1: Serving becomes better than absolute threshold;

Event A2: Serving becomes worse than absolute threshold;

Event A3: Neighbour becomes amount of offset better than PCell/PSCell;

Event A4: Neighbour becomes better than absolute threshold;

Event A5: PCell/PSCell becomes worse than absolute threshold1 AND Neighbour/SCell becomes better than another absolute threshold2;

Event A6: Neighbour becomes amount of offset better than SCell.

### *ReportConfigNR* information element

```
-- ASN1START
-- TAG-REPORTCONFIGNR-START

ReportConfigNR ::=
    reportType
        periodical
        eventTriggered
        ...
    reportCGI
    [ [
SEQUENCE {
CHOICE {
    PeriodicalReportConfig,
    EventTriggerConfig,
    ReportCGI,
```

```

        reportSFTD
    ]]
}
}

ReportCGI ::=
    cellForWhichToReportCGI
    ...
}

ReportSFTD-NR ::=
    reportSFTD-Meas
    reportRSRP
    ...
}

EventTriggerConfig ::=
    eventId
    eventA1
        a1-Threshold
        reportOnLeave
        hysteresis
        timeToTrigger
    },
    eventA2
        a2-Threshold
        reportOnLeave
        hysteresis
        timeToTrigger
    },
    eventA3
        a3-Offset
        reportOnLeave
        hysteresis
        timeToTrigger
        useWhiteCellList
    },
    eventA4
        a4-Threshold
        reportOnLeave
        hysteresis
        timeToTrigger
        useWhiteCellList
    },
    eventA5
        a5-Threshold1
        a5-Threshold2
        reportOnLeave
        hysteresis
        timeToTrigger
        useWhiteCellList
    },
    eventA6
        a6-Offset

```

```

ReportSFTD-NR

```

```

SEQUENCE {
    PhysCellId,
}

SEQUENCE {
    BOOLEAN,
    BOOLEAN,
}

SEQUENCE {
    CHOICE {
        SEQUENCE {
            MeasTriggerQuantity,
            BOOLEAN,
            Hysteresis,
            TimeToTrigger
        },
        SEQUENCE {
            MeasTriggerQuantity,
            BOOLEAN,
            Hysteresis,
            TimeToTrigger
        },
        SEQUENCE {
            MeasTriggerQuantityOffset,
            BOOLEAN,
            Hysteresis,
            TimeToTrigger,
            BOOLEAN
        },
        SEQUENCE {
            MeasTriggerQuantity,
            BOOLEAN,
            Hysteresis,
            TimeToTrigger,
            BOOLEAN
        },
        SEQUENCE {
            MeasTriggerQuantity,
            MeasTriggerQuantity,
            BOOLEAN,
            Hysteresis,
            TimeToTrigger,
            BOOLEAN
        },
        SEQUENCE {
            MeasTriggerQuantityOffset,

```

```

        reportOnLeave          BOOLEAN,
        hysteresis            Hysteresis,
        timeToTrigger        TimeToTrigger,
        useWhiteCellList     BOOLEAN
    },
    ...
},

rsType                      NR-RS-Type,

reportInterval              ReportInterval,
reportAmount                ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

reportQuantityCell         MeasReportQuantity,
maxReportCells             INTEGER (1..maxCellReport),

reportQuantityRS-Indexes   MeasReportQuantity
maxNrofRS-IndexesToReport INTEGER (1..maxNrofIndexesToReport)
includeBeamMeasurements    BOOLEAN,
reportAddNeighMeas         ENUMERATED {setup}
...
}
OPTIONAL, -- Need R
OPTIONAL, -- Need R
OPTIONAL, -- Need R

PeriodicalReportConfig ::=
    SEQUENCE {
        rsType                      NR-RS-Type,

        reportInterval              ReportInterval,
        reportAmount                ENUMERATED {r1, r2, r4, r8, r16, r32, r64, infinity},

        reportQuantityCell         MeasReportQuantity,
        maxReportCells             INTEGER (1..maxCellReport),

        reportQuantityRS-Indexes   MeasReportQuantity
        maxNrofRS-IndexesToReport INTEGER (1..maxNrofIndexesToReport)
        includeBeamMeasurements    BOOLEAN,
        useWhiteCellList          BOOLEAN,
        ...
    }
OPTIONAL, -- Need R
OPTIONAL, -- Need R

NR-RS-Type ::=
    ENUMERATED {ssb, csi-rs}

MeasTriggerQuantity ::=
    CHOICE {
        rsrp          RSRP-Range,
        rsrq          RSRQ-Range,
        sinr          SINR-Range
    }

MeasTriggerQuantityOffset ::=
    CHOICE {
        rsrp          INTEGER (-30..30),
        rsrq          INTEGER (-30..30),
        sinr          INTEGER (-30..30)
    }

```



```

MeasReportQuantity ::=
    SEQUENCE {
        rsrp          BOOLEAN,
        rsrq          BOOLEAN,
        sinr          BOOLEAN
    }

-- TAG-REPORTCONFIGNR-STOP
-- ASN1STOP

```

#### ReportConfigNR field descriptions

##### **reportType**

Type of the configured measurement report. In EN-DC, network does not configure report of type *reportCGI* using SRB3.

#### EventTriggerConfig field descriptions

##### **a3-Offset/a6-Offset**

Offset value(s) to be used in NR measurement report triggering condition for event a3/a6. The actual value is field value \* 0.5 dB.

##### **aN-ThresholdM**

Threshold value associated to the selected trigger quantity (e.g. RSRP, RSRQ, SINR) per RS Type (e.g. SS/PBCH block, CSI-RS) to be used in NR measurement report triggering condition for event number aN. If multiple thresholds are defined for event number aN, the thresholds are differentiated by M. The network configures aN-Threshold1 only for events A1, A2, A4, A5 and a5-Threshold2 only for event A5. In the same *eventA5*, the network configures the same quantity for the *MeasTriggerQuantity* of the *a5-Threshold1* and for the *MeasTriggerQuantity* of the *a5-Threshold2*.

##### **eventId**

Choice of NR event triggered reporting criteria.

##### **maxNrofRS-IndexesToReport**

Max number of RS indexes to include in the measurement report for A1-A6 events.

##### **maxReportCells**

Max number of non-serving cells to include in the measurement report.

##### **reportAddNeighMeas**

Indicates that the UE shall include the best neighbour cells per serving frequency.

##### **reportAmount**

Number of measurement reports applicable for *eventTriggered* as well as for *periodical* report types.

##### **reportOnLeave**

Indicates whether or not the UE shall initiate the measurement reporting procedure when the leaving condition is met for a cell in *cellsTriggeredList*, as specified in 5.5.4.1.

##### **reportQuantityCell**

The cell measurement quantities to be included in the measurement report.

##### **reportQuantityRS-Indexes**

Indicates which measurement information per RS index the UE shall include in the measurement report.

##### **timeToTrigger**

Time during which specific criteria for the event needs to be met in order to trigger a measurement report.

##### **useWhiteCellList**

Indicates whether only the cells included in the white-list of the associated *measObject* are applicable as specified in 5.5.4.1.

| <i>PeriodicalReportConfig</i> field descriptions   |
|--|
| <b><i>maxNrofRS-IndexesToReport</i></b><br>Max number of RS indexes to include in the measurement report.  |
| <b><i>maxReportCells</i></b><br>Max number of non-serving cells to include in the measurement report.  |
| <b><i>reportAmount</i></b><br>Number of measurement reports applicable for <i>eventTriggered</i> as well as for <i>periodical</i> report types                     |
| <b><i>reportQuantityCell</i></b><br>The cell measurement quantities to be included in the measurement report.  |
| <b><i>reportQuantityRS-Indexes</i></b><br>Indicates which measurement information per RS index the UE shall include in the measurement report.                     |
| <b><i>useWhiteCellList</i></b><br>Indicates whether only the cells included in the white-list of the associated measObject are applicable as specified in 5.5.4.1. |

| <i>ReportSFTD-NR</i> field descriptions   |
|---|
| <b><i>reportSFTD-Meas</i></b><br>Indicates whether UE is required to perform SFTD measurement between PCell and NR PSCell in NR-DC. |
| <b><i>reportRSRP</i></b><br>Indicates whether UE is required to include RSRP result of NR PSCell in SFTD measurement result.        |

## – *ReportConfigToAddModList*

The IE *ReportConfigToAddModList* concerns a list of reporting configurations to add or modify.

### **ReportConfigToAddModList information element**

```

-- ASN1START
-- TAG-REPORTCONFIGTOADDMODLIST-START

ReportConfigToAddModList ::=
    SEQUENCE (SIZE (1..maxReportConfigId)) OF ReportConfigToAddMod

ReportConfigToAddMod ::=
    SEQUENCE {
        reportConfigId          ReportConfigId,
        reportConfig            CHOICE {
            reportConfigNR      ReportConfigNR,
            . . . ,
            reportConfigInterRAT ReportConfigInterRAT
        }
    }

-- TAG-REPORTCONFIGTOADDMODLIST-STOP
-- ASN1STOP

```

## – *ReportInterval*

The IE *ReportInterval* indicates the interval between periodical reports. The *ReportInterval* is applicable if the UE performs periodical reporting (i.e. when *reportAmount* exceeds 1), for *triggerTypeevent* as well as for *triggerTypeperiodical*. Value *ms120* corresponds to 120 ms, value *ms240* corresponds to 240 ms and so on, while value *min1* corresponds to 1 min, *min6* corresponds to 6 min and so on.

### ***ReportInterval* information element**

```
-- ASN1START
-- TAG-REPORTINTERVAL-START

ReportInterval ::=
    ENUMERATED {ms120, ms240, ms480, ms640, ms1024, ms2048, ms5120, ms10240, ms20480, ms40960,
                min1,min6, min12, min30 }

-- TAG-REPORTINTERVAL-STOP
-- ASN1STOP
```

## – *ReselectionThreshold*

The IE *ReselectionThreshold* is used to indicate an Rx level threshold for cell reselection. Actual value of threshold = field value \* 2 [dB].

### ***ReselectionThreshold* information element**

```
-- ASN1START
-- TAG-RESELECTIONTHRESHOLD-START

ReselectionThreshold ::=
    INTEGER (0..31)

-- TAG-RESELECTIONTHRESHOLD-STOP
-- ASN1STOP
```

## – *ReselectionThresholdQ*

The IE *ReselectionThresholdQ* is used to indicate a quality level threshold for cell reselection. Actual value of threshold = field value [dB].

### ***ReselectionThresholdQ* information element**

```
-- ASN1START
-- TAG-RESELECTIONTHRESHOLDQ-START

ReselectionThresholdQ ::=
    INTEGER (0..31)

-- TAG-RESELECTIONTHRESHOLDQ-STOP
-- ASN1STOP
```

## – *ResumeCause*

The IE *ResumeCause* is used to indicate the resume cause in *RRCResumeRequest* and *RRCResumeRequest1*.

### ***ResumeCause* information element**

```
-- ASN1START
-- TAG-RESUMECAUSE-START

ResumeCause ::=
    ENUMERATED {emergency, highPriorityAccess, mt-Access, mo-Signalling,
                mo-Data, mo-VoiceCall, mo-VideoCall, mo-SMS, rna-Update, mps-PriorityAccess,
                mcs-PriorityAccess, spare1, spare2, spare3, spare4, spare5 }

-- TAG-RESUME-CAUSE-STOP
-- ASN1STOP
```

## – *RLC-BearerConfig*

The IE *RLC-BearerConfig* is used to configure an RLC entity, a corresponding logical channel in MAC and the linking to a PDCP entity (served radio bearer).

### ***RLC-BearerConfig* information element**

```
-- ASN1START
-- TAG-RLC-BEARERCONFIG-START

RLC-BearerConfig ::=
    logicalChannelIdentity      LogicalChannelIdentity,
    servedRadioBearer          CHOICE {
        srb-Identity            SRB-Identity,
        drb-Identity            DRB-Identity
    }
    reestablishRLC              ENUMERATED {true}
    rlc-Config                  RLC-Config
    mac-LogicalChannelConfig    LogicalChannelConfig
    ...
}

OPTIONAL, -- Cond LCH-SetupOnly
OPTIONAL, -- Need N
OPTIONAL, -- Cond LCH-Setup
OPTIONAL, -- Cond LCH-Setup

-- TAG-RLC-BEARERCONFIG-STOP
-- ASN1STOP
```

| <i>RLC-BearerConfig</i> field descriptions   |
|--|
| <b><i>logicalChannelIdentity</i></b><br>ID used commonly for the MAC logical channel and for the RLC bearer.   |
| <b><i>reestablishRLC</i></b><br>Indicates that RLC should be re-established. Network sets this to <i>true</i> whenever the security key used for the radio bearer associated with this RLC entity changes. For SRB2 and DRBs, it is also set to <i>true</i> during the resumption of the RRC connection or the first reconfiguration after reestablishment.  |
| <b><i>rlc-Config</i></b><br>Determines the RLC mode (UM, AM) and provides corresponding parameters. RLC mode reconfiguration can only be performed by DRB release/addition or full configuration.  |
| <b><i>servedRadioBearer</i></b><br>Associates the RLC Bearer with an SRB or a DRB. The UE shall deliver DL RLC SDUs received via the RLC entity of this RLC bearer to the PDCP entity of the <i>servedRadioBearer</i> . Furthermore, the UE shall advertise and deliver uplink PDCP PDUs of the uplink PDCP entity of the <i>servedRadioBearer</i> to the uplink RLC entity of this RLC bearer unless the uplink scheduling restrictions ( <i>moreThanOneRLC</i> in <i>PDCP-Config</i> and the restrictions in <i>LogicalChannelConfig</i> ) forbid it to do so. |

| Conditional Presence | Explanation   |
|----------------------|---|
| <i>LCH-Setup</i>     | This field is mandatory present upon creation of a new logical channel for a DRB. This field is optionally present, Need S, upon creation of a new logical channel for an SRB. It is optionally present, Need M, otherwise. |
| <i>LCH-SetupOnly</i> | This field is mandatory present upon creation of a new logical channel. It is absent, Need M otherwise.   |

## – *RLC-Config*

The IE *RLC-Config* is used to specify the RLC configuration of SRBs and DRBs.

### *RLC-Config* information element

```
-- ASN1START
-- TAG-RLC-CONFIG-START

RLC-Config ::=
    CHOICE {
        am
            SEQUENCE {
                ul-AM-RLC
                dl-AM-RLC
            },
        um-Bi-Directional
            SEQUENCE {
                ul-UM-RLC
                dl-UM-RLC
            },
        um-Uni-Directional-UL
            SEQUENCE {
                ul-UM-RLC
            },
        um-Uni-Directional-DL
            SEQUENCE {
                dl-UM-RLC
            },
        ...
    }

UL-AM-RLC ::=
    SEQUENCE {
        sn-FieldLength
    }
    OPTIONAL, -- Cond Reestab
```

```

    t-PollRetransmit          T-PollRetransmit,
    pollPDU                   PollPDU,
    pollByte                   PollByte,
    maxRetxThreshold          ENUMERATED { t1, t2, t3, t4, t6, t8, t16, t32 }
}

DL-AM-RLC ::=
    sn-FieldLength            SN-FieldLengthAM          OPTIONAL,  -- Cond Reestab
    t-Reassembly              T-Reassembly,
    t-StatusProhibit          T-StatusProhibit
}

UL-UM-RLC ::=
    sn-FieldLength            SN-FieldLengthUM          OPTIONAL  -- Cond Reestab
}

DL-UM-RLC ::=
    sn-FieldLength            SN-FieldLengthUM          OPTIONAL,  -- Cond Reestab
    t-Reassembly              T-Reassembly
}

T-PollRetransmit ::=
    ENUMERATED {
        ms5, ms10, ms15, ms20, ms25, ms30, ms35,
        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
        ms110, ms115, ms120, ms125, ms130, ms135,
        ms140, ms145, ms150, ms155, ms160, ms165,
        ms170, ms175, ms180, ms185, ms190, ms195,
        ms200, ms205, ms210, ms215, ms220, ms225,
        ms230, ms235, ms240, ms245, ms250, ms300,
        ms350, ms400, ms450, ms500, ms800, ms1000,
        ms2000, ms4000, spare5, spare4, spare3,
        spare2, spare1}

PollPDU ::=
    ENUMERATED {
        p4, p8, p16, p32, p64, p128, p256, p512, p1024, p2048, p4096, p6144, p8192, p12288, p16384, p20480,
        p24576, p28672, p32768, p40960, p49152, p57344, p65536, infinity, spare8, spare7, spare6, spare5, spare4,
        spare3, spare2, spare1}

PollByte ::=
    ENUMERATED {
        kB1, kB2, kB5, kB8, kB10, kB15, kB25, kB50, kB75,
        kB100, kB125, kB250, kB375, kB500, kB750, kB1000,
        kB1250, kB1500, kB2000, kB3000, kB4000, kB4500,
        kB5000, kB5500, kB6000, kB6500, kB7000, kB7500,
        mB8, mB9, mB10, mB11, mB12, mB13, mB14, mB15,
        mB16, mB17, mB18, mB20, mB25, mB30, mB40, infinity,
        spare20, spare19, spare18, spare17, spare16,
        spare15, spare14, spare13, spare12, spare11,
        spare10, spare9, spare8, spare7, spare6, spare5,
        spare4, spare3, spare2, spare1}

T-Reassembly ::=
    ENUMERATED {
        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,

```

```
ms40, ms45, ms50, ms55, ms60, ms65, ms70,
ms75, ms80, ms85, ms90, ms95, ms100, ms110,
ms120, ms130, ms140, ms150, ms160, ms170,
ms180, ms190, ms200, spare1}
```

```
T-StatusProhibit ::=
    ENUMERATED {
        ms0, ms5, ms10, ms15, ms20, ms25, ms30, ms35,
        ms40, ms45, ms50, ms55, ms60, ms65, ms70,
        ms75, ms80, ms85, ms90, ms95, ms100, ms105,
        ms110, ms115, ms120, ms125, ms130, ms135,
        ms140, ms145, ms150, ms155, ms160, ms165,
        ms170, ms175, ms180, ms185, ms190, ms195,
        ms200, ms205, ms210, ms215, ms220, ms225,
        ms230, ms235, ms240, ms245, ms250, ms300,
        ms350, ms400, ms450, ms500, ms800, ms1000,
        ms1200, ms1600, ms2000, ms2400, spare2, spare1}

SN-FieldLengthUM ::=
    ENUMERATED {size6, size12}
SN-FieldLengthAM ::=
    ENUMERATED {size12, size18}

-- TAG-RLC-CONFIG-STOP
-- ASN1STOP
```

#### RLC-Config field descriptions

|   |
|---|
| <b><i>maxRetxThreshold</i></b>  |
| Parameter for RLC AM in TS 38.322 [4]. Value <i>t1</i> corresponds to 1 retransmission, value <i>t2</i> corresponds to 2 retransmissions and so on.   |
| <b><i>pollByte</i></b>  |
| Parameter for RLC AM in TS 38.322 [4]. Value <i>kB25</i> corresponds to 25 kBytes, value <i>kB50</i> corresponds to 50 kBytes and so on. <i>infinity</i> corresponds to an infinite amount of kBytes.   |
| <b><i>pollPDU</i></b>   |
| Parameter for RLC AM in TS 38.322 [4]. Value <i>p4</i> corresponds to 4 PDUs, value <i>p8</i> corresponds to 8 PDUs and so on. <i>infinity</i> corresponds to an infinite number of PDUs.   |
| <b><i>sn-FieldLength</i></b>  |
| Indicates the RLC SN field size, see TS 38.322 [4], in bits. Value <i>size6</i> means 6 bits, value <i>size12</i> means 12 bits, value <i>size18</i> means 18 bits. The value of <i>sn-FieldLength</i> for a DRB shall be changed only using reconfiguration with sync. The network configures only value <i>size12</i> in <i>SN-FieldLengthAM</i> for SRB. |
| <b><i>t-PollRetransmit</i></b>  |
| Timer for RLC AM in TS 38.322 [4], in milliseconds. Value <i>ms5</i> means 5 ms, value <i>ms10</i> means 10 ms and so on.   |
| <b><i>t-Reassembly</i></b>  |
| Timer for reassembly in TS 38.322 [4], in milliseconds. Value <i>ms0</i> means 0 ms, value <i>ms5</i> means 5 ms and so on.   |
| <b><i>t-StatusProhibit</i></b>  |
| Timer for status reporting in TS 38.322 [4], in milliseconds. Value <i>ms0</i> means 0 ms, value <i>ms5</i> means 5 ms and so on.   |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>Reestab</i>       | The field is mandatory present at bearer setup. It is optionally present, need M, at RLC re-establishment. Otherwise it is absent. Need M. |

## – *RLF-TimersAndConstants*

The IE *RLF-TimersAndConstants* is used to configure UE specific timers and constants.

### *RLF-TimersAndConstants* information element

```
-- ASN1START
-- TAG-RLF-TIMERSANDCONSTANTS-START

RLF-TimersAndConstants ::=          SEQUENCE {
    t310                             ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000, ms4000, ms6000},
    n310                             ENUMERATED {n1, n2, n3, n4, n6, n8, n10, n20},
    n311                             ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10},
    . . .
    [[
    t311-v1530                       ENUMERATED {ms1000, ms3000, ms5000, ms10000, ms15000, ms20000, ms30000}
    ]]
}

-- TAG-RLF-TIMERSANDCONSTANTS-STOP
-- ASN1STOP
```

#### *RLF-TimersAndConstants* field descriptions

##### ***n3xy***

Constants are described in clause 7.3. Value *n1* corresponds to 1, value *n2* corresponds to 2 and so on.

##### ***t3xy***

Timers are described in clause 7.1. Value *ms0* corresponds to 0 ms, value *ms50* corresponds to 50 ms and so on.

## – *RNTI-Value*

The IE *RNTI-Value* represents a Radio Network Temporary Identity.

### *RNTI-Value* information element

```
-- ASN1START
-- TAG-RNTI-VALUE-START

RNTI-Value ::=                      INTEGER (0..65535)

-- TAG-RNTI-VALUE-STOP
-- ASN1STOP
```



– *RSRP-Range*

The IE *RSRP-Range* specifies the value range used in RSRP measurements and thresholds. For measurements, integer value for RSRP measurements is according to Table 10.1.6.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value – 156) dBm, except for the IE value 127, in which case the actual value is infinity.

***RSRP-Range* information element**

```
-- ASN1START
-- TAG-RSRP-RANGE-START

RSRP-Range ::=
                INTEGER(0..127)

-- TAG-RSRP-RANGE-STOP
-- ASN1STOP
```

– *RSRQ-Range*

The IE *RSRQ-Range* specifies the value range used in RSRQ measurements and thresholds. For measurements, integer value for RSRQ measurements is according to Table 10.1.11.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value – 87) / 2 dB.

***RSRQ-Range* information element**

```
-- ASN1START
-- TAG-RSRQ-RANGE-START

RSRQ-Range ::=
                INTEGER(0..127)

-- TAG-RSRQ-RANGE-STOP
-- ASN1STOP
```

– *SCellIndex*

The IE *SCellIndex* concerns a short identity, used to identify an SCell or PSCell. The value range is shared across the Cell Groups.

***SCellIndex* information element**

```
-- ASN1START
-- TAG-SCCELLINDEX-START

SCellIndex ::=
                INTEGER (1..31)

-- TAG-SCCELLINDEX-STOP
-- ASN1STOP
```

## – *SchedulingRequestConfig*

The IE *SchedulingRequestConfig* is used to configure the parameters, for the dedicated scheduling request (SR) resources.

### ***SchedulingRequestConfig* information element**

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTCONFIG-START

SchedulingRequestConfig ::= SEQUENCE {
    schedulingRequestToAddModList SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestToAddMod OPTIONAL, -- Need N
    schedulingRequestToReleaseList SEQUENCE (SIZE (1..maxNrofSR-ConfigPerCellGroup)) OF SchedulingRequestId OPTIONAL -- Need N
}

SchedulingRequestToAddMod ::= SEQUENCE {
    schedulingRequestId SchedulingRequestId,
    sr-ProhibitTimer ENUMERATED {ms1, ms2, ms4, ms8, ms16, ms32, ms64, ms128} OPTIONAL, -- Need S
    sr-TransMax ENUMERATED {n4, n8, n16, n32, n64, spare3, spare2, spare1}
}

-- TAG-SCHEDULINGREQUESTCONFIG-STOP
-- ASN1STOP
```

#### ***SchedulingRequestConfig* field descriptions**

##### ***schedulingRequestToAddModList***

List of Scheduling Request configurations to add or modify.

##### ***schedulingRequestToReleaseList***

List of Scheduling Request configurations to release.

#### ***SchedulingRequestToAddMod* field descriptions**

##### ***schedulingRequestId***

Used to modify a SR configuration and to indicate, in *LogicalChannelConfig*, the SR configuration to which a logical channel is mapped and to indicate, in *SchedulingRequestresourceConfig*, the SR configuration for which a scheduling request resource is used.

##### ***sr-ProhibitTimer***

Timer for SR transmission on PUCCH in TS 38.321 [3]. Value is in ms. Value *ms1* corresponds to 1ms, value *ms2* corresponds to 2ms, and so on. When the field is absent, the UE applies the value 0.

##### ***sr-TransMax***

Maximum number of SR transmissions as described in TS 38.321 [3]. Value *n4* corresponds to 4, value *n8* corresponds to 8, and so on.

## – *SchedulingRequestId*

The IE *SchedulingRequestId* is used to identify a Scheduling Request instance in the MAC layer.

### ***SchedulingRequestId* information element**

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTID-START

SchedulingRequestId ::=          INTEGER (0..7)

-- TAG-SCHEDULINGREQUESTID-STOP
-- ASN1STOP
```

## – *SchedulingRequestResourceConfig*

The IE *SchedulingRequestResourceConfig* determines physical layer resources on PUCCH where the UE may send the dedicated scheduling request (D-SR) (see TS 38.213 [13], clause 9.2.4).

### ***SchedulingRequestResourceConfig* information element**

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTRESOURCECONFIG-START

SchedulingRequestResourceConfig ::= SEQUENCE {
  schedulingRequestResourceId,
  schedulingRequestID
  periodicityAndOffset
    CHOICE {
      sym2
      sym6or7
      s11
      s12
      s14
      s15
      s18
      s110
      s116
      s120
      s140
      s180
      s1160
      s1320
      s1640
    }
  resource
}

-- Recurs in every slot
OPTIONAL, -- Need M
OPTIONAL, -- Need M

-- TAG-SCHEDULINGREQUESTRESOURCECONFIG-STOP
-- ASN1STOP
```

**SchedulingRequestResourceConfig field descriptions****periodicityAndOffset**

SR periodicity and offset in number of symbols or slots (see TS 38.213 [13], clause 9.2.4) The following periodicities may be configured depending on the chosen subcarrier spacing:

SCS = 15 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 5sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl

SCS = 30 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 10sl, 16sl, 20sl, 40sl, 80sl, 160sl

SCS = 60 kHz: 2sym, 7sym/6sym, 1sl, 2sl, 4sl, 8sl, 16sl, 20sl, 40sl, 80sl, 160sl, 320sl

SCS = 120 kHz: 2sym, 7sym, 1sl, 2sl, 4sl, 8sl, 16sl, 40sl, 80sl, 160sl, 320sl, 640sl

sym6or7 corresponds to 6 symbols if extended cyclic prefix and a SCS of 60 kHz are configured, otherwise it corresponds to 7 symbols.

For periodicities 2sym, 7sym and sl1 the UE assumes an offset of 0 slots.

**resource**

ID of the PUCCH resource in which the UE shall send the scheduling request. The actual *PUCCH-Resource* is configured in *PUCCH-Config* of the same UL BWP and serving cell as this *SchedulingRequestResourceConfig*. The network configures a *PUCCH-Resource* of *PUCCH-format0* or *PUCCH-format1* (other formats not supported) (see TS 38.213 [13], clause 9.2.4)

**schedulingRequestID**

The ID of the *SchedulingRequestConfig* that uses this scheduling request resource.

– **SchedulingRequestResourceId**

The IE *SchedulingRequestResourceId* is used to identify scheduling request resources on PUCCH.

**SchedulingRequestResourceId information element**

```
-- ASN1START
-- TAG-SCHEDULINGREQUESTRESOURCEID-START

SchedulingRequestResourceId ::=      INTEGER (1..maxNrofSR-Resources)

-- TAG-SCHEDULINGREQUESTRESOURCEID-STOP
-- ASN1STOP
```

– **ScramblingId**

The IE *ScramblingID* is used for scrambling channels and reference signals.

**ScramblingId information element**

```
-- ASN1START
-- TAG-SCRAMBLINGID-START

ScramblingId ::=                    INTEGER(0..1023)
```

```
-- TAG-SCRAMBLINGID-STOP
-- ASN1STOP
```

## – *SCS-SpecificCarrier*

The IE *SCS-SpecificCarrier* provides parameters determining the location and width of the actual carrier or the carrier bandwidth. It is defined specifically for a numerology (subcarrier spacing (SCS)) and in relation (frequency offset) to Point A.

### **SCS-SpecificCarrier information element**

```
-- ASN1START
-- TAG-SCS-SPECIFICCARRIER-START

SCS-SpecificCarrier ::= SEQUENCE {
    offsetToCarrier          INTEGER (0..2199),
    subcarrierSpacing       SubcarrierSpacing,
    carrierBandwidth        INTEGER (1..maxNrofPhysicalResourceBlocks),
    ...,
    [[
    txDirectCurrentLocation-v1530  INTEGER (0..4095)                OPTIONAL          -- Need S
    ]]
}

-- TAG-SCS-SPECIFICCARRIER-STOP
-- ASN1STOP
```

#### **SCS-SpecificCarrier field descriptions**

|   |
|---|
| <b>carrierBandwidth</b>   |
| Width of this carrier in number of PRBs (using the <i>subcarrierSpacing</i> defined for this carrier) (see TS 38.211 [16], clause 4.4.2).   |
| <b>offsetToCarrier</b>  |
| Offset in frequency domain between Point A (lowest subcarrier of common RB 0) and the lowest usable subcarrier on this carrier in number of PRBs (using the <i>subcarrierSpacing</i> defined for this carrier). The maximum value corresponds to 275*8-1. See TS 38.211 [16], clause 4.4.2.   |
| <b>txDirectCurrentLocation</b>  |
| Indicates the downlink Tx Direct Current location for the carrier. A value in the range 0..3299 indicates the subcarrier index within the carrier. The values in the value range 3301..4095 are reserved and ignored by the UE. If this field is absent for downlink within <i>ServingCellConfigCommon</i> and <i>ServingCellConfigCommonSIB1</i> , the UE assumes the default value of 3300 (i.e. "Outside the carrier"). (see TS 38.211 [16], clause 4.4.2). Network does not configure this field via <i>ServingCellConfig</i> or for uplink carriers. |
| <b>subcarrierSpacing</b>  |
| Subcarrier spacing of this carrier. It is used to convert the <i>offsetToCarrier</i> into an actual frequency. Only the values 15 kHz, 30 kHz or 60 kHz (FR1), and 60 kHz or 120 kHz (FR2) are applicable.  |

## – *SDAP-Config*

The IE *SDAP-Config* is used to set the configurable SDAP parameters for a data radio bearer. All configured instances of *SDAP-Config* with the same value of pdu-Session correspond to the same SDAP entity as specified in TS 37.324 [24].

**SDAP-Config information element**

```

-- ASN1START
-- TAG-SDAP-CONFIG-START

SDAP-Config ::=
    SEQUENCE {
        pdu-Session          PDU-SessionID,
        sdap-HeaderDL        ENUMERATED {present, absent},
        sdap-HeaderUL        ENUMERATED {present, absent},
        defaultDRB           BOOLEAN,
        mappedQoS-FlowsToAdd SEQUENCE (SIZE (1..maxNrofQFIs)) OF QFI OPTIONAL, -- Need N
        mappedQoS-FlowsToRelease SEQUENCE (SIZE (1..maxNrofQFIs)) OF QFI OPTIONAL, -- Need N
        ...
    }

QFI ::=
    INTEGER (0..maxQFI)

PDU-SessionID ::=
    INTEGER (0..255)

-- TAG-SDAP-CONFIG-STOP
-- ASN1STOP

```

**SDAP-Config field descriptions****defaultDRB**

Indicates whether or not this is the default DRB for this PDU session. Among all configured instances of *SDAP-Config* with the same value of *pdu-Session*, this field shall be set to *true* in at most one instance of *SDAP-Config* and to *false* in all other instances.

**mappedQoS-FlowsToAdd**

Indicates the list of QFIs of UL QoS flows of the PDU session to be additionally mapped to this DRB. A QFI value can be included at most once in all configured instances of *SDAP-Config* with the same value of *pdu-Session*. For QoS flow remapping, the QFI value of the remapped QoS flow is only included in *mappedQoS-FlowsToAdd* in *sdap-Config* corresponding to the new DRB and not included in *mappedQoS-FlowsToRelease* in *sdap-Config* corresponding to the old DRB.

**mappedQoS-FlowsToRelease**

Indicates the list of QFIs of QoS flows of the PDU session to be released from existing QoS flow to DRB mapping of this DRB.

**pdu-Session**

Identity of the PDU session whose QoS flows are mapped to the DRB.

**sdap-HeaderUL**

Indicates whether or not a SDAP header is present for UL data on this DRB. The field cannot be changed after a DRB is established. The network sets this field to *present* if the field *defaultDRB* is set to *true*.

**sdap-HeaderDL**

Indicates whether or not a SDAP header is present for DL data on this DRB. The field cannot be changed after a DRB is established.

– **SearchSpace**

The IE *SearchSpace* defines how/where to search for PDCCH candidates. Each search space is associated with one *ControlResourceSet*. For a scheduled cell in the case of cross carrier scheduling, except for *nrofCandidates*, all the optional fields are absent.

**SearchSpace** information element

```

-- ASN1START
-- TAG-SEARCHSPACE-START

SearchSpace ::=
    searchSpaceId
    controlResourceSetId
    monitoringSlotPeriodicityAndOffset
        s11
        s12
        s14
        s15
        s18
        s110
        s116
        s120
        s140
        s180
        s1160
        s1320
        s1640
        s11280
        s12560
    }
    duration
    monitoringSymbolsWithinSlot
    nrofCandidates
        aggregationLevel1
        aggregationLevel2
        aggregationLevel4
        aggregationLevel8
        aggregationLevel16
    }
    searchSpaceType
        common
            dci-Format0-0-AndFormat1-0
                ...
            }
            dci-Format2-0
                nrofCandidates-SFI
                    aggregationLevel1
                    aggregationLevel2
                    aggregationLevel4
                    aggregationLevel8
                    aggregationLevel16
                },
                ...
            }
            dci-Format2-1
                ...
            }
            dci-Format2-2
                ...
        }
}
SEQUENCE {
    SearchSpaceId,
    ControlResourceSetId
OPTIONAL, -- Cond SetupOnly
    CHOICE {
        NULL,
        INTEGER (0..1),
        INTEGER (0..3),
        INTEGER (0..4),
        INTEGER (0..7),
        INTEGER (0..9),
        INTEGER (0..15),
        INTEGER (0..19),
        INTEGER (0..39),
        INTEGER (0..79),
        INTEGER (0..159),
        INTEGER (0..319),
        INTEGER (0..639),
        INTEGER (0..1279),
        INTEGER (0..2559)
    }
    INTEGER (2..2559)
OPTIONAL, -- Cond Setup
OPTIONAL, -- Need R
    BIT STRING (SIZE (14))
    SEQUENCE {
        ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8},
        ENUMERATED {n0, n1, n2, n3, n4, n5, n6, n8}
    }
OPTIONAL, -- Cond Setup
    CHOICE {
        SEQUENCE {
            SEQUENCE {
                SEQUENCE {
                    SEQUENCE {
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                    }
                }
            }
        }
        SEQUENCE {
            SEQUENCE {
                SEQUENCE {
                    SEQUENCE {
                        ENUMERATED {n1, n2}
OPTIONAL, -- Need R
                    }
                }
            }
        }
    }
}

```

```

    }
    dci-Format2-3
      dummy1
      dummy2
      ...
    }
  },
  ue-Specific
    dci-Formats
      ...
    }
  }
}

SEQUENCE {
  ENUMERATED {s11, s12, s14, s15, s18, s110, s116, s120} OPTIONAL, -- Cond Setup
  ENUMERATED {n1, n2},
}

SEQUENCE {
  ENUMERATED {formats0-0-And-1-0, formats0-1-And-1-1},
}

OPTIONAL -- Need R
OPTIONAL -- Need R
OPTIONAL -- Cond Setup

-- TAG-SEARCHSPACE-STOP
-- ASN1STOP

```



| <b>SearchSpace field descriptions</b>   |
|---|
| <p><b>common</b><br/>Configures this search space as common search space (CSS) and DCI formats to monitor.</p>  |
| <p><b>controlResourceSetId</b><br/>The CORESET applicable for this SearchSpace. Value 0 identifies the common CORESET#0 configured in MIB and in <i>ServingCellConfigCommon</i>. Values 1..<i>maxNrofControlResourceSets</i>-1 identify CORESETs configured in System Information or by dedicated signalling. The CORESETs with <i>non-zero controlResourceSetId</i> locate in the same BWP as this <i>SearchSpace</i>.</p>   |
| <p><b>dummy1, dummy2</b><br/>This field is not used in the specification. If received it shall be ignored by the UE.</p>  |
| <p><b>dci-Format0-0-AndFormat1-0</b><br/>If configured, the UE monitors the DCI formats 0_0 and 1_0 according to TS 38.213 [13], clause 10.1.</p>   |
| <p><b>dci-Format2-0</b><br/>If configured, UE monitors the DCI format 2_0 according to TS 38.213 [13], clause 10.1, 11.1.1.</p>   |
| <p><b>dci-Format2-1</b><br/>If configured, UE monitors the DCI format 2_1 according to TS 38.213 [13], clause 10.1, 11.2.</p>   |
| <p><b>dci-Format2-2</b><br/>If configured, UE monitors the DCI format 2_2 according to TS 38.213 [13], clause 10.1, 11.3.</p>   |
| <p><b>dci-Format2-3</b><br/>If configured, UE monitors the DCI format 2_3 according to TS 38.213 [13], clause 10.1, 11.4.</p>   |
| <p><b>dci-Formats</b><br/>Indicates whether the UE monitors in this USS for DCI formats 0-0 and 1-0 or for formats 0-1 and 1-1.</p>   |
| <p><b>duration</b><br/>Number of consecutive slots that a SearchSpace lasts in every occasion, i.e., upon every period as given in the <i>periodicityAndOffset</i>. If the field is absent, the UE applies the value 1 slot, except for DCI format 2_0. The UE ignores this field for DCI format 2_0. The maximum valid duration is <i>periodicity</i>-1 (<i>periodicity</i> as given in the <i>monitoringSlotPeriodicityAndOffset</i>).</p>  |
| <p><b>monitoringSlotPeriodicityAndOffset</b><br/>Slots for PDCCH Monitoring configured as periodicity and offset. If the UE is configured to monitor DCI format 2_1, only the values 'sl1', 'sl2' or 'sl4' are applicable. If the UE is configured to monitor DCI format 2_0, only the values 'sl1', 'sl2', 'sl4', 'sl5', 'sl8', 'sl10', 'sl16', and 'sl20' are applicable (see TS 38.213 [13], clause 10).</p>   |
| <p><b>monitoringSymbolsWithinSlot</b><br/>The first symbol(s) for PDCCH monitoring in the slots configured for PDCCH monitoring (see <i>monitoringSlotPeriodicityAndOffset</i> and <i>duration</i>). The most significant (left) bit represents the first OFDM in a slot, and the second most significant (left) bit represents the second OFDM symbol in a slot and so on. The bit(s) set to one identify the first OFDM symbol(s) of the control resource set within a slot. If the cyclic prefix of the BWP is set to extended CP, the last two bits within the bit string shall be ignored by the UE. For DCI format 2_0, the first one symbol applies if the <i>duration</i> of CORESET (in the IE <i>ControlResourceSet</i>) identified by <i>controlResourceSetId</i> indicates 3 symbols, the first two symbols apply if the <i>duration</i> of CORESET identified by <i>controlResourceSetId</i> indicates 2 symbols, and the first three symbols apply if the <i>duration</i> of CORESET identified by <i>controlResourceSetId</i> indicates 1 symbol.<br/>See TS 38.213 [13], clause 10.</p> |
| <p><b>nrofCandidates-SFI</b><br/>The number of PDCCH candidates specifically for format 2-0 for the configured aggregation level. If an aggregation level is absent, the UE does not search for any candidates with that aggregation level. The network configures only one aggregationLevel and the corresponding number of candidates (see TS 38.213 [13], clause 11.1.1).</p>  |
| <p><b>nrofCandidates</b><br/>Number of PDCCH candidates per aggregation level. The number of candidates and aggregation levels configured here applies to all formats unless a particular value is specified or a format-specific value is provided (see inside <i>searchSpaceType</i>). If configured in the <i>SearchSpace</i> of a cross carrier scheduled cell, this field determines the number of candidates and aggregation levels to be used on the linked scheduling cell (see TS 38.213 [13], clause 10).</p>   |

|  |
|--|
| <p><b>searchSpaceId</b><br/>Identity of the search space. SearchSpaceId = 0 identifies the <i>searchSpaceZero</i> configured via PBCH (MIB) or <i>ServingCellConfigCommon</i> and may hence not be used in the <i>SearchSpace</i> IE. The searchSpaceId is unique among the BWPs of a Serving Cell. In case of cross carrier scheduling, search spaces with the same <i>searchSpaceId</i> in scheduled cell and scheduling cell are linked to each other. The UE applies the search space for the scheduled cell only if the DL BWPs in which the linked search spaces are configured in scheduling cell and scheduled cell are both active.</p> |
| <p><b>searchSpaceType</b><br/>Indicates whether this is a common search space (present) or a UE specific search space as well as DCI formats to monitor for.</p>   |
| <p><b>ue-Specific</b><br/>Configures this search space as UE specific search space (USS). The UE monitors the DCI format with CRC scrambled by C-RNTI, CS-RNTI (if configured), and SP-CSI-RNTI (if configured)</p>  |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>Setup</i>         | This field is mandatory present upon creation of a new <i>SearchSpace</i> . It is optionally present, Need M, otherwise. |
| <i>SetupOnly</i>     | This field is mandatory present upon creation of a new <i>SearchSpace</i> . It is absent, Need M, otherwise.             |

## – SearchSpaceId

The IE *SearchSpaceId* is used to identify Search Spaces. The ID space is used across the BWPs of a Serving Cell. The search space with the *SearchSpaceId* = 0 identifies the search space configured via PBCH (MIB) and in *ServingCellConfigCommon* (*searchSpaceZero*). The number of Search Spaces per BWP is limited to 10 including the common and UE specific Search Spaces.

### SearchSpaceId information element

```
-- ASN1START
-- TAG-SEARCHSPACEID-START

SearchSpaceId ::=
    INTEGER (0..maxNrofSearchSpaces-1)

-- TAG-SEARCHSPACEID-STOP
-- ASN1STOP
```

## – SearchSpaceZero

The IE *SearchSpaceZero* is used to configure SearchSpace#0 of the initial BWP (see TS 38.213 [13], clause 13).

### SearchSpaceZero information element

```
-- ASN1START
-- TAG-SEARCHSPACEZERO-START

SearchSpaceZero ::=
    INTEGER (0..15)

-- TAG-SEARCHSPACEZERO-STOP
-- ASN1STOP
```

## – SecurityAlgorithmConfig

The IE *SecurityAlgorithmConfig* is used to configure AS integrity protection algorithm and AS ciphering algorithm for SRBs and DRBs.

### SecurityAlgorithmConfig information element

```
-- ASN1START
-- TAG-SECURITYALGORITHMCONFIG-START

SecurityAlgorithmConfig ::= SEQUENCE {
    cipheringAlgorithm      CipheringAlgorithm,
    integrityProtAlgorithm  IntegrityProtAlgorithm  OPTIONAL,  -- Need R
    ...
}

IntegrityProtAlgorithm ::= ENUMERATED {
    nia0, nia1, nia2, nia3, spare4, spare3,
    spare2, spare1, ...}

CipheringAlgorithm ::= ENUMERATED {
    nea0, nea1, nea2, nea3, spare4, spare3,
    spare2, spare1, ...}

-- TAG-SECURITYALGORITHMCONFIG-STOP
-- ASN1STOP
```

#### SecurityAlgorithmConfig field descriptions

##### ***cipheringAlgorithm***

Indicates the ciphering algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms *nea0-nea3* are identical to the LTE algorithms *eea0-3*. The algorithms configured for all bearers using master key shall be the same, and the algorithms configured for all bearers using secondary key, if any, shall be the same. If UE is connected to E-UTRA/EPC, this field indicates the ciphering algorithm to be used for RBs configured with NR PDCP, as specified in TS 33.501 [11].

##### ***integrityProtAlgorithm***

Indicates the integrity protection algorithm to be used for SRBs and DRBs, as specified in TS 33.501 [11]. The algorithms *nia0-nia3* are identical to the E-UTRA algorithms *eia0-3*. The algorithms configured for all bearers using master key shall be the same and the algorithms configured for all bearers using secondary key, if any, shall be the same. The network does not configure *nia0* except for unauthenticated emergency sessions for unauthenticated UEs in LSM (limited service mode). If UE is connected to E-UTRA/EPC, this field indicates the integrity protection algorithm to be used for SRBs configured with NR PDCP, as specified in TS 33.501 [11]. The network does not configure *nia0* for SRB3.

## – ServCellIndex

The IE *ServCellIndex* concerns a short identity, used to identify a serving cell (i.e. the PCell, the PSCell or an SCell). Value 0 applies for the PCell, while the *SCellIndex* that has previously been assigned applies for SCells.

**ServCellIndex** information element

```

-- ASN1START
-- TAG-SERVCELLINDEX-START

ServCellIndex ::=
    INTEGER (0..maxNrofServingCells-1)

-- TAG-SERVCELLINDEX-STOP
-- ASN1STOP

```

## – **ServingCellConfig**

The IE *ServingCellConfig* is used to configure (add or modify) the UE with a serving cell, which may be the SpCell or an SCell of an MCG or SCG. The parameters herein are mostly UE specific but partly also cell specific (e.g. in additionally configured bandwidth parts). Reconfiguration between a PUCCH and PUCCHless SCell is only supported using an SCell release and add.

**ServingCellConfig** information element

```

-- ASN1START
-- TAG-SERVINGCELLCONFIG-START

ServingCellConfig ::=
    SEQUENCE {
        tdd-UL-DL-ConfigurationDedicated    TDD-UL-DL-ConfigDedicated    OPTIONAL,    -- Cond TDD
        initialDownlinkBWP                  BWP-DownlinkDedicated        OPTIONAL,    -- Need M
        downlinkBWP-ToReleaseList            SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id    OPTIONAL,    -- Need N
        downlinkBWP-ToAddModList            SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Downlink    OPTIONAL,    -- Need N
        firstActiveDownlinkBWP-Id          BWP-Id                        OPTIONAL,    -- Cond SyncAndCellAdd
        bwp-InactivityTimer                  ENUMERATED {ms2, ms3, ms4, ms5, ms6, ms8, ms10, ms20, ms30,
                                                    ms40,ms50, ms60, ms80,ms100, ms200,ms300, ms500,
                                                    ms750, ms1280, ms1920, ms2560, spare10, spare9, spare8,
                                                    spare7, spare6, spare5, spare4, spare3, spare2, spare1 }    OPTIONAL,    --Need R
        defaultDownlinkBWP-Id              BWP-Id                        OPTIONAL,    -- Need S
        uplinkConfig                          UplinkConfig                  OPTIONAL,    -- Need M
        supplementaryUplink                  UplinkConfig                  OPTIONAL,    -- Need M
        pdccch-ServingCellConfig            SetupRelease { PDCCH-ServingCellConfig }    OPTIONAL,    -- Need M
        pdsch-ServingCellConfig            SetupRelease { PDSCH-ServingCellConfig }    OPTIONAL,    -- Need M
        csi-MeasConfig                      SetupRelease { CSI-MeasConfig }    OPTIONAL,    -- Need M
        sCellDeactivationTimer              ENUMERATED {ms20, ms40, ms80, ms160, ms200, ms240,
                                                    ms320, ms400, ms480, ms520, ms640, ms720,
                                                    ms840, ms1280, spare2,spare1}    OPTIONAL,    -- Cond ServingCellWithoutPUCCH
        crossCarrierSchedulingConfig        CrossCarrierSchedulingConfig    OPTIONAL,    -- Need M
        tag-Id                                TAG-Id,
        dummy                                ENUMERATED {enabled}          OPTIONAL,    -- Need R
        pathlossReferenceLinking            ENUMERATED {spCell, sCell}    OPTIONAL,    -- Cond SCellOnly
        servingCellMO                        MeasObjectId                  OPTIONAL,    -- Cond MeasObject
        . . . ,
        [
            lte-CRS-ToMatchAround            SetupRelease { RateMatchPatternLTE-CRS }    OPTIONAL,    -- Need M
            rateMatchPatternToAddModList    SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern    OPTIONAL,    -- Need N
            rateMatchPatternToReleaseList    SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId    OPTIONAL,    -- Need N
        ]
    }

```

```

    downlinkChannelBW-PerSCS-List      SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier      OPTIONAL      -- Need S
    ]]
}

UplinkConfig ::=
    initialUplinkBWP                    BWP-UplinkDedicated                        OPTIONAL,    -- Need M
    uplinkBWP-ToReleaseList             SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Id      OPTIONAL,    -- Need N
    uplinkBWP-ToAddModList              SEQUENCE (SIZE (1..maxNrofBWPs)) OF BWP-Uplink  OPTIONAL,    -- Need N
    firstActiveUplinkBWP-Id            BWP-Id                                          OPTIONAL,    -- Cond SyncAndCellAdd
    pusch-ServingCellConfig             SetupRelease { PUSCH-ServingCellConfig }        OPTIONAL,    -- Need M
    carrierSwitching                    SetupRelease { SRS-CarrierSwitching }          OPTIONAL,    -- Need M
    ...,
    [[
    powerBoostPi2BPSK                   BOOLEAN                                          OPTIONAL,    -- Need M
    uplinkChannelBW-PerSCS-List          SEQUENCE (SIZE (1..maxSCSs)) OF SCS-SpecificCarrier  OPTIONAL      -- Need S
    ]]
}

-- TAG-SERVINGCELLCONFIG-STOP
-- ASN1STOP

```

| <b>ServingCellConfig field descriptions</b>  |
|--|
| <p><b><i>bwp-InactivityTimer</i></b><br/>The duration in ms after which the UE falls back to the default Bandwidth Part (see TS 38.321 [3], clause 5.15). When the network releases the timer configuration, the UE stops the timer without switching to the default BWP.</p>  |
| <p><b><i>crossCarrierSchedulingConfig</i></b><br/>Indicates whether this serving cell is cross-carrier scheduled by another serving cell or whether it cross-carrier schedules another serving cell.</p>   |
| <p><b><i>defaultDownlinkBWP-Id</i></b><br/>The initial bandwidth part is referred to by BWP-Id = 0. ID of the downlink bandwidth part to be used upon expiry of the BWP inactivity timer. This field is UE specific. When the field is absent the UE uses the initial BWP as default BWP. (see TS 38.213 [13], clause 12 and TS 38.321 [3], clause 5.15).</p>  |
| <p><b><i>downlinkBWP-ToAddModList</i></b><br/>List of additional downlink bandwidth parts to be added or modified. (see TS 38.213 [13], clause 12).</p>  |
| <p><b><i>downlinkBWP-ToReleaseList</i></b><br/>List of additional downlink bandwidth parts to be released. (see TS 38.213 [13], clause 12).</p>  |
| <p><b><i>downlinkChannelBW-PerSCS-List</i></b><br/>A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in <i>scs-SpecificCarrierList</i> in <i>DownlinkConfigCommon</i> / <i>DownlinkConfigCommonSIB</i>. Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39].</p>  |
| <p><b><i>firstActiveDownlinkBWP-Id</i></b><br/>If configured for an SpCell, this field contains the ID of the DL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.<br/>If configured for an SCell, this field contains the ID of the downlink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by BWP-Id = 0.<br/>Upon PCell change and PSCell addition/change, the network sets the <i>firstActiveDownlinkBWP-Id</i> and <i>firstActiveUplinkBWP-Id</i> to the same value.</p>   |
| <p><b><i>initialDownlinkBWP</i></b><br/>The dedicated (UE-specific) configuration for the initial downlink bandwidth-part (i.e. DL BWP#0). If any of the optional IEs are configured within this IE, the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1</p>   |
| <p><b><i>lte-CRS-ToMatchAround</i></b><br/>Parameters to determine an LTE CRS pattern that the UE shall rate match around.</p>   |
| <p><b><i>pathlossReferenceLinking</i></b><br/>Indicates whether UE shall apply as pathloss reference either the downlink of SpCell (PCell for MCG or PSCell for SCG) or of SCell that corresponds with this uplink (see TS 38.213 [13], clause 7).</p>   |
| <p><b><i>pdsch-ServingCellConfig</i></b><br/>PDSCH related parameters that are not BWP-specific.</p>   |
| <p><b><i>rateMatchPatternToAddModList</i></b><br/>Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the nested bitmaps. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology. See TS 38.214 [19], clause 5.1.2.2.3.</p>  |
| <p><b><i>sCellDeactivationTimer</i></b><br/>SCell deactivation timer in TS 38.321 [3]. If the field is absent, the UE applies the value infinity.</p>  |
| <p><b><i>servingCellMO</i></b><br/><i>measObjectId</i> of the <i>MeasObjectNR</i> in <i>MeasConfig</i> which is associated to the serving cell. For this <i>MeasObjectNR</i>, the following relationship applies between this <i>MeasObjectNR</i> and <i>frequencyInfoDL</i> in <i>ServingCellConfigCommon</i> of the serving cell: if <i>ssbFrequency</i> is configured, its value is the same as the <i>absoluteFrequencySSB</i> and if <i>csi-rs-ResourceConfigMobility</i> is configured, the value of its <i>subcarrierSpacing</i> is present in one entry of the <i>scs-SpecificCarrierList</i>, <i>csi-RS-CellListMobility</i> includes an entry corresponding to the serving cell (with <i>cellId</i> equal to <i>physCellId</i> in <i>ServingCellConfigCommon</i>) and the frequency range indicated by the <i>csi-rs-MeasurementBW</i> of the entry in <i>csi-RS-CellListMobility</i> is included in the frequency range indicated by the entry of the <i>scs-SpecificCarrierList</i>.</p> |

|  |
|--|
| <b>supplementaryUplink</b><br>Network may configure this field only when <i>supplementaryUplinkConfig</i> is configured in <i>ServingCellConfigCommon</i> or <i>ServingCellConfigCommonSIB</i> . |
| <b>tag-Id</b><br>Timing Advance Group ID, as specified in TS 38.321 [3], which this cell belongs to.   |
| <b>uplinkConfig</b><br>Network may configure this field only when <i>uplinkConfigCommon</i> is configured in <i>ServingCellConfigCommon</i> or <i>ServingCellConfigCommonSIB</i> .               |

| <b>UplinkConfig field descriptions</b>  |
|---|
| <b>carrierSwitching</b><br>Includes parameters for configuration of carrier based SRS switching (see TS 38.214 [19], clause 6.2.1.3.  |
| <b>firstActiveUplinkBWP-Id</b><br>If configured for an SpCell, this field contains the ID of the UL BWP to be activated upon performing the RRC (re-)configuration. If the field is absent, the RRC (re-)configuration does not impose a BWP switch.<br>If configured for an SCell, this field contains the ID of the uplink bandwidth part to be used upon MAC-activation of an SCell. The initial bandwidth part is referred to by <i>BandwidthPartId</i> = 0.  |
| <b>initialUplinkBWP</b><br>The dedicated (UE-specific) configuration for the initial uplink bandwidth-part (i.e. UL BWP#0). If any of the optional IEs are configured within this IE as part of the IE <i>uplinkConfig</i> , the UE considers the BWP#0 to be an RRC configured BWP (from UE capability viewpoint). Otherwise, the UE does not consider the BWP#0 as an RRC configured BWP (from UE capability viewpoint). Network always configures the UE with a value for this field if no other BWPs are configured. NOTE1  |
| <b>powerBoostPi2BPSK</b><br>If this field is set to <i>true</i> , the UE determines the maximum output power for PUCCH/PUSCH transmissions that use pi/2 BPSK modulation according to TS 38.101-1 [15], clause 6.2.4.   |
| <b>pusch-ServingCellConfig</b><br>PUSCH related parameters that are not BWP-specific.   |
| <b>uplinkBWP-ToAddModList</b><br>The additional bandwidth parts for uplink to be added or modified. In case of TDD uplink- and downlink BWP with the same <i>bandwidthPartId</i> are considered as a BWP pair and must have the same center frequency.  |
| <b>uplinkBWP-ToReleaseList</b><br>The additional bandwidth parts for uplink to be released.   |
| <b>uplinkChannelBW-PerSCS-List</b><br>A set of UE specific channel bandwidth and location configurations for different subcarrier spacings (numerologies). Defined in relation to Point A. The UE uses the configuration provided in this field only for the purpose of channel bandwidth and location determination. If absent, UE uses the configuration indicated in <i>scs-SpecificCarrierList</i> in <i>UplinkConfigCommon</i> / <i>UplinkConfigCommonSIB</i> . Network only configures channel bandwidth that corresponds to the channel bandwidth values defined in TS 38.101-1 [15] and TS 38.101-2 [39]. |

NOTE 1: If the dedicated part of initial UL/DL BWP configuration is absent, the initial BWP can be used but with some limitations. For example, changing to another BWP requires *RRCReconfiguration* since DCI format 1\_0 doesn't support DCI-based switching.

| Conditional Presence           | Explanation  |
|--------------------------------|--|
| <i>MeasObject</i>              | This field is mandatory present for the SpCell if the UE has a <i>measConfig</i> , and it is optionally present, Need M, for SCells.   |
| <i>SCellOnly</i>               | This field is optionally present, Need R, for SCells. It is absent otherwise.  |
| <i>ServingCellWithoutPUCCH</i> | This field is optionally present, Need S, for SCells except PUCCH SCells. It is absent otherwise.  |
| <i>SyncAndCellAdd</i>          | This field is mandatory present for a SpCell upon PCell change and PCell addition/change and upon <i>RRCSetup/RRCResume</i> .<br>The field is mandatory present for an SCell upon addition.<br>For SpCell, the field is optionally present, Need N, upon reconfiguration without <i>reconfigurationWithSync</i> .<br>In all other cases the field is absent. |
| <i>TDD</i>                     | This field is optionally present, Need R, for TDD cells. It is absent otherwise.   |

## – *ServingCellConfigCommon*

The IE *ServingCellConfigCommon* is used to configure cell specific parameters of a UE's serving cell. The IE contains parameters which a UE would typically acquire from SSB, MIB or SIBs when accessing the cell from IDLE. With this IE, the network provides this information in dedicated signalling when configuring a UE with a SCells or with an additional cell group (SCG). It also provides it for SpCells (MCG and SCG) upon reconfiguration with sync.

### ***ServingCellConfigCommon* information element**

```
-- ASN1START
-- TAG-SERVINGCELLCONFIGCOMMON-START

ServingCellConfigCommon ::= SEQUENCE {
    physCellId PhysCellId OPTIONAL, -- Cond HOAndServCellAdd,
    downlinkConfigCommon DownlinkConfigCommon OPTIONAL, -- Cond HOAndServCellAdd
    uplinkConfigCommon UplinkConfigCommon OPTIONAL, -- Need M
    supplementaryUplinkConfig UplinkConfigCommon OPTIONAL, -- Need S
    n-TimingAdvanceOffset ENUMERATED { n0, n25600, n39936 } OPTIONAL, -- Need S
    ssb-PositionsInBurst CHOICE {
        shortBitmap BIT STRING (SIZE (4)),
        mediumBitmap BIT STRING (SIZE (8)),
        longBitmap BIT STRING (SIZE (64))
    } OPTIONAL, -- Cond AbsFreqSSB
    ssb-periodicityServingCell ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160, spare2, spare1 } OPTIONAL, -- Need S
    dmrs-TypeA-Position ENUMERATED {pos2, pos3},
    lte-CRS-ToMatchAround SetupRelease { RateMatchPatternLTE-CRS } OPTIONAL, -- Need M
    rateMatchPatternToAddModList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPattern OPTIONAL, -- Need N
    rateMatchPatternToReleaseList SEQUENCE (SIZE (1..maxNrofRateMatchPatterns)) OF RateMatchPatternId OPTIONAL, -- Need N
    ssbSubcarrierSpacing SubcarrierSpacing OPTIONAL, -- Cond HOAndServCellWithSSB
    tdd-UL-DL-ConfigurationCommon TDD-UL-DL-ConfigCommon OPTIONAL, -- Cond TDD
    ss-PBCH-BlockPower INTEGER (-60..50),
    ...
}

-- TAG-SERVINGCELLCONFIGCOMMON-STOP
-- ASN1STOP
```



| <b>ServingCellConfigCommon field descriptions</b>  |
|--|
| <p><b>dmrs-TypeA-Position</b><br/>Position of (first) DM-RS for downlink (see TS 38.211 [16], clause 7.4.1.1.1) and uplink (TS 38.211 [16], clause 6.4.1.1.3).</p>   |
| <p><b>downlinkConfigCommon</b><br/>The common downlink configuration of the serving cell, including the frequency information configuration and the initial downlink BWP common configuration. The parameters provided herein should match the parameters configured by MIB and SIB1 (if provided) of the serving cell, with the exception of <i>controlResourceSetZero</i> and <i>searchSpaceZero</i> which can be configured in <i>ServingCellConfigCommon</i> even if MIB indicates that they are absent.</p>   |
| <p><b>longBitmap</b><br/>Bitmap when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1.</p>  |
| <p><b>lte-CRS-ToMatchAround</b><br/>Parameters to determine an LTE CRS pattern that the UE shall rate match around.</p>  |
| <p><b>mediumBitmap</b><br/>Bitmap when maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1.</p>   |
| <p><b>n-TimingAdvanceOffset</b><br/>The N_TA-Offset to be applied for all uplink transmissions on this serving cell. If the field is absent, the UE applies the value defined for the duplex mode and frequency range of this serving cell. See TS 38.133 [14], table 7.1.2-2.</p>   |
| <p><b>rateMatchPatternToAddModList</b><br/>Resources patterns which the UE should rate match PDSCH around. The UE rate matches around the union of all resources indicated in the nested bitmaps. Rate match patterns defined here on cell level apply only to PDSCH of the same numerology (see TS 38.214 [19], clause 5.1.4.1).</p>  |
| <p><b>shortBitmap</b><br/>Bitmap when maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1.</p>  |
| <p><b>ss-PBCH-BlockPower</b><br/>Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for SSB transmission, see TS 38.213 [13], clause 7.</p>   |
| <p><b>ssb-periodicityServingCell</b><br/>The SSB periodicity in ms for the rate matching purpose. If the field is absent, the UE applies the value ms5. (see TS 38.213 [13], clause 4.1)</p>   |
| <p><b>ssb-PositionsInBurst</b><br/>Indicates the time domain positions of the transmitted SS-blocks in a half frame with SS/PBCH blocks as defined in TS 38.213 [13], clause 4.1. The first/ leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted. The network configures the same pattern in this field as in the corresponding field in <i>ServingCellConfigCommonSIB</i>.</p> |
| <p><b>ssbSubcarrierSpacing</b><br/>Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable.</p>   |
| <p><b>supplementaryUplinkConfig</b><br/>The network configures this field only if <i>uplinkConfigCommon</i> is configured. If this field is absent, the UE shall release the <i>supplementaryUplinkConfig</i> and the <i>supplementaryUplink</i> configured in <i>ServingCellConfig</i> of this serving cell, if configured.</p>   |
| <p><b>tdd-UL-DL-ConfigurationCommon</b><br/>A cell-specific TDD UL/DL configuration, see TS 38.213 [13], clause 11.1.</p>  |

| Conditional Presence        | Explanation  |
|-----------------------------|--|
| <i>AbsFreqSSB</i>           | The field is absent when <i>absoluteFrequencySSB</i> in <i>frequencyInfoDL</i> is absent, otherwise the field is mandatory present.          |
| <i>HOAndServCellAdd</i>     | This field is mandatory present upon PCell change and upon serving cell (PSCell/SCell) addition. Otherwise, the field is absent.             |
| <i>HOAndServCellWithSSB</i> | This field is mandatory present upon PCell change and upon serving cell (SCell with SSB or PSCell) addition. Otherwise, the field is absent. |
| <i>TDD</i>                  | The field is optionally present, Need R, for TDD cells; otherwise it is absent.  |

## – *ServingCellConfigCommonSIB*

The IE *ServingCellConfigCommonSIB* is used to configure cell specific parameters of a UE's serving cell in SIB1.

### ***ServingCellConfigCommonSIB* information element**

```

-- ASN1START
-- TAG-SERVINGCELLCONFIGCOMMONSIB-START

ServingCellConfigCommonSIB ::= SEQUENCE {
  downlinkConfigCommon      DownlinkConfigCommonSIB,
  uplinkConfigCommon        UplinkConfigCommonSIB                OPTIONAL, -- Need R
  supplementaryUplink        UplinkConfigCommonSIB                OPTIONAL, -- Need R
  n-TimingAdvanceOffset     ENUMERATED { n0, n25600, n39936 }     OPTIONAL, -- Need S
  ssb-PositionsInBurst      SEQUENCE {
    inOneGroup               BIT STRING (SIZE (8)),
    groupPresence            BIT STRING (SIZE (8))                OPTIONAL -- Cond FR2-Only
  },
  ssb-PeriodicityServingCell ENUMERATED {ms5, ms10, ms20, ms40, ms80, ms160},

  tdd-UL-DL-ConfigurationCommon TDD-UL-DL-ConfigCommon          OPTIONAL, -- Cond TDD
  ss-PBCH-BlockPower          INTEGER (-60..50),
  ...
}

-- TAG-SERVINGCELLCONFIGCOMMONSIB-STOP
-- ASN1STOP

```

| <b>ServingCellConfigCommonSIB field descriptions</b> |   |
|--|---|
| <b>groupPresence</b>                                 | This field is present when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1. The first/leftmost bit corresponds to the SS/PBCH index 0-7, the second bit corresponds to SS/PBCH block 8-15, and so on. Value 0 in the bitmap indicates that the SSBs according to <i>inOneGroup</i> are absent. Value 1 indicates that the SS/PBCH blocks are transmitted in accordance with <i>inOneGroup</i> .   |
| <b>inOneGroup</b>                                    | When maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1, only the 4 leftmost bits are valid; the UE ignores the 4 rightmost bits. When maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1, all 8 bits are valid. The first/ leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. When maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1, all 8 bit are valid; The first/ leftmost bit corresponds to the first SS/PBCH block index in the group (i.e., to SSB index 0, 8, and so on); the second bit corresponds to the second SS/PBCH block index in the group (i.e., to SSB index 1, 9, and so on), and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted. |
| <b>n-TimingAdvanceOffset</b>                         | The N_TA-Offset to be applied for random access on this serving cell. If the field is absent, the UE applies the value defined for the duplex mode and frequency range of this serving cell. See TS 38.133 [14], table 7.1.2-2.   |
| <b>ssb-PositionsInBurst</b>                          | Time domain positions of the transmitted SS-blocks in an SS-burst as defined in TS 38.213 [13], clause 4.1.   |
| <b>ss-PBCH-BlockPower</b>                            | Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for SSB transmission, see TS 38.213 [13], clause 7.   |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>FR2-Only</i>      | This field is mandatory present for an FR2 carrier frequency. It is absent otherwise and UE releases any configured value. |
| <i>TDD</i>           | The field is optionally present, Need R, for TDD cells; otherwise it is absent.  |

### – ShortI-RNTI-Value

The IE *ShortI-RNTI-Value* is used to identify the suspended UE context of a UE in RRC\_INACTIVE using fewer bits compared to I-RNTI-Value.

#### ShortI-RNTI-Value information element

```
-- ASN1START
-- TAG-SHORTI-RNTI-VALUE-START

ShortI-RNTI-Value ::=  BIT STRING (SIZE(24))

-- TAG-SHORTI-RNTI-VALUE-STOP
-- ASN1STOP
```

### – ShortMAC-I

The IE *ShortMAC-I* is used to identify and verify the UE at RRC connection re-establishment. The 16 least significant bits of the MAC-I calculated using the AS security configuration of the source PCell, as specified in 5.3.7.4.

**ShortMAC-I information element**

```

-- ASN1START
-- TAG-SHORTMAC-I-START

ShortMAC-I ::=
    BIT STRING (SIZE (16))

-- TAG-SHORTMAC-I-STOP
-- ASN1STOP

```

– **SINR-Range**

The IE *SINR-Range* specifies the value range used in SINR measurements and thresholds. For measurements, integer value for SINR measurements is according to Table 10.1.16.1-1 in TS 38.133 [14]. For thresholds, the actual value is (IE value – 46) / 2 dB.

**SINR-Range information element**

```

-- ASN1START
-- TAG-SINR-RANGE-START

SINR-Range ::=
    INTEGER(0..127)

-- TAG-SINR-RANGE-STOP
-- ASN1STOP

```

– **SI-SchedulingInfo**

The IE *SI-SchedulingInfo* contains information needed for acquisition of SI messages.

**SI-SchedulingInfo information element**

```

-- ASN1START
-- TAG-SI-SCHEDULINGINFO-START

SI-SchedulingInfo ::=
    SEQUENCE {
        schedulingInfoList
            SEQUENCE (SIZE (1..maxSI-Message)) OF SchedulingInfo,
        si-WindowLength
            ENUMERATED {s5, s10, s20, s40, s80, s160, s320, s640, s1280},
        si-RequestConfig
            SI-RequestConfig
            OPTIONAL, -- Cond MSG-1
        si-RequestConfigSUL
            SI-RequestConfig
            OPTIONAL, -- Cond SUL-MSG-1
        systemInformationAreaID
            BIT STRING (SIZE (24))
            OPTIONAL, -- Need R
        ...
    }

SchedulingInfo ::=
    SEQUENCE {
        si-BroadcastStatus
            ENUMERATED {broadcasting, notBroadcasting},
        si-Periodicity
            ENUMERATED {rf8, rf16, rf32, rf64, rf128, rf256, rf512},
        sib-MappingInfo
            SIB-Mapping
    }

```

```

}
SIB-Mapping ::=
SEQUENCE (SIZE (1..maxSIB)) OF SIB-TypeInfo
SIB-TypeInfo ::=
SEQUENCE {
  type
    ENUMERATED {sibType2, sibType3, sibType4, sibType5, sibType6, sibType7, sibType8, sibType9,
      spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1,... },
  valueTag
    INTEGER (0..31)
    OPTIONAL, -- Cond SIB-TYPE
  areaScope
    ENUMERATED {true}
    OPTIONAL -- Need S
}
-- Configuration for Msg1 based SI Request
SI-RequestConfig ::=
SEQUENCE {
  rach-OccasionsSI
    SEQUENCE {
      rach-ConfigSI
        RACH-ConfigGeneric,
      ssb-perRACH-Occasion
        ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}
    }
    OPTIONAL, -- Need R
  si-RequestPeriod
    ENUMERATED {one, two, four, six, eight, ten, twelve, sixteen}
    OPTIONAL, -- Need R
  si-RequestResources
    SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResources
}
SI-RequestResources ::=
SEQUENCE {
  ra-PreambleStartIndex
    INTEGER (0..63),
  ra-AssociationPeriodIndex
    INTEGER (0..15)
    OPTIONAL, -- Need R
  ra-ssb-OccasionMaskIndex
    INTEGER (0..15)
    OPTIONAL -- Need R
}
-- TAG-SI-SCHEDULINGINFO-STOP
-- ASN1STOP

```

#### **SchedulingInfo field descriptions**

##### **areaScope**

Indicates that a SIB is area specific. If the field is absent, the SIB is cell specific.

##### **si-BroadcastStatus**

Indicates if the SI message is being broadcasted or not. Change of *si-BroadcastStatus* should not result in system information change notifications in Short Message transmitted with P-RNTI over DCI (see clause 6.5). The value of the indication is valid until the end of the BCCH modification period when set to *broadcasting*.

##### **si-Periodicity**

Periodicity of the SI-message in radio frames. Value *rf8* corresponds to 8 radio frames, value *rf16* corresponds to 16 radio frames, and so on.

| <b>SI-RequestConfig field descriptions</b>  |
|---|
| <p><b><i>rach-OccasionsSI</i></b><br/>Configuration of dedicated RACH Occassions for SI. If the field is absent, the UE uses the corresponding parameters configured in <i>rach-ConfigCommon</i> of the initial uplink BWP.</p>   |
| <p><b><i>si-RequestPeriod</i></b><br/>Periodicity of the <i>SI-Request</i> configuration in number of association periods.</p>  |
| <p><b><i>si-RequestResources</i></b><br/>If there is only one entry in the list, the configuration is used for all SI messages for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i>. Otherwise the 1<sup>st</sup> entry in the list corresponds to the first SI message in <i>schedulingInfoList</i> for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i>, 2<sup>nd</sup> entry in the list corresponds to the second SI message in <i>schedulingInfoList</i> for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i> and so on. Change of <i>si-RequestResources</i> should not result in system information change notification.</p> |

| <b>SI-RequestResources field descriptions</b>  |
|--|
| <p><b><i>ra-AssociationPeriodIndex</i></b><br/>Index of the association period in the <i>si-RequestPeriod</i> in which the UE can send the SI request for SI message(s) corresponding to this <i>SI-RequestResources</i>, using the preambles indicated by <i>ra-PreambleStartIndex</i> and <i>rach</i> occasions indicated by <i>ra-ssb-OccasionMaskIndex</i>.</p>  |
| <p><b><i>ra-PreambleStartIndex</i></b><br/>If N SSBs are associated with a RACH occasion, where <math>N \geq 1</math>, for the <i>i</i>-th SSB (<math>i=0, \dots, N-1</math>) the preamble with preamble index = <math>ra-PreambleStartIndex + i</math> is used for SI request; For <math>N &lt; 1</math>, the preamble with preamble index = <math>ra-PreambleStartIndex</math> is used for SI request.</p> |

| <b>SI-SchedulingInfo field descriptions</b>  |
|--|
| <p><b><i>si-RequestConfig</i></b><br/>Configuration of Msg1 resources that the UE uses for requesting SI-messages for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i>. If the field is absent the UE uses Msg3 to request SI-messages for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i> (if any).</p>                            |
| <p><b><i>si-RequestConfigSUL</i></b><br/>Configuration of Msg1 resources that the UE uses for requesting SI-messages for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i>. If the field is absent the UE uses Msg3 to request SI-messages for which <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i> (if any) on supplementary uplink.</p> |
| <p><b><i>si-WindowLength</i></b><br/>The length of the SI scheduling window. Value <i>s5</i> corresponds to 5 slots, value <i>s10</i> corresponds to 10 slots and so on. The network always configures <i>si-WindowLength</i> to be shorter than or equal to the <i>si-Periodicity</i>.</p>  |
| <p><b><i>systemInformationAreaID</i></b><br/>Indicates the system information area that the cell belongs to, if any. Any SIB with <i>areaScope</i> within the SI is considered to belong to this <i>systemInformationAreaID</i>. The <i>systemInformationAreaID</i> is unique within a PLMN.</p>   |

| <b>Conditional presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>MSG-1</i>                | The field is optionally present, Need R, if <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i> for any SI-message included in <i>SchedulingInfo</i> . It is absent otherwise.  |
| <i>SIB-TYPE</i>             | The field is mandatory present if the SIB type is different from <i>SIB6</i> , <i>SIB7</i> or <i>SIB8</i> . For <i>SIB6</i> , <i>SIB7</i> and <i>SIB8</i> it is absent.  |
| <i>SUL-MSG-1</i>            | The field is optionally present, Need R, if this serving cell is configured with a supplementary uplink and if <i>si-BroadcastStatus</i> is set to <i>notBroadcasting</i> for any SI-message included in <i>SchedulingInfo</i> . It is absent otherwise. |

– *SK-Counter*

The IE *SK-Counter* is a counter used upon initial configuration of SN security for NR-DC and NE-DC, as well as upon refresh of  $S\text{-}K_{\text{gNB}}$  or  $S\text{-}K_{\text{eNB}}$  based on the current or newly derived  $K_{\text{gNB}}$  during RRC Resume or RRC Reconfiguration, as defined in TS 33.501 [11].

```
-- ASN1START
-- TAG-SKCOUNTER-START

SK-Counter ::= INTEGER (0..65535)

-- TAG-SKCOUNTER-STOP
-- ASN1STOP
```

– *SlotFormatCombinationsPerCell*

The IE *SlotFormatCombinationsPerCell* is used to configure the SlotFormatCombinations applicable for one serving cell (see TS 38.213 [13], clause 11.1.1).

***SlotFormatCombinationsPerCell* information element**

```
-- ASN1START
-- TAG-SLOTFORMATCOMBINATIONSPERCELL-START

SlotFormatCombinationsPerCell ::= SEQUENCE {
    servingCellId          ServCellIndex,
    subcarrierSpacing      SubcarrierSpacing,
    subcarrierSpacing2     SubcarrierSpacing                                OPTIONAL, -- Need R
    slotFormatCombinations SEQUENCE (SIZE (1..maxNrofSlotFormatCombinationsPerSet)) OF SlotFormatCombination
                                                                    OPTIONAL, -- Need M
    positionInDCI          INTEGER(0..maxSFI-DCI-PayloadSize-1)           OPTIONAL, -- Need M
    ...
}

SlotFormatCombination ::= SEQUENCE {
    slotFormatCombinationId SlotFormatCombinationId,
    slotFormats              SEQUENCE (SIZE (1..maxNrofSlotFormatsPerCombination)) OF INTEGER (0..255)
}

SlotFormatCombinationId ::= INTEGER (0..maxNrofSlotFormatCombinationsPerSet-1)

-- TAG-SLOTFORMATCOMBINATIONSPERCELL-STOP
-- ASN1STOP
```

| <b>SlotFormatCombination field descriptions</b>   |
|---|
| <b>slotFormatCombinationId</b><br>This ID is used in the DCI payload to dynamically select this <i>SlotFormatCombination</i> , see TS 38.213 [13], clause 11.1.1. |
| <b>slotFormats</b><br>Slot formats that occur in consecutive slots in time domain order as listed here (see TS 38.213 [13], clause 11.1.1).                       |

| <b>SlotFormatCombinationsPerCell field descriptions</b>   |
|---|
| <b>positionInDCI</b><br>The (starting) position (bit) of the slotFormatCombinationId (SFI-Index) for this serving cell (servingCellId) within the DCI payload (see TS 38.213 [13], clause 11.1.1).  |
| <b>servingCellId</b><br>The ID of the serving cell for which the slotFormatCombinations are applicable.   |
| <b>slotFormatCombinations</b><br>A list with <i>SlotFormatCombinations</i> . Each <i>SlotFormatCombination</i> comprises of one or more <i>SlotFormats</i> (see TS 38.211 [16], clause 4.3.2). The total number of <i>slotFormats</i> in the <i>slotFormatCombinations</i> list does not exceed 512.  |
| <b>subcarrierSpacing2</b><br>Reference subcarrier spacing for a Slot Format Combination on an FDD or SUL cell (see TS 38.213 [13], clause 11.1.1). For FDD, subcarrierSpacing (SFI-scs) is the reference SCS for DL BWP and subcarrierSpacing2 (SFI-scs2) is the reference SCS for UL BWP. For SUL, <i>subcarrierSpacing</i> (SFI-scs) is the reference SCS for non-SUL carrier and <i>subcarrierSpacing2</i> (SFI-scs2) is the reference SCS for SUL carrier. The network configures a value that is smaller than or equal to any SCS of configured BWPs of the serving cell that the command applies to. And the network configures a value that is smaller than or equal to the SCS of the serving cell which the UE monitors for SFI indications. |
| <b>subcarrierSpacing</b><br>Reference subcarrier spacing for this Slot Format Combination. The network configures a value that is smaller than or equal to any SCS of configured BWPs of the serving cell that the command applies to. And the network configures a value that is smaller than or equal to the SCS of the serving cell which the UE monitors for SFI indications (see TS 38.213 [13], clause 11.1.1).   |

## – SlotFormatIndicator

The IE *SlotFormatIndicator* is used to configure monitoring a Group-Common-PDCCH for Slot-Format-Indicators (SFI).

### SlotFormatIndicator information element

```

-- ASN1START
-- TAG-SLOTFORMATINDICATOR-START

SlotFormatIndicator ::= SEQUENCE {
    sfi-RNTI                RNTI-Value,
    dci-PayloadSize         INTEGER (1..maxSFI-DCI-PayloadSize),
    slotFormatCombToModList SEQUENCE (SIZE(1..maxNrofAggregatedCellsPerCellGroup)) OF SlotFormatCombinationsPerCell OPTIONAL, -- Need N
    slotFormatCombToReleaseList SEQUENCE (SIZE(1..maxNrofAggregatedCellsPerCellGroup)) OF ServCellIndex OPTIONAL, -- Need N
    ...
}

-- TAG-SLOTFORMATINDICATOR-STOP
-- ASN1STOP

```



| <b>SlotFormatIndicator</b> field descriptions   |
|---|
| <b>dcI-PayloadSize</b><br>Total length of the DCI payload scrambled with SFI-RNTI (see TS 38.213 [13], clause 11.1.1).                |
| <b>sfi-RNTI</b><br>RNTI used for SFI on the given cell (see TS 38.213 [13], clause 11.1.1).   |
| <b>slotFormatCombToAddModList</b><br>A list of SlotFormatCombinations for the UE's serving cells (see TS 38.213 [13], clause 11.1.1). |

## – S-NSSAI

The IE *S-NSSAI* (*Single Network Slice Selection Assistance Information*) identifies a Network Slice end to end and comprises a slice/service type and a slice differentiator, see TS 23.003 [21].

### S-NSSAI information element

```
-- ASN1START
-- TAG-S-NSSAI-START

S-NSSAI ::=
    CHOICE{
        sst                BIT STRING (SIZE (8)),
        sst-SD             BIT STRING (SIZE (32))
    }

-- TAG-S-NSSAI-STOP
-- ASN1STOP
```

| <b>S-NSSAI</b> field descriptions   |
|---|
| <b>sst</b><br>Indicates the S-NSSAI consisting of Slice/Service Type, see TS 23.003 [21].                             |
| <b>sst-SD</b><br>Indicates the S-NSSAI consisting of Slice/Service Type and Slice Differentiator, see TS 23.003 [21]. |

## – SpeedStateScaleFactors

The IE *SpeedStateScaleFactors* concerns factors, to be applied when the UE is in medium or high speed state, used for scaling a mobility control related parameter.

### SpeedStateScaleFactors information element

```
-- ASN1START
-- TAG-SPEEDSTATESCALEFACTORS-START

SpeedStateScaleFactors ::=
    SEQUENCE {
        sf-Medium          ENUMERATED {oDot25, oDot5, oDot75, lDot0},
    }

-- TAG-SPEEDSTATESCALEFACTORS-STOP
-- ASN1STOP
```

```

    sf-High          ENUMERATED {oDot25, oDot5, oDot75, lDot0}
  }
-- TAG-SPEEDSTATESCALEFACTORS-STOP
-- ASN1STOP

```

#### **SpeedStateScaleFactors field descriptions**

##### **sf-High**

The concerned mobility control related parameter is multiplied with this factor if the UE is in High Mobility state as defined in TS 38.304 [20]. Value *oDot25* corresponds to 0.25, value *oDot5* corresponds to 0.5, *oDot75* corresponds to 0.75 and so on.

##### **sf-Medium**

The concerned mobility control related parameter is multiplied with this factor if the UE is in Medium Mobility state as defined in TS 38.304 [20]. Value *oDot25* corresponds to 0.25, value *oDot5* corresponds to 0.5, value *oDot75* corresponds to 0.75, and so on.

## – SPS-Config

The IE *SPS-Config* is used to configure downlink semi-persistent transmission. Downlink SPS may be configured on the SpCell as well as on SCells. The network ensures *SPS-Config* is configured for at most one cell in a cell group.

#### **SPS-Config information element**

```

-- ASN1START
-- TAG-SPS-CONFIG-START

SPS-Config ::=
  periodicity          ENUMERATED {ms10, ms20, ms32, ms40, ms64, ms80, ms128, ms160, ms320, ms640,
                                spare6, spare5, spare4, spare3, spare2, spare1},
  nrofHARQ-Processes  INTEGER (1..8),
  n1PUCCH-AN          PUCCH-ResourceId          OPTIONAL, -- Need M
  mcs-Table           ENUMERATED {qam64LowSE}    OPTIONAL, -- Need S
  ...
}

-- TAG-SPS-CONFIG-STOP
-- ASN1STOP

```

| <b>SPS-Config field descriptions</b>   |
|--|
| <p><b><i>mcs-Table</i></b><br/>Indicates the MCS table the UE shall use for DL SPS (see TS 38.214 [19], clause 5.1.3.1. If present, the UE shall use the MCS table of low-SE 64QAM table indicated in Table 5.1.3.1-3 of TS 38.214 [19]. If this field is absent and field <i>mcs-table</i> in PDSCH-Config is set to 'qam256' and the activating DCI is of format 1_1, the UE applies the 256QAM table indicated in Table 5.1.3.1-2 of TS 38.214 [19]. Otherwise, the UE applies the non-low-SE 64QAM table indicated in Table 5.1.3.1-1 of TS 38.214 [19].</p> |
| <p><b><i>n1PUCCH-AN</i></b><br/>HARQ resource for PUCCH for DL SPS. The network configures the resource either as format0 or format1. The actual <i>PUCCH-Resource</i> is configured in <i>PUCCH-Config</i> and referred to by its ID. See TS 38.213 [13], clause 9.2.3.</p>   |
| <p><b><i>nrofHARQ-Processes</i></b><br/>Number of configured HARQ processes for SPS DL (see TS 38.321 [3], clause 5.8.1).</p>  |
| <p><b><i>periodicity</i></b><br/>Periodicity for DL SPS (see TS 38.214 [19] and TS 38.321 [3], clause 5.8.1).</p>  |

## – ***SRB-Identity***

The IE *SRB-Identity* is used to identify a Signalling Radio Bearer (SRB) used by a UE.

### ***SRB-Identity* information element**

```
-- ASN1START
-- TAG-SRB-IDENTITY-START

SRB-Identity ::=                INTEGER (1..3)

-- TAG-SRB-IDENTITY-STOP
-- ASN1STOP
```

## – ***SRS-CarrierSwitching***

The IE *SRS-CarrierSwitching* is used to configure for SRS carrier switching when PUSCH is not configured and independent SRS power control from that of PUSCH.

### ***SRS-CarrierSwitching* information element**

```
-- ASN1START
-- TAG-SRS-CARRIERSWITCHING-START

SRS-CarrierSwitching ::=
  srs-SwitchFromServCellIndex    SEQUENCE {
    INTEGER (0..31)                OPTIONAL, -- Need M
    srs-SwitchFromCarrier          ENUMERATED {sUL, nUL},
    srs-TPC-PDCCH-Group           CHOICE {
      typeA                        SEQUENCE (SIZE (1..32)) OF SRS-TPC-PDCCH-Config,
      typeB                        SRS-TPC-PDCCH-Config
    }
  }
  OPTIONAL, -- Need M
```

```

    monitoringCells          SEQUENCE (SIZE (1..maxNrofServingCells)) OF ServCellIndex          OPTIONAL,  -- Need M
    ...
}

SRS-TPC-PDCCH-Config ::=
    srs-CC-SetIndexlist      SEQUENCE {
                                SEQUENCE (SIZE(1..4)) OF SRS-CC-SetIndex                      OPTIONAL  -- Need M
    }

SRS-CC-SetIndex ::=
    cc-SetIndex              INTEGER (0..3)
    cc-IndexInOneCC-Set      INTEGER (0..7)
    }

-- TAG-SRS-CARRIERSWITCHING-STOP
-- ASN1STOP

```

| <b>SRS-CC-SetIndex field descriptions</b>   |
|---|
| <b>cc-IndexInOneCC-Set</b><br>Indicates the CC index in one CC set for Type A (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4). |
| <b>cc-SetIndex</b><br>Indicates the CC set index for Type A associated (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4).        |

| <b>SRS-CarrierSwitching field descriptions</b>   |
|--|
| <b>monitoringCells</b><br>A set of serving cells for monitoring PDCCH conveying SRS DCI format with CRC scrambled by TPC-SRS-RNTI (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.3).  |
| <b>srs-SwitchFromServCellIndex</b><br>Indicates the serving cell whose UL transmission may be interrupted during SRS transmission on a PUSCH-less cell. During SRS transmission on a PUSCH-less cell, the UE may temporarily suspend the UL transmission on a serving cell with PUSCH in the same CG to allow the PUSCH-less cell to transmit SRS. (see TS 38.214 [19], clause 6.2.1.3). |
| <b>srs-TPC-PDCCH-Group</b><br>Network configures the UE with either typeA-SRS-TPC-PDCCH-Group or typeB-SRS-TPC-PDCCH-Group, if any.  |
| <b>typeA</b><br>Type A trigger configuration for SRS transmission on a PUSCH-less SCell (see TS 38.213 [13], clause 11.4).   |
| <b>typeB</b><br>Type B trigger configuration for SRS transmission on a PUSCH-less SCell (see TS 38.213 [13], clause 11.4).   |

| <b>SRS-TPC-PDCCH-Config field descriptions</b>  |
|---|
| <b>srs-CC-SetIndexlist</b><br>A list of pairs of [cc-SetIndex; cc-IndexInOneCC-Set] (see TS 38.212 [17], TS 38.213 [13], clause 7.3.1, 11.4). |

## – SRS-Config

The IE *SRS-Config* is used to configure sounding reference signal transmissions. The configuration defines a list of SRS-Resources and a list of SRS-ResourceSets. Each resource set defines a set of SRS-Resources. The network triggers the transmission of the set of SRS-Resources using a configured aperiodicSRS-ResourceTrigger (L1 DCI).

**SRS-Config information element**

```

-- ASN1START
-- TAG-SRS-CONFIG-START

SRS-Config ::=
    SEQUENCE {
        srs-ResourceSetToReleaseList SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSetId OPTIONAL, -- Need N
        srs-ResourceSetToAddModList SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet OPTIONAL, -- Need N
        srs-ResourceToReleaseList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-ResourceId OPTIONAL, -- Need N
        srs-ResourceToAddModList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource OPTIONAL, -- Need N
        tpc-Accumulation ENUMERATED {disabled} OPTIONAL, -- Need S
        ...
    }

SRS-ResourceSet ::=
    SEQUENCE {
        srs-ResourceSetId SRS-ResourceSetId,
        srs-ResourceIdList SEQUENCE (SIZE(1..maxNrofSRS-ResourcesPerSet)) OF SRS-ResourceId OPTIONAL, -- Cond Setup
        resourceType CHOICE {
            aperiodic SEQUENCE {
                aperiodicSRS-ResourceTrigger INTEGER (1..maxNrofSRS-TriggerStates-1),
                csi-RS NZP-CSI-RS-ResourceId OPTIONAL, -- Cond NonCodebook
                slotOffset INTEGER (1..32) OPTIONAL, -- Need S
                ...
                [[
                    aperiodicSRS-ResourceTriggerList-v1530 SEQUENCE (SIZE(1..maxNrofSRS-TriggerStates-2))
                        OF INTEGER (1..maxNrofSRS-TriggerStates-1) OPTIONAL -- Need M
                ]]
            },
            semi-persistent SEQUENCE {
                associatedCSI-RS NZP-CSI-RS-ResourceId OPTIONAL, -- Cond NonCodebook
                ...
            },
            periodic SEQUENCE {
                associatedCSI-RS NZP-CSI-RS-ResourceId OPTIONAL, -- Cond NonCodebook
                ...
            }
        },
        usage ENUMERATED {beamManagement, codebook, nonCodebook, antennaSwitching},
        alpha Alpha OPTIONAL, -- Need S
        p0 INTEGER (-202..24) OPTIONAL, -- Cond Setup
        pathlossReferenceRS CHOICE {
            ssb-Index SSB-Index,
            csi-RS-Index NZP-CSI-RS-ResourceId
        } OPTIONAL, -- Need M
        srs-PowerControlAdjustmentStates ENUMERATED { sameAsFci2, separateClosedLoop } OPTIONAL, -- Need S
        ...
    }

SRS-ResourceSetId ::=
    INTEGER (0..maxNrofSRS-ResourceSets-1)

SRS-Resource ::=
    SEQUENCE {
        srs-ResourceId SRS-ResourceId,
        nrofSRS-Ports ENUMERATED {port1, ports2, ports4},
        ptrs-PortIndex ENUMERATED {n0, n1 } OPTIONAL, -- Need R
    }

```

```

transmissionComb
  n2
    combOffset-n2
    cyclicShift-n2
  },
  n4
    combOffset-n4
    cyclicShift-n4
  }
},
resourceMapping
  startPosition
  nrofSymbols
  repetitionFactor
},
freqDomainPosition
freqDomainShift
freqHopping
  c-SRS
  b-SRS
  b-hop
},
groupOrSequenceHopping
resourceType
  aperiodic
    ...
  },
  semi-persistent
    periodicityAndOffset-sp
    ...
  },
  periodic
    periodicityAndOffset-p
    ...
  }
},
sequenceId
spatialRelationInfo
...
}

SRS-SpatialRelationInfo ::= SEQUENCE {
  servingCellId
  referenceSignal
  ssb-Index
  csi-RS-Index
  srs
    resourceId
    uplinkBWP
  }
}

SRS-ResourceId ::= INTEGER (0..maxNrofSRS-Resources-1)

```

CHOICE {  
 SEQUENCE {  
 INTEGER (0..1),  
 INTEGER (0..7)  
 },  
 SEQUENCE {  
 INTEGER (0..3),  
 INTEGER (0..11)  
 }  
},  
SEQUENCE {  
 INTEGER (0..5),  
 ENUMERATED {n1, n2, n4},  
 ENUMERATED {n1, n2, n4}  
},  
INTEGER (0..67),  
INTEGER (0..268),  
SEQUENCE {  
 INTEGER (0..63),  
 INTEGER (0..3),  
 INTEGER (0..3)  
},  
ENUMERATED { neither, groupHopping, sequenceHopping },  
CHOICE {  
 SEQUENCE {  
 ...  
 },  
 SEQUENCE {  
 SRS-PeriodicityAndOffset,  
 ...  
 },  
 SEQUENCE {  
 SRS-PeriodicityAndOffset,  
 ...  
 }  
},  
INTEGER (0..1023),  
SRS-SpatialRelationInfo  
OPTIONAL, -- Need R  
...  
}

SEQUENCE {  
 ServCellIndex  
 CHOICE {  
 SSB-Index,  
 NZP-CSI-RS-ResourceId,  
 SEQUENCE {  
 SRS-ResourceId,  
 BWP-Id  
 }  
 }  
}

OPTIONAL, -- Need S

```
SRS-PeriodicityAndOffset ::= CHOICE {
  s11          NULL,
  s12          INTEGER(0..1),
  s14          INTEGER(0..3),
  s15          INTEGER(0..4),
  s18          INTEGER(0..7),
  s110         INTEGER(0..9),
  s116         INTEGER(0..15),
  s120         INTEGER(0..19),
  s132         INTEGER(0..31),
  s140         INTEGER(0..39),
  s164         INTEGER(0..63),
  s180         INTEGER(0..79),
  s1160        INTEGER(0..159),
  s1320        INTEGER(0..319),
  s1640        INTEGER(0..639),
  s11280       INTEGER(0..1279),
  s12560       INTEGER(0..2559)
}

-- TAG-SRS-CONFIG-STOP
-- ASN1STOP
```

**SRS-Config field descriptions*****tpc-Accumulation***

If the field is absent, UE applies TPC commands via accumulation. If disabled, UE applies the TPC command without accumulation (this applies to SRS when a separate closed loop is configured for SRS) (see TS 38.213 [13], clause 7.3)

| <b>SRS-Resource field descriptions</b>  |
|---|
| <p><b>cyclicShift-n2</b><br/>Cyclic shift configuration (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>cyclicShift-n4</b><br/>Cyclic shift configuration (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>freqHopping</b><br/>Includes parameters capturing SRS frequency hopping (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>groupOrSequenceHopping</b><br/>Parameter(s) for configuring group or sequence hopping (see TS 38.211 [16], clause 6.4.1.4.2).</p>   |
| <p><b>periodicityAndOffset-p</b><br/>Periodicity and slot offset for this SRS resource. All values are in "number of slots". Value <i>s1</i> corresponds to a periodicity of 1 slot, value <i>s2</i> corresponds to a periodicity of 2 slots, and so on. For each periodicity the corresponding offset is given in number of slots. For periodicity <i>s1</i> the offset is 0 slots (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>periodicityAndOffset-sp</b><br/>Periodicity and slot offset for this SRS resource. All values are in "number of slots". Value <i>s1</i> corresponds to a periodicity of 1 slot, value <i>s2</i> corresponds to a periodicity of 2 slots, and so on. For each periodicity the corresponding offset is given in number of slots. For periodicity <i>s1</i> the offset is 0 slots (see TS 38.214 [19], clause 6.2.1).</p>  |
| <p><b>ptrs-PortIndex</b><br/>The PTRS port index for this SRS resource for non-codebook based UL MIMO. This is only applicable when the corresponding <i>PTRS-UplinkConfig</i> is set to CP-OFDM. The <i>ptrs-PortIndex</i> configured here must be smaller than the <i>maxNrofPorts</i> configured in the <i>PTRS-UplinkConfig</i> (see TS 38.214 [19], clause 6.2.3.1).</p>   |
| <p><b>resourceMapping</b><br/>OFDM symbol location of the SRS resource within a slot including number of OFDM symbols (<math>N = 1, 2</math> or <math>4</math> per SRS resource), <i>startPosition</i> (<math>SRSSymbolStartPosition = 0..5</math>; "0" refers to the last symbol, "1" refers to the second last symbol) and RepetitionFactor (<math>r = 1, 2</math> or <math>4</math>) (see TS 38.214 [19], clause 6.2.1 and TS 38.211 [16], clause 6.4.1.4). The configured SRS resource does not exceed the slot boundary.</p> |
| <p><b>resourceType</b><br/>Periodicity and offset for semi-persistent and periodic SRS resource (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>sequenceId</b><br/>Sequence ID used to initialize pseudo random group and sequence hopping (see TS 38.214 [19], clause 6.2.1).</p>  |
| <p><b>spatialRelationInfo</b><br/>Configuration of the spatial relation between a reference RS and the target SRS. Reference RS can be SSB/CSI-RS/SRS (see TS 38.214 [19], clause 6.2.1).</p>   |
| <p><b>transmissionComb</b><br/>Comb value (2 or 4) and comb offset (<math>0..combValue-1</math>) (see TS 38.214 [19], clause 6.2.1).</p>  |



| <b>SRS-ResourceSet field descriptions</b> |   |
|---|---|
| <b>alpha</b>                              | alpha value for SRS power control (see TS 38.213 [13], clause 7.3). When the field is absent the UE applies the value 1.  |
| <b>aperiodicSRS-ResourceTriggerList</b>   | An additional list of DCI "code points" upon which the UE shall transmit SRS according to this SRS resource set configuration (see TS 38.214 [19], clause 6.1.1.2).   |
| <b>aperiodicSRS-ResourceTrigger</b>       | The DCI "code point" upon which the UE shall transmit SRS according to this SRS resource set configuration (see TS 38.214 [19], clause 6.1.1.2).  |
| <b>associatedCSI-RS</b>                   | ID of CSI-RS resource associated with this SRS resource set in non-codebook based operation (see TS 38.214 [19], clause 6.1.1.2).   |
| <b>csi-RS</b>                             | ID of CSI-RS resource associated with this SRS resource set. (see TS 38.214 [19], clause 6.1.1.2).  |
| <b>p0</b>                                 | P0 value for SRS power control. The value is in dBm. Only even values (step size 2) are allowed (see TS 38.213 [13], clause 7.3).   |
| <b>pathlossReferenceRS</b>                | A reference signal (e.g. a CSI-RS config or a SS block) to be used for SRS path loss estimation (see TS 38.213 [13], clause 7.3).   |
| <b>resourceType</b>                       | Time domain behavior of SRS resource configuration, see TS 38.214 [19], clause 6.2.1. The network configures SRS resources in the same resource set with the same time domain behavior on periodic, aperiodic and semi-persistent SRS.  |
| <b>slotOffset</b>                         | An offset in number of slots between the triggering DCI and the actual transmission of this <i>SRS-ResourceSet</i> . If the field is absent the UE applies no offset (value 0).   |
| <b>srs-PowerControlAdjustmentStates</b>   | Indicates whether $h_{srs,c(i)} = fc(i,1)$ or $h_{srs,c(i)} = fc(i,2)$ (if twoPUSCH-PC-AdjustmentStates are configured) or separate close loop is configured for SRS. This parameter is applicable only for Uls on which UE also transmits PUSCH. If absent or release, the UE applies the value sameAs-Fci1 (see TS 38.213 [13], clause 7.3).      |
| <b>srs-ResourceIdList</b>                 | The IDs of the SRS-Resources used in this <i>SRS-ResourceSet</i> . If this <i>SRS-ResourceSet</i> is configured with usage set to codebook, the <i>srs-ResourceIdList</i> contains at most 2 entries. If this <i>SRS-ResourceSet</i> is configured with usage set to <i>nonCodebook</i> , the <i>srs-ResourceIdList</i> contains at most 4 entries. |
| <b>srs-ResourceSetId</b>                  | The ID of this resource set. It is unique in the context of the BWP in which the parent <i>SRS-Config</i> is defined.   |
| <b>usage</b>                              | Indicates if the SRS resource set is used for beam management, codebook based or non-codebook based transmission or antenna switching. See TS 38.214 [19], clause 6.2.1. Reconfiguration between codebook based and non-codebook based transmission is not supported.   |

| Conditional Presence | Explanation  |
|----------------------|--|
| <i>Setup</i>         | This field is mandatory present upon configuration of <i>SRS-ResourceSet</i> or <i>SRS-Resource</i> and optionally present, Need M, otherwise. |
| <i>NonCodebook</i>   | This field is optionally present, Need M, in case of non-codebook based transmission, otherwise the field is absent.                           |

– **SRS-TPC-CommandConfig**

The IE *SRS-TPC-CommandConfig* is used to configure the UE for extracting TPC commands for SRS from a group-TPC messages on DCI

**SRS-TPC-CommandConfig information element**

-- ASN1START

```

-- TAG-SRS-TPC-COMMANDCONFIG-START

SRS-TPC-CommandConfig ::=
    SEQUENCE {
        startingBitOfFormat2-3          INTEGER (1..31)          OPTIONAL, -- Need R
        fieldTypeFormat2-3              INTEGER (0..1)          OPTIONAL, -- Need R
        . . .
        [
            startingBitOfFormat2-3SUL-v1530  INTEGER (1..31)    OPTIONAL -- Need R
        ]
    }

-- TAG-SRS-TPC-COMMANDCONFIG-STOP
-- ASN1STOP

```

#### **SRS-TPC-CommandConfig field descriptions**

##### **fieldTypeFormat2-3**

The type of a field within the group DCI with SRS request fields (optional), which indicates how many bits in the field are for SRS request (0 or 2). Note that for Type A, there is a common SRS request field for all SCells in the set, but each SCell has its own TPC command bits. See TS 38.212 [17] clause 7.3.1 and , TS 38.213 [13], clause 11.3.

##### **startingBitOfFormat2-3**

The starting bit position of a block within the group DCI with SRS request fields (optional) and TPC commands. The value 1 of the field corresponds to the first/left most bit of format2-3. The value 2 of the field corresponds to the second bit format2-3, and so on (see TS 38.212 [17], clause 7.3.1 and TS 38.213 [13], clause 11.3).

##### **startingBitOfFormat2-3SUL**

The starting bit position of a block within the group DCI with SRS request fields (optional) and TPC commands for SUL carrier (see TS 38.212 [17], clause 7.3.1 and TS 38.213 [13], clause 11.3).

## – SSB-Index

The IE *SSB-Index* identifies an SS-Block within an SS-Burst. See TS 38.213 [13], clause 4.1.

#### **SSB-Index information element**

```

-- ASN1START
-- TAG-SSB-INDEX-START

SSB-Index ::=
    INTEGER (0..maxNrofSSBs-1)

-- TAG-SSB-INDEX-STOP
-- ASN1STOP

```

## – SSB-MTC

The IE *SSB-MTC* is used to configure measurement timing configurations, i.e., timing occasions at which the UE measures SSBs.

**SSB-MTC information element**

```

-- ASN1START
-- TAG-SSB-MTC-START

SSB-MTC ::=
    periodicityAndOffset
        sf5
        sf10
        sf20
        sf40
        sf80
        sf160
    },
    duration
}

SEQUENCE {
    CHOICE {
        INTEGER (0..4),
        INTEGER (0..9),
        INTEGER (0..19),
        INTEGER (0..39),
        INTEGER (0..79),
        INTEGER (0..159)
    }
    ENUMERATED { sf1, sf2, sf3, sf4, sf5 }
}

SSB-MTC2 ::=
    pci-List
    periodicity
}

SEQUENCE {
    SEQUENCE (SIZE (1..maxNrofPCIsPerSMTC)) OF PhysCellId
    ENUMERATED {sf5, sf10, sf20, sf40, sf80, spare3, spare2, spare1}
}

-- TAG-SSB-MTC-STOP
-- ASN1STOP

```

**SSB-MTC field descriptions****duration**

Duration of the measurement window in which to receive SS/PBCH blocks. It is given in number of subframes (see TS 38.213 [13], clause 4.1).

**periodicityAndOffset**

Periodicity and offset of the measurement window in which to receive SS/PBCH blocks, see 5.5.2.10. Periodicity and offset are given in number of subframes.

**SSB-MTC2 field descriptions****pci-List**

PCIs that are known to follow this SMTC.

– **SSB-ToMeasure**

The IE *SSB-ToMeasure* is used to configure a pattern of SSBs.

**SSB-ToMeasure information element**

```

-- ASN1START
-- TAG-SSB-TOMEASURE-START

SSB-ToMeasure ::=
    shortBitmap
    mediumBitmap
}

CHOICE {
    BIT STRING (SIZE (4)),
    BIT STRING (SIZE (8)),
}

```

```

    longBitmap          BIT STRING (SIZE (64))
  }
-- TAG-SSB-TOMEASURE-STOP
-- ASN1STOP

```

#### **SSB-ToMeasure field descriptions**

**longBitmap**

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 64 as defined in TS 38.213 [13], clause 4.1.

**mediumBitmap**

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 8 as defined in TS 38.213 [13], clause 4.1.

**shortBitmap**

Bitmap when maximum number of SS/PBCH blocks per half frame equals to 4 as defined in TS 38.213 [13], clause 4.1.

### – *SS-RSSI-Measurement*

The IE *SS-RSSI-Measurement* is used to configure RSSI measurements based on synchronization reference signals.

#### **SS-RSSI-Measurement information element**

```

-- ASN1START
-- TAG-SS-RSSI-MEASUREMENT-START

SS-RSSI-Measurement ::=
    measurementSlots  BIT STRING (SIZE (1..80)),
    endSymbol          INTEGER(0..3)
}

-- TAG-SS-RSSI-MEASUREMENT-STOP
-- ASN1STOP

```

#### **SS-RSSI-Measurement field descriptions**

**endSymbol**

Within a slot that is configured for RSSI measurements (see *measurementSlots*) the UE measures the RSSI from symbol 0 to symbol *endSymbol*. This field identifies the entry in Table 5.1.3-1 in TS 38.215 [9], which determines the actual end symbol.

**measurementSlots**

Indicates the slots in which the UE can perform RSSI measurements. The length of the BIT STRING is equal to the number of slots in the configured SMTC window (determined by the duration and by the subcarrierSpacing). The first (left-most / most significant) bit in the bitmap corresponds to the first slot in the SMTC window, the second bit in the bitmap corresponds to the second slot in the SMTC window, and so on. The UE measures in slots for which the corresponding bit in the bitmap is set to 1.

### – *SubcarrierSpacing*

The IE *SubcarrierSpacing* determines the subcarrier spacing. Restrictions applicable for certain frequencies, channels or signals are clarified in the fields that use this IE.

**SubcarrierSpacing** information element

```

-- ASN1START
-- TAG-SUBCARRIERSPACING-START

SubcarrierSpacing ::=
    ENUMERATED {kHz15, kHz30, kHz60, kHz120, kHz240, spare3, spare2, spare1}

-- TAG-SUBCARRIERSPACING-STOP
-- ASN1STOP

```

– **TAG-Config**

The IE *TAG-Config* is used to configure parameters for a time-alignment group.

**TAG-Config** information element

```

-- ASN1START
-- TAG-TAG-CONFIG-START

TAG-Config ::=
    SEQUENCE {
        tag-ToReleaseList
            SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG-Id
            OPTIONAL, -- Need N
        tag-ToAddModList
            SEQUENCE (SIZE (1..maxNrofTAGs)) OF TAG
            OPTIONAL -- Need N
    }

TAG ::=
    SEQUENCE {
        tag-Id
            TAG-Id,
        timeAlignmentTimer
            TimeAlignmentTimer,
        ...
    }

TAG-Id ::=
    INTEGER (0..maxNrofTAGs-1)

TimeAlignmentTimer ::=
    ENUMERATED {ms500, ms750, ms1280, ms1920, ms2560, ms5120, ms10240, infinity}

-- TAG-TAG-CONFIG-STOP
-- ASN1STOP

```

**TAG field descriptions****tag-Id**

Indicates the TAG of the SpCell or an SCell, see TS 38.321 [3]. Uniquely identifies the TAG within the scope of a Cell Group (i.e. MCG or SCG).

**timeAlignmentTimer**

Value in ms of the *timeAlignmentTimer* for TAG with ID *tag-Id*, as specified in TS 38.321 [3].

– **TCI-State**

The IE *TCI-State* associates one or two DL reference signals with a corresponding quasi-colocation (QCL) type.

**TCI-State information element**

```

-- ASN1START
-- TAG-TCI-STATE-START

TCI-State ::=
    tci-StateId
    qcl-Type1
    qcl-Type2
    ...
    SEQUENCE {
        TCI-StateId,
        QCL-Info,
        QCL-Info
    }
    OPTIONAL, -- Need R

QCL-Info ::=
    cell
    bwp-Id
    referenceSignal
        csi-rs
        ssb
    },
    qcl-Type
    ...
    SEQUENCE {
        ServCellIndex
        BWP-Id
        CHOICE {
            NZP-CSI-RS-ResourceId,
            SSB-Index
        }
        ENUMERATED {typeA, typeB, typeC, typeD},
    }
    OPTIONAL, -- Need R
    OPTIONAL, -- Cond CSI-RS-Indicated

-- TAG-TCI-STATE-STOP
-- ASN1STOP

```

**QCL-Info field descriptions*****bwp-Id***

The DL BWP which the RS is located in.

***cell***

The UE's serving cell in which the *referenceSignal* is configured. If the field is absent, it applies to the serving cell in which the *TCI-State* is configured. The RS can be located on a serving cell other than the serving cell in which the *TCI-State* is configured only if the *qcl-Type* is configured as *typeC* or *typeD*. See TS 38.214 [19] clause 5.1.5.

***referenceSignal***

Reference signal with which quasi-collocation information is provided as specified in TS 38.214 [19] subclause 5.1.5.

***qcl-Type***

QCL type as specified in TS 38.214 [19] subclause 5.1.5.

| Conditional Presence    | Explanation  |
|-------------------------|--|
| <i>CSI-RS-Indicated</i> | This field is mandatory present if <i>csi-rs</i> is included, absent otherwise |

– ***TCI-StateId***

The IE *TCI-StateId* is used to identify one *TCI-State* configuration.

***TCI-StateId* information element**

```

-- ASN1START
-- TAG-TCI-STATEID-START

TCI-StateId ::=
    INTEGER (0..maxNrofTCI-States-1)

-- TAG-TCI-STATEID-STOP
-- ASN1STOP

```

***TDD-UL-DL-Config***

The IE *TDD-UL-DL-Config* determines the Uplink/Downlink TDD configuration. There are both, UE- and cell specific IEs.

***TDD-UL-DL-Config* information element**

```

-- ASN1START
-- TAG-TDD-UL-DL-CONFIG-START

TDD-UL-DL-ConfigCommon ::=
    SEQUENCE {
        referenceSubcarrierSpacing
            SubcarrierSpacing,
        pattern1
            TDD-UL-DL-Pattern,
        pattern2
            TDD-UL-DL-Pattern
        ...
    }
    OPTIONAL, -- Need R

TDD-UL-DL-Pattern ::=
    SEQUENCE {
        dl-UL-TransmissionPeriodicity
            ENUMERATED {ms0p5, ms0p625, ms1, ms1p25, ms2, ms2p5, ms5, ms10},
        nrofDownlinkSlots
            INTEGER (0..maxNrofSlots),
        nrofDownlinkSymbols
            INTEGER (0..maxNrofSymbols-1),
        nrofUplinkSlots
            INTEGER (0..maxNrofSlots),
        nrofUplinkSymbols
            INTEGER (0..maxNrofSymbols-1),
        ...
        [[
            dl-UL-TransmissionPeriodicity-v1530
                ENUMERATED {ms3, ms4}
        ]]
    }
    OPTIONAL -- Need R

TDD-UL-DL-ConfigDedicated ::=
    SEQUENCE {
        slotSpecificConfigurationsToAddModList
            SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotConfig
        slotSpecificConfigurationsToReleaseList
            SEQUENCE (SIZE (1..maxNrofSlots)) OF TDD-UL-DL-SlotIndex
        ...
    }
    OPTIONAL, -- Need N
    OPTIONAL, -- Need N

TDD-UL-DL-SlotConfig ::=
    SEQUENCE {
        slotIndex
            TDD-UL-DL-SlotIndex,
        symbols
            CHOICE {
                allDownlink
                    NULL,
                allUplink
                    NULL,
                explicit
                    SEQUENCE {
                        nrofDownlinkSymbols
                            INTEGER (1..maxNrofSymbols-1)
                    }
            }
    }
    OPTIONAL, -- Need S

```

```

        nrofUplinkSymbols          INTEGER (1..maxNrofSymbols-1)          OPTIONAL  -- Need S
    }
}
TDD-UL-DL-SlotIndex ::=          INTEGER (0..maxNrofSlots-1)

-- TAG-TDD-UL-DL-CONFIG-STOP
-- ASN1STOP

```

#### **TDD-UL-DL-ConfigCommon field descriptions**

##### **referenceSubcarrierSpacing**

Reference SCS used to determine the time domain boundaries in the UL-DL pattern which must be common across all subcarrier specific carriers, i.e., independent of the actual subcarrier spacing used for data transmission. Only the values 15, 30 or 60 kHz (FR1), and 60 or 120 kHz (FR2) are applicable. The network configures a not larger than any SCS of configured BWPs for the serving cell. See TS 38.213 [13], clause 11.1.

#### **TDD-UL-DL-Pattern field descriptions**

##### **dl-UL-TransmissionPeriodicity**

Periodicity of the DL-UL pattern, see TS 38.213 [13], clause 11.1. If the *dl-UL-TransmissionPeriodicity-v1530* is signalled, UE shall ignore the *dl-UL-TransmissionPeriodicity* (without suffix).

##### **nrofDownlinkSlots**

Number of consecutive full DL slots at the beginning of each DL-UL pattern, see TS 38.213 [13], clause 11.1. In this release, the maximum value for this field is 80.

##### **nrofDownlinkSymbols**

Number of consecutive DL symbols in the beginning of the slot following the last full DL slot (as derived from *nrofDownlinkSlots*). The value 0 indicates that there is no partial-downlink slot. (see TS 38.213 [13], clause 11.1).

##### **nrofUplinkSlots**

Number of consecutive full UL slots at the end of each DL-UL pattern, see TS 38.213 [13], clause 11.1. In this release, the maximum value for this field is 80.

##### **nrofUplinkSymbols**

Number of consecutive UL symbols in the end of the slot preceding the first full UL slot (as derived from *nrofUplinkSlots*). The value 0 indicates that there is no partial-uplink slot. (see TS 38.213 [13], clause 11.1).

#### **TDD-UL-DL-ConfigDedicated field descriptions**

##### **slotSpecificConfigurationsToAddModList**

The *slotSpecificConfigurationToAddModList* allows overriding UL/DL allocations provided in *tdd-UL-DL-configurationCommon*, see TS 38.213 [13], clause 11.1.



| <b>TDD-UL-DL-SlotConfig field descriptions</b>  |
|---|
| <p><b><i>nrofDownlinkSymbols</i></b><br/>Number of consecutive DL symbols in the beginning of the slot identified by <i>slotIndex</i>. If the field is absent the UE assumes that there are no leading DL symbols. (see TS 38.213 [13], clause 11.1).</p>   |
| <p><b><i>nrofUplinkSymbols</i></b><br/>Number of consecutive UL symbols in the end of the slot identified by <i>slotIndex</i>. If the field is absent the UE assumes that there are no trailing UL symbols. (see TS 38.213 [13], clause 11.1).</p>  |
| <p><b><i>slotIndex</i></b><br/>Identifies a slot within a <i>dl-UL-TransmissionPeriodicity</i> (given in <i>tdd-UL-DL-configurationCommon</i>).</p>   |
| <p><b><i>symbols</i></b><br/>The direction (downlink or uplink) for the symbols in this slot. Value <i>allDownlink</i> indicates that all symbols in this slot are used for downlink; value <i>allUplink</i> indicates that all symbols in this slot are used for uplink; value <i>explicit</i> indicates explicitly how many symbols in the beginning and end of this slot are allocated to downlink and uplink, respectively.</p> |

### – *TrackingAreaCode*

The IE *TrackingAreaCode* is used to identify a tracking area within the scope of a PLMN, see TS 24.501 [23].

#### ***TrackingAreaCode* information element**

```
-- ASN1START
-- TAG-TRACKINGAREACODE-START

TrackingAreaCode ::= BIT STRING (SIZE (24))

-- TAG-TRACKINGAREACODE-STOP
-- ASN1STOP
```

### – *T-Reselection*

The IE *T-Reselection* concerns the cell reselection timer  $T_{resel}^{RAT}$  for NR and E-UTRA Value in seconds. For value 0, behaviour as specified in 7.1.2 applies.

#### ***T-Reselection* information element**

```
-- ASN1START
-- TAG-TRESELECTION-START

T-Reselection ::= INTEGER (0..7)

-- TAG-TRESELECTION-STOP
-- ASN1STOP
```

## – *TimeToTrigger*

The IE *TimeToTrigger* specifies the value range used for time to trigger parameter, which concerns the time during which specific criteria for the event needs to be met in order to trigger a measurement report. Value *ms0* corresponds to 0 ms and behaviour as specified in 7.1.2 applies, value *ms40* corresponds to 40 ms, and so on.

### ***TimeToTrigger* information element**

```
-- ASN1START
-- TAG-TIMETOTRIGGER-START

TimeToTrigger ::=
    ENUMERATED {
        ms0, ms40, ms64, ms80, ms100, ms128, ms160, ms256,
        ms320, ms480, ms512, ms640, ms1024, ms1280, ms2560,
        ms5120}

-- TAG-TIMETOTRIGGER-STOP
-- ASN1STOP
```

## – *UAC-BarringInfoSetIndex*

The IE *UAC-BarringInfoSetIndex* provides the index of the entry in *uac-BarringInfoSetList*. Value 1 corresponds to the first entry in *uac-BarringInfoSetList*, value 2 corresponds to the second entry in this list and so on. An index value referring to an entry not included in *uac-BarringInfoSetList* indicates no barring.

### ***UAC-BarringInfoSetIndex* information element**

```
-- ASN1START
-- TAG-UAC-BARRINGINFOSETINDEX-START

UAC-BarringInfoSetIndex ::=
    INTEGER (1..maxBarringInfoSet)

-- TAG-UAC-BARRINGINFOSETINDEX-STOP
-- ASN1STOP
```

## – *UAC-BarringInfoSetList*

The IE *UAC-BarringInfoSetList* provides a list of access control parameter sets. An access category can be configured with access parameters according to one of the sets.

### ***UAC-BarringInfoSetList* information element**

```
-- ASN1START
-- TAG-UAC-BARRINGINFOSETLIST-START

UAC-BarringInfoSetList ::=
    SEQUENCE (SIZE(1..maxBarringInfoSet)) OF UAC-BarringInfoSet

UAC-BarringInfoSet ::=
    SEQUENCE {
        uac-BarringFactor    ENUMERATED {p00, p05, p10, p15, p20, p25, p30, p40,
                                           p50, p60, p70, p75, p80, p85, p90, p95},
        uac-BarringTime     ENUMERATED {s4, s8, s16, s32, s64, s128, s256, s512},
```

```

    uac-BarringForAccessIdentity      BIT STRING (SIZE(7))
}
-- TAG-UAC-BARRINGINFOSETLIST-STOP
-- ASN1STOP

```

#### **UAC-BarringInfoSetList field descriptions**

##### **uac-BarringInfoSetList**

List of access control parameter sets. Each access category can be configured with access parameters corresponding to a particular set by *uac-barringInfoSetIndex*. Association of an access category with an index that has no corresponding entry in the *uac-BarringInfoSetList* is valid configuration and indicates no barring.

##### **uac-BarringForAccessIdentity**

Indicates whether access attempt is allowed for each Access Identity. The leftmost bit, bit 0 in the bit string corresponds to Access Identity 1, bit 1 in the bit string corresponds to Access Identity 2, bit 2 in the bit string corresponds to Access Identity 11, bit 3 in the bit string corresponds to Access Identity 12, bit 4 in the bit string corresponds to Access Identity 13, bit 5 in the bit string corresponds to Access Identity 14, and bit 6 in the bit string corresponds to Access Identity 15. Value 0 means that access attempt is allowed for the corresponding access identity.

##### **uac-BarringFactor**

Represents the probability that access attempt would be allowed during access barring check.

##### **uac-BarringTime**

The minimum time in seconds before a new access attempt is to be performed after an access attempt was barred at access barring check for the same access category.

## – UAC-BarringPerCatList

The IE *UAC-BarringPerCatList* provides access control parameters for a list of access categories.

#### **UAC-BarringPerCatList information element**

```

-- ASN1START
-- TAG-UAC-BARRINGPERCATLIST-START

UAC-BarringPerCatList ::=
    SEQUENCE (SIZE (1..maxAccessCat-1)) OF UAC-BarringPerCat

UAC-BarringPerCat ::=
    SEQUENCE {
        accessCategory          INTEGER (1..maxAccessCat-1),
        uac-barringInfoSetIndex UAC-BarringInfoSetIndex
    }

-- TAG-UAC-BARRINGPERCATLIST-STOP
-- ASN1STOP

```

#### **UAC-BarringPerCatList field descriptions**

##### **accessCategory**

The Access Category according to TS 22.261 [25].

## – UAC-BarringPerPLMN-List

The IE *UAC-BarringPerPLMN-List* provides access category specific access control parameters, which are configured per PLMN.

### UAC-BarringPerPLMN-List information element

```
-- ASN1START
-- TAG-UAC-BARRINGPERPLMN-LIST-START

UAC-BarringPerPLMN-List ::=
    SEQUENCE (SIZE (1.. maxPLMN)) OF UAC-BarringPerPLMN

UAC-BarringPerPLMN ::=
    SEQUENCE {
        plmn-IdentityIndex      INTEGER (1..maxPLMN),
        uac-ACBarringListType  CHOICE {
            uac-ImplicitACBarringList  SEQUENCE (SIZE(maxAccessCat-1)) OF UAC-BarringInfoSetIndex,
            uac-ExplicitACBarringList  UAC-BarringPerCatList
        }
    }
    OPTIONAL -- Need S

-- TAG-UAC-BARRINGPERPLMN-LIST-STOP
-- ASN1STOP
```

#### UAC-BarringPerPLMN-List field descriptions

##### **uac-ACBarringListType**

Access control parameters for each access category valid only for a specific PLMN. UE behaviour upon absence of this field is specified in clause 5.3.14.2.

##### **plmn-IdentityIndex**

Index of the PLMN across the *plmn-IdentityList* fields included in SIB1.

## – UE-TimersAndConstants

The IE *UE-TimersAndConstants* contains timers and constants used by the UE in RRC\_CONNECTED, RRC\_INACTIVE and RRC\_IDLE.

### UE-TimersAndConstants information element

```
-- ASN1START
-- TAG-UE-TIMERSANDCONSTANTS-START

UE-TimersAndConstants ::=
    SEQUENCE {
        t300      ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000},
        t301      ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000},
        t310      ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000},
        n310      ENUMERATED {n1, n2, n3, n4, n6, n8, n10, n20},
        t311      ENUMERATED {ms1000, ms3000, ms5000, ms10000, ms15000, ms20000, ms30000},
        n311      ENUMERATED {n1, n2, n3, n4, n5, n6, n8, n10},
        t319      ENUMERATED {ms100, ms200, ms300, ms400, ms600, ms1000, ms1500, ms2000},
        ...
    }

```

```
-- TAG-UE-TIMERSANDCONSTANTS-STOP
-- ASN1STOP
```

## – UplinkConfigCommon

The IE *UplinkConfigCommon* provides common uplink parameters of a cell.

### UplinkConfigCommon information element

```
-- ASN1START
-- TAG-UPLINKCONFIGCOMMON-START

UplinkConfigCommon ::=
    SEQUENCE {
        frequencyInfoUL          FrequencyInfoUL          OPTIONAL,  -- Cond InterFreqHOAndServCellAdd
        initialUplinkBWP         BWP-UplinkCommon         OPTIONAL,  -- Cond ServCellAdd
        dummy                    TimeAlignmentTimer
    }

-- TAG-UPLINKCONFIGCOMMON-STOP
-- ASN1STOP
```

#### UplinkConfigCommon field descriptions

##### **frequencyInfoUL**

Absolute uplink frequency configuration and subcarrier specific virtual carriers.

##### **initialUplinkBWP**

The initial uplink BWP configuration for a SpCell (PCell of MCG or SCG) and SCell (see TS 38.213 [13], clause 12).

| Conditional Presence             | Explanation  |
|----------------------------------|--|
| <i>InterFreqHOAndServCellAdd</i> | This field is mandatory present for inter-frequency handover and upon serving cell (PSCell/SCell) addition. Otherwise, the field is optionally present, Need M.    |
| <i>ServCellAdd</i>               | This field is mandatory present upon serving cell addition (for PSCell and SCell) and upon handover from E-UTRA to NR. It is optionally present, Need M otherwise. |

## – UplinkConfigCommonSIB

The IE *UplinkConfigCommonSIB* provides common uplink parameters of a cell.

### UplinkConfigCommonSIB information element

```
-- ASN1START
-- TAG-UPLINKCONFIGCOMMONSIB-START
```

```

UplinkConfigCommonSIB ::=
    frequencyInfoUL
    initialUplinkBWP
    timeAlignmentTimerCommon
}

-- TAG-UPLINKCONFIGCOMMONSIB-STOP
-- ASN1STOP

```

| <i>UplinkConfigCommonSIB</i> field descriptions  |
|--|
| <b><i>frequencyInfoUL</i></b><br>Absolute uplink frequency configuration and subcarrier specific virtual carriers.                         |
| <b><i>InitialUplinkBWP</i></b><br>The initial uplink BWP configuration for a SpCell (PCell of MCG or SCG) (see TS 38.213 [13], clause 12). |

### – *UplinkTxDirectCurrentList*

The IE *UplinkTxDirectCurrentList* indicates the Tx Direct Current locations per serving cell for each configured UL BWP in the serving cell, based on the BWP numerology and the associated carrier bandwidth.

#### *UplinkTxDirectCurrentList* information element

```

-- ASN1START
-- TAG-UPLINKTXDIRECTCURRENTLIST-START

UplinkTxDirectCurrentList ::=
    SEQUENCE (SIZE (1..maxNrofServingCells)) OF UplinkTxDirectCurrentCell

UplinkTxDirectCurrentCell ::=
    SEQUENCE {
        servCellIndex
        uplinkDirectCurrentBWP
        [[
            uplinkDirectCurrentBWP-SUL
        ]]
    }

UplinkTxDirectCurrentBWP ::=
    SEQUENCE {
        bwp-Id
        shift7dot5kHz
        txDirectCurrentLocation
    }

-- TAG-UPLINKTXDIRECTCURRENTLIST-STOP
-- ASN1STOP

```

| <i>UplinkTxDirectCurrentBWP</i> field descriptions  |
|---|
| <b><i>bwp-Id</i></b><br>The BWP-Id of the corresponding uplink BWP.   |
| <b><i>shift7dot5kHz</i></b><br>Indicates whether there is 7.5 kHz shift or not. 7.5 kHz shift is applied if the field is set to <i>true</i> . Otherwise 7.5 kHz shift is not applied.   |
| <b><i>txDirectCurrentLocation</i></b><br>The uplink Tx Direct Current location for the carrier. Only values in the value range of this field between 0 and 3299, which indicate the subcarrier index within the carrier corresponding to the numerology of the corresponding uplink BWP and value 3300, which indicates "Outside the carrier" and value 3301, which indicates "Undetermined position within the carrier" are used in this version of the specification. |

| <i>UplinkTxDirectCurrentCell</i> field descriptions   |
|---|
| <b><i>servCellIndex</i></b><br>The serving cell ID of the serving cell corresponding to the <i>uplinkDirectCurrentBWP</i> .                                     |
| <b><i>uplinkDirectCurrentBWP</i></b><br>The Tx Direct Current locations for all the uplink BWPs configured at the corresponding serving cell.                   |
| <b><i>uplinkDirectCurrentBWP-SUL</i></b><br>The Tx Direct Current locations for all the supplementary uplink BWPs configured at the corresponding serving cell. |

## – *ZP-CSI-RS-Resource*

The IE *ZP-CSI-RS-Resource* is used to configure a Zero-Power (ZP) CSI-RS resource (see TS 38.214 [19], clause 5.1.4.2). Reconfiguration of a *ZP-CSI-RS-Resource* between periodic or semi-persistent and aperiodic is not supported.

### ***ZP-CSI-RS-Resource* information element**

```
-- ASN1START
-- TAG-ZP-CSI-RS-RESOURCE-START

ZP-CSI-RS-Resource ::=
    SEQUENCE {
        zp-CSI-RS-ResourceId
            ZP-CSI-RS-ResourceId,
        resourceMapping
            CSI-RS-ResourceMapping,
        periodicityAndOffset
            CSI-ResourcePeriodicityAndOffset
            OPTIONAL, --Cond PeriodicOrSemiPersistent
        ...
    }

ZP-CSI-RS-ResourceId ::=
    INTEGER (0..maxNrofZP-CSI-RS-Resources-1)

-- TAG-ZP-CSI-RS-RESOURCE-STOP
-- ASN1STOP
```

| <b>ZP-CSI-RS-Resource field descriptions</b>   |
|--|
| <p><b>periodicityAndOffset</b><br/>Periodicity and slot offset for periodic/semi-persistent ZP-CSI-RS (see TS 38.214 [19], clause 5.1.4.2). Network always configures the UE with a value for this field for periodic and semi-persistent ZP-CSI-RS resource (as indicated in PDSCH-Config).</p> |
| <p><b>resourceMapping</b><br/>OFDM symbol and subcarrier occupancy of the ZP-CSI-RS resource within a slot.</p>  |
| <p><b>zp-CSI-RS-ResourceId</b><br/>ZP CSI-RS resource configuration ID (see TS 38.214 [19], clause 5.1.4.2).</p>   |

| <b>Conditional Presence</b>     | <b>Explanation</b>   |
|---------------------------------|--|
| <i>PeriodicOrSemiPersistent</i> | The field is optionally present, Need M, for periodic and semi-persistent ZP-CSI-RS-Resources (as indicated in PDSCH-Config). The field is absent otherwise. |

### – *ZP-CSI-RS-ResourceSet*

The IE *ZP-CSI-RS-ResourceSet* refers to a set of *ZP-CSI-RS-Resources* using their *ZP-CSI-RS-ResourceIds*.

#### **ZP-CSI-RS-ResourceSet information element**

```
-- ASN1START
-- TAG-ZP-CSI-RS-RESOURCESET-START

ZP-CSI-RS-ResourceSet ::=
    SEQUENCE {
        zp-CSI-RS-ResourceSetId      ZP-CSI-RS-ResourceSetId,
        zp-CSI-RS-ResourceIdList    SEQUENCE (SIZE(1..maxNrofZP-CSI-RS-ResourcesPerSet)) OF ZP-CSI-RS-ResourceId,
        ...
    }

-- TAG-ZP-CSI-RS-RESOURCESET-STOP
-- ASN1STOP
```

| <b>ZP-CSI-RS-ResourceSet field descriptions</b>  |
|--|
| <p><b>zp-CSI-RS-ResourceIdList</b><br/>The list of <i>ZP-CSI-RS-ResourceId</i> identifying the <i>ZP-CSI-RS-Resource</i> elements belonging to this set.</p> |

### – *ZP-CSI-RS-ResourceSetId*

The IE *ZP-CSI-RS-ResourceSetId* identifies a *ZP-CSI-RS-ResourceSet*.

#### **ZP-CSI-RS-ResourceSetId information element**

```
-- ASN1START
-- TAG-ZP-CSI-RS-RESOURCESETID-START
```



```
ZP-CSI-RS-ResourceSetId ::= INTEGER (0..maxNrofZP-CSI-RS-ResourceSets-1)
-- TAG-ZP-CSI-RS-RESOURCESETID-STOP
-- ASN1STOP
```

### 6.3.3 UE capability information elements

#### – *AccessStratumRelease*

The IE *AccessStratumRelease* indicates the release supported by the UE.

##### ***AccessStratumRelease* information element**

```
-- ASN1START
-- TAG-ACCESSSTRATUMRELEASE-START
AccessStratumRelease ::= ENUMERATED {
    rel15, spare7, spare6, spare5, spare4, spare3, spare2, spare1, ... }
-- TAG-ACCESSSTRATUMRELEASE-STOP
-- ASN1STOP
```

#### – *BandCombinationList*

The IE *BandCombinationList* contains a list of NR CA and/or MR-DC band combinations (also including DL only or UL only band).

##### ***BandCombinationList* information element**

```
-- ASN1START
-- TAG-BANDCOMBINATIONLIST-START
BandCombinationList ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination
BandCombinationList-v1540 ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1540
BandCombinationList-v1550 ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1550
BandCombinationList-v1560 ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-v1560
BandCombination ::= SEQUENCE {
    bandList SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandParameters,
    featureSetCombination FeatureSetCombinationId,
    ca-ParametersEUTRA CA-ParametersEUTRA OPTIONAL,
    ca-ParametersNR CA-ParametersNR OPTIONAL,
    mrdc-Parameters MRDC-Parameters OPTIONAL,
}
```

```

supportedBandwidthCombinationSet BIT STRING (SIZE (1..32))           OPTIONAL,
powerClass-v1530                  ENUMERATED {pc2}                   OPTIONAL
}

BandCombination-v1540 ::=
bandList-v1540                    SEQUENCE {
ca-ParametersNR-v1540              SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandParameters-v1540,
                                     CA-ParametersNR-v1540              OPTIONAL
}

BandCombination-v1550 ::=
ca-ParametersNR-v1550              SEQUENCE {
                                     CA-ParametersNR-v1550
}

BandCombination-v1560 ::=
ne-DC-BC                          ENUMERATED {supported}         OPTIONAL,
ca-ParametersNRDC                  CA-ParametersNRDC          OPTIONAL,
ca-ParametersEUTRA-v1560           CA-ParametersEUTRA-v1560  OPTIONAL,
ca-ParametersNR-v1560              CA-ParametersNR-v1560     OPTIONAL
}

BandParameters ::=
eutra                               CHOICE {
bandEUTRA                          SEQUENCE {
ca-BandwidthClassDL-EUTRA           FreqBandIndicatorEUTRA,
ca-BandwidthClassUL-EUTRA           CA-BandwidthClassEUTRA    OPTIONAL,
                                     CA-BandwidthClassEUTRA    OPTIONAL
},
nr                                   SEQUENCE {
bandNR                              FreqBandIndicatorNR,
ca-BandwidthClassDL-NR              CA-BandwidthClassNR      OPTIONAL,
ca-BandwidthClassUL-NR              CA-BandwidthClassNR      OPTIONAL
}
}

BandParameters-v1540 ::=
srs-CarrierSwitch                  CHOICE {
nr                                   SEQUENCE {
srs-SwitchingTimesListNR            SEQUENCE (SIZE (1..maxSimultaneousBands)) OF SRS-SwitchingTimeNR
},
eutra                               SEQUENCE {
srs-SwitchingTimesListEUTRA         SEQUENCE (SIZE (1..maxSimultaneousBands)) OF SRS-SwitchingTimeEUTRA
}
}
OPTIONAL,
srs-TxSwitch                       SEQUENCE {
supportedSRS-TxPortSwitch           ENUMERATED {t1r2, t1r4, t2r4, t1r4-t2r4, t1r1, t2r2, t4r4, notSupported},
txSwitchImpactToRx                  INTEGER (1..32)            OPTIONAL,
txSwitchWithAnotherBand              INTEGER (1..32)            OPTIONAL
}
OPTIONAL
}

-- TAG-BANDCOMBINATIONLIST-STOP
-- ASN1STOP

```

| <b>BandCombination field descriptions</b>  |
|--|
| <p><b>BandCombinationList-v1540, BandCombinationList-v1550, BandCombinationList-v1560</b><br/>The UE shall include the same number of entries, and listed in the same order, as in <i>BandCombinationList</i> (without suffix).</p>  |
| <p><b>ca-ParametersNRDC</b><br/>If the field is included for a band combination in the NR-DC capability container, the field indicates support of NR-DC. Otherwise, the field is absent.</p>   |
| <p><b>ne-DC-BC</b><br/>If the field is included for a band combination in the MR-DC capability container, the field indicates support of NE-DC. Otherwise, the field is absent.</p>  |
| <p><b>powerClass</b><br/>Power class that the UE supports when operating according to this band combination. If the field is absent, the UE supports the default power class. If this power class is higher than the power class that the UE supports on the individual bands of this band combination (<i>ue-PowerClass</i> in <i>BandNR</i>), the latter determines maximum TX power available in each band. The UE sets the new power class parameter only in band combinations with two FR1 uplink serving cells.</p>  |
| <p><b>supportedBandwidthCombinationSet</b><br/>For NR SA and for inter-band EN-DC, the field defines the bandwidth combinations for the NR part of the band combination. For intra-band EN-DC, the field indicates the supported bandwidth combination set applicable to the NR and LTE band combinations. The first (left-most) bit in the bitmap corresponds to the BCS#0 and so on. If the bit is set to 1, the UE supports the corresponding BCS.</p>  |
| <p><b>srs-SwitchingTimesListNR</b><br/>Indicates, for a particular pair of NR bands, the RF retuning time when switching between a NR carrier corresponding to this band entry and another (PUSCH-less) NR carrier corresponding to the band entry in the order indicated below:</p> <ul style="list-style-type: none"> <li>- For the first NR band, the UE shall include the same number of entries for NR bands as in <i>bandList</i>, i.e. first entry corresponds to first NR band in <i>bandList</i> and so on,</li> <li>- For the second NR band, the UE shall include one entry less, i.e. first entry corresponds to the second NR band in <i>bandList</i> and so on</li> <li>- And so on</li> </ul>                                     |
| <p><b>srs-SwitchingTimesListEUTRA</b><br/>Indicates, for a particular pair of E-UTRA bands, the RF retuning time when switching between an E-UTRA carrier corresponding to this band entry and another (PUSCH-less) E-UTRA carrier corresponding to the band entry in the order indicated below:</p> <ul style="list-style-type: none"> <li>- For the first E-UTRA band, the UE shall include the same number of entries for E-UTRA bands as in <i>bandList</i>, i.e. first entry corresponds to first E-UTRA band in <i>bandList</i> and so on,</li> <li>- For the second E-UTRA band, the UE shall include one entry less, i.e. first entry corresponds to the second E-UTRA band in <i>bandList</i> and so on</li> <li>- And so on</li> </ul> |

## – CA-BandwidthClassEUTRA

The IE *CA-BandwidthClassEUTRA* indicates the E-UTRA CA bandwidth class as defined in TS 36.101 [22], table 5.6A-1.

### CA-BandwidthClassEUTRA information element

```
-- ASN1START
-- TAG-CA-BANDWIDTHCLASSEUTRA-START

CA-BandwidthClassEUTRA ::=      ENUMERATED {a, b, c, d, e, f, ...}

-- TAG-CA-BANDWIDTHCLASSEUTRA-STOP
-- ASN1STOP
```

## – CA-BandwidthClassNR

The IE *CA-BandwidthClassNR* indicates the NR CA bandwidth class as defined in TS 38.101-1 [15], table 5.3A.5-1 and TS 38.101-2 [39], table 5.3A.4-1.

### CA-BandwidthClassNR information element

```
-- ASN1START
-- TAG-CA-BANDWIDTHCLASSNR-START

CA-BandwidthClassNR ::=
    ENUMERATED {a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, ...}

-- TAG-CA-BANDWIDTHCLASSNR-STOP
-- ASN1STOP
```

## – CA-ParametersEUTRA

The IE *CA-ParameterEUTRA* contains the E-UTRA part of band combination parameters for a given MR-DC band combination.

NOTE: If additional E-UTRA band combination parameters are defined in TS 36.331 [10], which are supported for MR-DC, they will be defined here as well.

### CA-ParametersEUTRA information element

```
-- ASN1START
-- TAG-CA-PARAMETERSEUTRA-START

CA-ParametersEUTRA ::=
    SEQUENCE {
        multipleTimingAdvance          ENUMERATED {supported}           OPTIONAL,
        simultaneousRx-Tx              ENUMERATED {supported}           OPTIONAL,
        supportedNAICS-2CRS-AP         BIT STRING (SIZE (1..8))       OPTIONAL,
        additionalRx-Tx-PerformanceReq ENUMERATED {supported}           OPTIONAL,
        ue-CA-PowerClass-N             ENUMERATED {class2}             OPTIONAL,
        supportedBandwidthCombinationSetEUTRA-v1530 BIT STRING (SIZE (1..32)) OPTIONAL,
        ...
    }

CA-ParametersEUTRA-v1560 ::=
    SEQUENCE {
        totalWeightedLayers            INTEGER (2..128)                OPTIONAL
    }

-- TAG-CA-PARAMETERSEUTRA-STOP
-- ASN1STOP
```

## – CA-ParametersNR

The IE *CA-ParametersNR* contains carrier aggregation related capabilities that are defined per band combination.

**CA-ParametersNR information element**

```

-- ASN1START
-- TAG-CA-PARAMETERSNR-START

CA-ParametersNR ::=
    SEQUENCE {
        dummy
            ENUMERATED {supported} OPTIONAL,
        parallelTxSRS-PUCCH-PUSCH
            ENUMERATED {supported} OPTIONAL,
        parallelTxPRACH-SRS-PUCCH-PUSCH
            ENUMERATED {supported} OPTIONAL,
        simultaneousRxTxInterBandCA
            ENUMERATED {supported} OPTIONAL,
        simultaneousRxTxSUL
            ENUMERATED {supported} OPTIONAL,
        diffNumerologyAcrossPUCCH-Group
            ENUMERATED {supported} OPTIONAL,
        diffNumerologyWithinPUCCH-GroupSmallerSCS
            ENUMERATED {supported} OPTIONAL,
        supportedNumberTAG
            ENUMERATED {n2, n3, n4} OPTIONAL,
        ...
    }

CA-ParametersNR-v1540 ::=
    SEQUENCE {
        simultaneousSRS-AssocCSI-RS-AllCC
            INTEGER (5..32) OPTIONAL,
        csi-RS-IM-ReceptionForFeedbackPerBandComb
            SEQUENCE {
                maximumSimultaneousNZP-CSI-RS-ActBWP-AllCC
                    INTEGER (1..64) OPTIONAL,
                totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC
                    INTEGER (2..256) OPTIONAL,
            }
        simultaneousCSI-ReportsAllCC
            INTEGER (5..32) OPTIONAL,
        dualPA-Architecture
            ENUMERATED {supported} OPTIONAL
    }

CA-ParametersNR-v1550 ::=
    SEQUENCE {
        dummy
            ENUMERATED {supported} OPTIONAL
    }

CA-ParametersNR-v1560 ::=
    SEQUENCE {
        diffNumerologyWithinPUCCH-GroupLargerSCS
            ENUMERATED {supported} OPTIONAL
    }

-- TAG-CA-PARAMETERSNR-STOP
-- ASN1STOP

```

| <b>CA-ParametersNR field description</b>   |
|--|
| <p><b>maxNumberSimultaneousNZIP-CR-ActBWP-AIIC</b><br/>Limits the total number of NZIP-CR-ActBWP-AIIC resources that the NW may configure across all CCs (irrespective of the associated codebook type). The network applies this limit in addition to the limits signalled in <i>MIMO-ParametersPerBand</i>-&gt; <i>maxNumberSimultaneousNZIP-CR-ActBWP-AIIC</i> and in <i>Phy-ParametersFRX-Diff</i>-&gt; <i>maxNumberSimultaneousNZIP-CR-ActBWP-AIIC</i>.</p> |
| <p><b>simultaneousCR-ReportsAIIC</b><br/>This parameter may further limit <i>simultaneousCR-ReportsPerCC</i> in <i>MIMO-ParametersPerBand</i> and <i>Phy-ParametersFRX-Diff</i> for each band in a given band combination.</p>   |
| <p><b>simultaneousSRS-AssocCR-ActBWP-AIIC</b><br/>This parameter may further limit <i>simultaneousSRS-AssocCR-ActBWP-AIIC</i> in <i>MIMO-ParametersPerBand</i> and <i>Phy-ParametersFRX-Diff</i> for each band in a given band combination.</p>  |
| <p><b>totalNumberPortsSimultaneousNZIP-CR-ActBWP-AIIC</b><br/>Limits the total number of ports that the NW may configure across all CCs (irrespective of the associated codebook type). The network applies this limit in addition to the limits signalled in <i>MIMO-ParametersPerBand</i>-&gt; <i>totalNumberPortsSimultaneousNZIP-CR-ActBWP-AIIC</i> and in <i>Phy-ParametersFRX-Diff</i>-&gt; <i>totalNumberPortsSimultaneousNZIP-CR-ActBWP-AIIC</i>.</p>    |

## – CA-ParametersNRDC

The IE *CA-ParametersNRDC* contains dual connectivity related capabilities that are defined per band combination.

### **CA-ParametersNRDC information element**

```
-- ASN1START
-- TAG-CA-PARAMETERS-NRDC-START

CA-ParametersNRDC ::=
    SEQUENCE {
        ca-ParametersNR-ForDC          CA-ParametersNR          OPTIONAL,
        ca-ParametersNR-ForDC-v1540   CA-ParametersNR-v1540     OPTIONAL,
        ca-ParametersNR-ForDC-v1550   CA-ParametersNR-v1550     OPTIONAL,
        ca-ParametersNR-ForDC-v1560   CA-ParametersNR-v1560     OPTIONAL,
        featureSetCombinationDC        FeatureSetCombinationId  OPTIONAL
    }

-- TAG-CA-PARAMETERS-NRDC-STOP
-- ASN1STOP
```

### **CA-ParametersNRDC field descriptions**

#### **ca-ParametersNR-forDC (with and without suffix)**

If this field is present for a band combination, it reports the UE capabilities when NR-DC is configured with the band combination. If this field is absent for a band combination, the *ca-ParametersNR* (with and without suffix) in *BandCombination* is applicable to the UE configured with NR-DC for the band combination.

#### **featureSetCombinationDC**

If this field is present for a band combination, it reports the feature set combination supported for the band combination when NR-DC is configured. If this field is absent for a band combination, the *featureSetCombination* in *BandCombination* (without suffix) is applicable to the UE configured with NR-DC for the band combination.

## – CodebookParameters

The IE *CodebookParameters* is used to convey codebook related parameters.

### CodebookParameters information element

```

-- ASN1START
-- TAG-CODEBOOKPARAMETERS-START

CodebookParameters ::= SEQUENCE {
  type1 SEQUENCE {
    singlePanel SEQUENCE {
      supportedCSI-RS-ResourceList SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
      modes ENUMERATED {mode1, mode1andMode2},
      maxNumberCSI-RS-PerResourceSet INTEGER (1..8)
    },
    multiPanel SEQUENCE {
      supportedCSI-RS-ResourceList SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
      modes ENUMERATED {mode1, mode2, both},
      nrofPanels ENUMERATED {n2, n4},
      maxNumberCSI-RS-PerResourceSet INTEGER (1..8)
    }
  } OPTIONAL
  type2 SEQUENCE {
    supportedCSI-RS-ResourceList SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
    parameterLx INTEGER (2..4),
    amplitudeScalingType ENUMERATED {wideband, widebandAndSubband},
    amplitudeSubsetRestriction ENUMERATED {supported} OPTIONAL
  } OPTIONAL,
  type2-PortSelection SEQUENCE {
    supportedCSI-RS-ResourceList SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource,
    parameterLx INTEGER (2..4),
    amplitudeScalingType ENUMERATED {wideband, widebandAndSubband}
  } OPTIONAL
}

SupportedCSI-RS-Resource ::= SEQUENCE {
  maxNumberTxPortsPerResource ENUMERATED {p2, p4, p8, p12, p16, p24, p32},
  maxNumberResourcesPerBand INTEGER (1..64),
  totalNumberTxPortsPerBand INTEGER (2..256)
}

-- TAG-CODEBOOKPARAMETERS-STOP
-- ASN1STOP

```

## – FeatureSetCombination

The IE *FeatureSetCombination* is a two-dimensional matrix of *FeatureSet* entries.

Each *FeatureSetsPerBand* contains a list of feature sets applicable to the carrier(s) of one band entry of the associated band combination. Across the associated bands, the UE shall support the combination of *FeatureSets* at the same position in the *FeatureSetsPerBand*. All *FeatureSetsPerBand* in one *FeatureSetCombination* must have the same number of entries.

The number of *FeatureSetsPerBand* in the *FeatureSetCombination* must be equal to the number of band entries in an associated band combination. The first *FeatureSetPerBand* applies to the first band entry of the band combination, and so on.

Each *FeatureSet* contains either a pair of NR or E-UTRA feature set IDs for UL and DL.

In case of NR, the actual feature sets for UL and DL are defined in the *FeatureSets* IE and referred to from here by their ID, i.e., their position in the *featureSetsUplink* / *featureSetsDownlink* list in the *FeatureSet* IE.

In case of E-UTRA, the feature sets referred to from this list are defined in TS 36.331 [10] and conveyed as part of the *UE-EUTRA-Capability* container.

The *FeatureSetUplink* and *FeatureSetDownlink* referred to from the *FeatureSet* comprise, among other information, a set of *FeatureSetUplinkPerCC-Id:s* and *FeatureSetDownlinkPerCC-Id:s*. The number of these per-CC IDs determines the number of carriers that the UE is able to aggregate contiguously in frequency domain in the corresponding band. The number of carriers supported by the UE is also restricted by the bandwidth class indicated in the associated *BandCombination*, if present.

In feature set combinations the UE shall exclude entries for fallback combinations with same capabilities, since the network may anyway assume that the UE supports those.

NOTE 1: The UE may advertise fallback band-combinations in which it supports additional functionality explicitly in two ways: Either by setting *FeatureSet* IDs to zero (inter-band and intra-band non-contiguous fallback) and by reducing the number of *FeatureSet-PerCC* Ids in a *Feature Set* (intra-band contiguous fallback). Or by separate *BandCombination* entries with associated *FeatureSetCombinations*.

NOTE 2: The UE may advertise a *FeatureSetCombination* containing only fallback band combinations. That means, in a *FeatureSetCombination*, each group of *FeatureSets* across the bands may contain at least one pair of *FeatureSetUplinkId* and *FeatureSetDownlinkId* which is set to 0/0.

NOTE 3: The Network configures serving cell(s) and BWP(s) configuration to comply with capabilities derived from the combination of *FeatureSets* at the same position in the *FeatureSetsPerBand*, regardless of activated/deactivated serving cell(s) and BWP(s).

### ***FeatureSetCombination* information element**

```
-- ASN1START
-- TAG-FEATURESETCOMBINATION-START

FeatureSetCombination ::=
    SEQUENCE (SIZE (1..maxSimultaneousBands)) OF FeatureSetsPerBand

FeatureSetsPerBand ::=
    SEQUENCE (SIZE (1..maxFeatureSetsPerBand)) OF FeatureSet

FeatureSet ::=
    CHOICE {
        eutra
            SEQUENCE {
                downlinkSetEUTRA      FeatureSetEUTRA-DownlinkId,
                uplinkSetEUTRA        FeatureSetEUTRA-UplinkId
            },
        nr
            SEQUENCE {
                downlinkSetNR          FeatureSetDownlinkId,
                uplinkSetNR            FeatureSetUplinkId
            }
    }
```



```

}
-- TAG-FEATURESETCOMBINATION-STOP
-- ASN1STOP

```

### – *FeatureSetCombinationId*

The IE *FeatureSetCombinationId* identifies a *FeatureSetCombination*. The *FeatureSetCombinationId* of a *FeatureSetCombination* is the position of the *FeatureSetCombination* in the *featureSetCombinations* list (in *UE-NR-Capability* or *UE-MRDC-Capability*). The *FeatureSetCombinationId* = 0 refers to the first entry in the *featureSetCombinations* list (in *UE-NR-Capability* or *UE-MRDC-Capability*).

NOTE: The *FeatureSetCombinationId* = 1024 is not used due to the maximum entry number of *featureSetCombinations*.

#### **FeatureSetCombinationId information element**

```

-- ASN1START
-- TAG-FEATURESETCOMBINATIONID-START

FeatureSetCombinationId ::=          INTEGER (0.. maxFeatureSetCombinations)

-- TAG-FEATURESETCOMBINATIONID-STOP
-- ASN1STOP

```

### – *FeatureSetDownlink*

The IE *FeatureSetDownlink* indicates a set of features that the UE supports on the carriers corresponding to one band entry in a band combination.

#### **FeatureSetDownlink information element**

```

-- ASN1START
-- TAG-FEATURESETDOWNLINK-START

FeatureSetDownlink ::=
    featureSetListPerDownlinkCC          SEQUENCE {
        intraBandFreqSeparationDL        FreqSeparationClass                OPTIONAL,
        scalingFactor                     ENUMERATED {f0p4, f0p75, f0p8}          OPTIONAL,
        crossCarrierScheduling-OtherSCS   ENUMERATED {supported}                OPTIONAL,
        scellWithoutSSB                   ENUMERATED {supported}                OPTIONAL,
        csi-RS-MeasSCellWithoutSSB       ENUMERATED {supported}                OPTIONAL,
        dummy1                             ENUMERATED {supported}                OPTIONAL,
        type1-3-CSS                       ENUMERATED {supported}                OPTIONAL,
        pdcch-MonitoringAnyOccasions      ENUMERATED {withoutDCI-Gap, withDCI-Gap}  OPTIONAL,
        dummy2                             ENUMERATED {supported}                OPTIONAL,
        ue-SpecificUL-DL-Assignment       ENUMERATED {supported}                OPTIONAL,
        searchSpaceSharingCA-DL           ENUMERATED {supported}                OPTIONAL,
        timeDurationForQCL                SEQUENCE {

```

```

        scs-60kHz          ENUMERATED {s7, s14, s28}          OPTIONAL,
        scs-120kHz        ENUMERATED {s14, s28}             OPTIONAL,
    }
    pdsch-ProcessingType1-DifferentTB-PerSlot SEQUENCE {
        scs-15kHz          ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
        scs-30kHz          ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
        scs-60kHz          ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
        scs-120kHz        ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
    }
    dummy3                 DummyA                          OPTIONAL,
    dummy4                 SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyB  OPTIONAL,
    dummy5                 SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyC  OPTIONAL,
    dummy6                 SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyD  OPTIONAL,
    dummy7                 SEQUENCE (SIZE (1.. maxNrofCodebooks)) OF DummyE  OPTIONAL,
}

FeatureSetDownlink-v1540 ::= SEQUENCE {
    oneFL-DMRS-TwoAdditionalDMRS-DL          ENUMERATED {supported}          OPTIONAL,
    additionalDMRS-DL-Alt                    ENUMERATED {supported}          OPTIONAL,
    twoFL-DMRS-TwoAdditionalDMRS-DL          ENUMERATED {supported}          OPTIONAL,
    oneFL-DMRS-ThreeAdditionalDMRS-DL        ENUMERATED {supported}          OPTIONAL,
    pdcch-MonitoringAnyOccasionsWithSpanGap SEQUENCE {
        scs-15kHz          ENUMERATED {set1, set2, set3}      OPTIONAL,
        scs-30kHz          ENUMERATED {set1, set2, set3}      OPTIONAL,
        scs-60kHz          ENUMERATED {set1, set2, set3}      OPTIONAL,
        scs-120kHz        ENUMERATED {set1, set2, set3}      OPTIONAL,
    } OPTIONAL,
    pdsch-SeparationWithGap                  ENUMERATED {supported}          OPTIONAL,
    pdsch-ProcessingType2                    SEQUENCE {
        scs-15kHz          ProcessingParameters              OPTIONAL,
        scs-30kHz          ProcessingParameters              OPTIONAL,
        scs-60kHz          ProcessingParameters              OPTIONAL,
    } OPTIONAL,
    pdsch-ProcessingType2-Limited            SEQUENCE {
        differentTB-PerSlot-SCS-30kHz          ENUMERATED {upto1, upto2, upto4, upto7}
    } OPTIONAL,
    dl-MCS-TableAlt-DynamicIndication        ENUMERATED {supported}          OPTIONAL,
}

DummyA ::= SEQUENCE {
    maxNumberNZP-CSI-RS-PerCC                INTEGER (1..32),
    maxNumberPortsAcrossNZP-CSI-RS-PerCC     ENUMERATED {p2, p4, p8, p12, p16, p24, p32, p40, p48, p56, p64, p72, p80,
        p88, p96, p104, p112, p120, p128, p136, p144, p152, p160, p168,
        p176, p184, p192, p200, p208, p216, p224, p232, p240, p248, p256},
    maxNumberCS-IM-PerCC                    ENUMERATED {n1, n2, n4, n8, n16, n32},
    maxNumberSimultaneousCSI-RS-ActBWP-AllCC ENUMERATED {n5, n6, n7, n8, n9, n10, n12, n14, n16, n18, n20, n22, n24, n26,
        n28, n30, n32, n34, n36, n38, n40, n42, n44, n46, n48, n50, n52,
        n54, n56, n58, n60, n62, n64},
    totalNumberPortsSimultaneousCSI-RS-ActBWP-AllCC ENUMERATED {p8, p12, p16, p24, p32, p40, p48, p56, p64, p72, p80,
        p88, p96, p104, p112, p120, p128, p136, p144, p152, p160, p168,
        p176, p184, p192, p200, p208, p216, p224, p232, p240, p248, p256}
}

DummyB ::= SEQUENCE {

```

```

    maxNumberTxPortsPerResource    ENUMERATED {p2, p4, p8, p12, p16, p24, p32},
    maxNumberResources              INTEGER (1..64),
    totalNumberTxPorts              INTEGER (2..256),
    supportedCodebookMode           ENUMERATED {mode1, mode1AndMode2},
    maxNumberCSI-RS-PerResourceSet  INTEGER (1..8)
}

DummyC ::= SEQUENCE {
    maxNumberTxPortsPerResource    ENUMERATED {p8, p16, p32},
    maxNumberResources              INTEGER (1..64),
    totalNumberTxPorts              INTEGER (2..256),
    supportedCodebookMode           ENUMERATED {mode1, mode2, both},
    supportedNumberPanels           ENUMERATED {n2, n4},
    maxNumberCSI-RS-PerResourceSet  INTEGER (1..8)
}

DummyD ::= SEQUENCE {
    maxNumberTxPortsPerResource    ENUMERATED {p4, p8, p12, p16, p24, p32},
    maxNumberResources              INTEGER (1..64),
    totalNumberTxPorts              INTEGER (2..256),
    parameterLx                     INTEGER (2..4),
    amplitudeScalingType            ENUMERATED {wideband, widebandAndSubband},
    amplitudeSubsetRestriction      ENUMERATED {supported} OPTIONAL,
    maxNumberCSI-RS-PerResourceSet  INTEGER (1..8)
}

DummyE ::= SEQUENCE {
    maxNumberTxPortsPerResource    ENUMERATED {p4, p8, p12, p16, p24, p32},
    maxNumberResources              INTEGER (1..64),
    totalNumberTxPorts              INTEGER (2..256),
    parameterLx                     INTEGER (2..4),
    amplitudeScalingType            ENUMERATED {wideband, widebandAndSubband},
    maxNumberCSI-RS-PerResourceSet  INTEGER (1..8)
}

-- TAG-FEATURESETDOWNLINK-STOP
-- ASN1STOP

```

#### **FeatureSetDownlink field descriptions**

##### **crossCarrierScheduling-OtherSCS**

The UE shall set this field to the same value as *crossCarrierScheduling-OtherSCS* in the associated *FeatureSetUplink* (if present).

##### **featureSetListPerDownlinkCC**

Indicates which features the UE supports on the individual carriers of the feature set (and hence of a band entry that refer to the feature set). The UE shall hence include at least as many *FeatureSetDownlinkPerCC-Id* in this list as the number of carriers it supports according to the *ca-BandwidthClassDL*, except if indicating additional functionality by reducing the number of *FeatureSetDownlinkPerCC-Id* in the feature set (see NOTE 1 in *FeatureSetCombination* IE description). The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the *FeatureSetDownlinkPerCC-Id* in this list.

## – *FeatureSetDownlinkId*

The IE *FeatureSetDownlinkId* identifies a downlink feature set. The *FeatureSetDownlinkId* of a *FeatureSetDownlink* is the index position of the *FeatureSetDownlink* in the *featureSetsDownlink* list in the *FeatureSets* IE. The first element in that list is referred to by *FeatureSetDownlinkId* = 1. The *FeatureSetDownlinkId*=0 is not used by an actual *FeatureSetDownlink* but means that the UE does not support a carrier in this band of a band combination.

### ***FeatureSetDownlinkId* information element**

```
-- ASN1START
-- TAG-FEATURESETDOWNLINKID-START

FeatureSetDownlinkId ::=          INTEGER (0..maxDownlinkFeatureSets)

-- TAG-FEATURESETDOWNLINKID-STOP
-- ASN1STOP
```

## – *FeatureSetDownlinkPerCC*

The IE *FeatureSetDownlinkPerCC* indicates a set of features that the UE supports on the corresponding carrier of one band entry of a band combination.

### ***FeatureSetDownlinkPerCC* information element**

```
-- ASN1START
-- TAG-FEATURESETDOWNLINKPERCC-START

FeatureSetDownlinkPerCC ::=      SEQUENCE {
    supportedSubcarrierSpacingDL   SubcarrierSpacing,
    supportedBandwidthDL           SupportedBandwidth,
    channelBW-90mhz                ENUMERATED {supported}           OPTIONAL,
    maxNumberMIMO-LayersPDSCH      MIMO-LayersDL                   OPTIONAL,
    supportedModulationOrderDL      ModulationOrder                 OPTIONAL
}

-- TAG-FEATURESETDOWNLINKPERCC-STOP
-- ASN1STOP
```

## – *FeatureSetDownlinkPerCC-Id*

The IE *FeatureSetDownlinkPerCC-Id* identifies a set of features applicable to one carrier of a feature set. The *FeatureSetDownlinkPerCC-Id* of a *FeatureSetDownlinkPerCC* is the index position of the *FeatureSetDownlinkPerCC* in the *featureSetsDownlinkPerCC*. The first element in the list is referred to by *FeatureSetDownlinkPerCC-Id* = 1, and so on.

### ***FeatureSetDownlinkPerCC-Id* information element**

```
-- ASN1START
```

```
-- TAG-FEATURESETDOWNLINKPERCC-ID-START
FeatureSetDownlinkPerCC-Id ::=          INTEGER (1..maxPerCC-FeatureSets)
-- TAG-FEATURESETDOWNLINKPERCC-ID-STOP
-- ASN1STOP
```

### – *FeatureSetEUTRA-DownlinkId*

The IE *FeatureSetEUTRA-DownlinkId* identifies a downlink feature set in E-UTRA list (see TS 36.331 [10]). The first element in that list is referred to by *FeatureSetEUTRA-DownlinkId* = 1. The *FeatureSetEUTRA-DownlinkId*=0 is used when the UE does not support a carrier in this band of a band combination.

#### ***FeatureSetEUTRA-DownlinkId* information element**

```
-- ASN1START
-- TAG-FEATURESETEUTRADOWNLINKID-START
FeatureSetEUTRA-DownlinkId ::=          INTEGER (0..maxEUTRA-DL-FeatureSets)
-- TAG-FEATURESETEUTRADOWNLINKID-STOP
-- ASN1STOP
```

### – *FeatureSetEUTRA-UplinkId*

The IE *FeatureSetEUTRA-UplinkId* identifies an uplink feature set in E-UTRA list (see TS 36.331 [10]). The first element in that list is referred to by *FeatureSetEUTRA-UplinkId* = 1. The *FeatureSetEUTRA-UplinkId* = 0 is used when the UE does not support a carrier in this band of a band combination.

#### ***FeatureSetEUTRA-UplinkId* information element**

```
-- ASN1START
-- TAG-FEATURESETEUTRAUPLINKID-START
FeatureSetEUTRA-UplinkId ::=            INTEGER (0..maxEUTRA-UL-FeatureSets)
-- TAG-FEATURESETEUTRAUPLINKID-STOP
-- ASN1STOP
```

### – *FeatureSets*

The IE *FeatureSets* is used to provide pools of downlink and uplink features sets. A *FeatureSetCombination* refers to the IDs of the feature set(s) that the UE supports in that *FeatureSetCombination*. The *BandCombination* entries in the *BandCombinationList* then indicate the ID of the *FeatureSetCombination* that the UE supports for that band combination.

The entries in the lists in this IE are identified by their index position. For example, the *FeatureSetUplinkPerCC-Id* = 4 identifies the 4<sup>th</sup> element in the *featureSetsUplinkPerCC* list.

NOTE: When feature sets (per CC) IEs require extension in future versions of the specification, new versions of the *FeatureSetDownlink*, *FeatureSetUplink*, *FeatureSets*, *FeatureSetDownlinkPerCC* and/or *FeatureSetUplinkPerCC* will be created and instantiated in corresponding new lists in the *FeatureSets* IE. For example, if new capability bits are to be added to the *FeatureSetDownlink*, they will instead be defined in a new *FeatureSetDownlink-rxy* which will be instantiated in a new *featureSetDownlinkList-rxy* list. If a UE indicates in a *FeatureSetCombination* that it supports the *FeatureSetDownlink* with ID #5, it implies that it supports both the features in *FeatureSetDownlink* #5 and *FeatureSetDownlink-rxy* #5 (if present). The number of entries in the new list(s) shall be the same as in the original list(s).

### FeatureSets information element

```
-- ASN1START
-- TAG-FEATURESETS-START

FeatureSets ::= SEQUENCE {
    featureSetsDownlink          SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink          OPTIONAL,
    featureSetsDownlinkPerCC     SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetDownlinkPerCC     OPTIONAL,
    featureSetsUplink            SEQUENCE (SIZE (1..maxUplinkFeatureSets)) OF FeatureSetUplink            OPTIONAL,
    featureSetsUplinkPerCC       SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetUplinkPerCC       OPTIONAL,
    ...,
    [
        featureSetsDownlink-v1540 SEQUENCE (SIZE (1..maxDownlinkFeatureSets)) OF FeatureSetDownlink-v1540  OPTIONAL,
        featureSetsUplink-v1540   SEQUENCE (SIZE (1..maxUplinkFeatureSets)) OF FeatureSetUplink-v1540   OPTIONAL,
        featureSetsUplinkPerCC-v1540 SEQUENCE (SIZE (1..maxPerCC-FeatureSets)) OF FeatureSetUplinkPerCC-v1540 OPTIONAL
    ]
}

-- TAG-FEATURESETS-STOP
-- ASN1STOP
```

### FeatureSetUplink

The IE *FeatureSetUplink* is used to indicate the features that the UE supports on the carriers corresponding to one band entry in a band combination.

### FeatureSetUplink information element

```
-- ASN1START
-- TAG-FEATURESETUPLINK-START

FeatureSetUplink ::= SEQUENCE {
    featureSetListPerUplinkCC SEQUENCE (SIZE (1..maxNrofServingCells)) OF FeatureSetUplinkPerCC-Id,
    scalingFactor             ENUMERATED {f0p4, f0p75, f0p8}             OPTIONAL,
    crossCarrierScheduling-OtherSCS ENUMERATED {supported}             OPTIONAL,
    intraBandFreqSeparationUL   FreqSeparationClass                   OPTIONAL,
    searchSpaceSharingCA-UL     ENUMERATED {supported}                 OPTIONAL,
    dummy1                      DummyI                                  OPTIONAL,
    supportedSRS-Resources      SRS-Resources                          OPTIONAL,
}
```

```

twoPUCCH-Group          ENUMERATED {supported}          OPTIONAL,
dynamicSwitchSUL        ENUMERATED {supported}          OPTIONAL,
simultaneousTxSUL-NonSUL  ENUMERATED {supported}          OPTIONAL,
pusch-ProcessingType1-DifferentTB-PerSlot SEQUENCE {
  scs-15kHz              ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
  scs-30kHz              ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
  scs-60kHz              ENUMERATED {upto2, upto4, upto7}  OPTIONAL,
  scs-120kHz             ENUMERATED {upto2, upto4, upto7}  OPTIONAL
}
dummy2                  DummyF                          OPTIONAL
}

FeatureSetUplink-v1540 ::= SEQUENCE {
  zeroSlotOffsetAperiodicSRS          ENUMERATED {supported}          OPTIONAL,
  pa-PhaseDiscontinuityImpacts        ENUMERATED {supported}          OPTIONAL,
  pusch-SeparationWithGap              ENUMERATED {supported}          OPTIONAL,
  pusch-ProcessingType2                SEQUENCE {
    scs-15kHz                          ProcessingParameters          OPTIONAL,
    scs-30kHz                          ProcessingParameters          OPTIONAL,
    scs-60kHz                          ProcessingParameters          OPTIONAL
  } OPTIONAL,
  ul-MCS-TableAlt-DynamicIndication    ENUMERATED {supported}          OPTIONAL
}

SRS-Resources ::= SEQUENCE {
  maxNumberAperiodicSRS-PerBWP          ENUMERATED {n1, n2, n4, n8, n16},
  maxNumberAperiodicSRS-PerBWP-PerSlot  INTEGER (1..6),
  maxNumberPeriodicSRS-PerBWP          ENUMERATED {n1, n2, n4, n8, n16},
  maxNumberPeriodicSRS-PerBWP-PerSlot  INTEGER (1..6),
  maxNumberSemiPersistentSRS-PerBWP    ENUMERATED {n1, n2, n4, n8, n16},
  maxNumberSemiPersistentSRS-PerBWP-PerSlot  INTEGER (1..6),
  maxNumberSRS-Ports-PerResource       ENUMERATED {n1, n2, n4}
}

DummyF ::= SEQUENCE {
  maxNumberPeriodicCSI-ReportPerBWP     INTEGER (1..4),
  maxNumberAperiodicCSI-ReportPerBWP    INTEGER (1..4),
  maxNumberSemiPersistentCSI-ReportPerBWP  INTEGER (0..4),
  simultaneousCSI-ReportsAllCC          INTEGER (5..32)
}

-- TAG-FEATURESETUPLINK-STOP
-- ASN1STOP

```

**FeatureSetUplink field descriptions****crossCarrierScheduling-OtherSCS**

The UE shall set this field to the same value as *crossCarrierScheduling-OtherSCS* in the associated *FeatureSetDownlink* (if present).

**featureSetsPerUplinkCC**

Indicates which features the UE supports on the individual carriers of the feature set (and hence of a band entry that refers to the feature set). The UE shall hence include at least as many *FeatureSetUplinkPerCC-Id* in this list as the number of carriers it supports according to the *ca-BandwidthClassUL*, except if indicating additional functionality by reducing the number of *FeatureSetUplinkPerCC-Id* in the feature set (see NOTE 1 in *FeatureSetCombination* IE description). The order of the elements in this list is not relevant, i.e., the network may configure any of the carriers in accordance with any of the *FeatureSetUplinkPerCC-Id* in this list.

– **FeatureSetUplinkId**

The IE *FeatureSetUplinkId* identifies an uplink feature set. The *FeatureSetUplinkId* of a *FeatureSetUplink* is the index position of the *FeatureSetUplink* in the *featureSetsUplink* list in the *FeatureSets* IE. The first element in the list is referred to by *FeatureSetUplinkId* = 1, and so on. The *FeatureSetUplinkId* = 0 is not used by an actual *FeatureSetUplink* but means that the UE does not support a carrier in this band of a band combination.

**FeatureSetUplinkId information element**

```
-- ASN1START
-- TAG-FEATURESETUPLINKID-START

FeatureSetUplinkId ::=
    INTEGER (0..maxUplinkFeatureSets)

-- TAG-FEATURESETUPLINKID-STOP
-- ASN1STOP
```

– **FeatureSetUplinkPerCC**

The IE *FeatureSetDownlinkPerCC* indicates a set of features that the UE supports on the corresponding carrier of one band entry of a band combination.

**FeatureSetUplinkPerCC information element**

```
-- ASN1START
-- TAG-FEATURESETUPLINKPERCC-START

FeatureSetUplinkPerCC ::=
    SEQUENCE {
        supportedSubcarrierSpacingUL          SubcarrierSpacing,
        supportedBandwidthUL                  SupportedBandwidth,
        channelBW-90mhz                       ENUMERATED {supported} OPTIONAL,
        mimo-CB-PUSCH                          SEQUENCE {
            maximumMIMO-LayersCB-PUSCH        MIMO-LayersUL          OPTIONAL,
            maximumSRS-ResourcePerSet         INTEGER (1..2)
        }
        maximumMIMO-LayersNonCB-PUSCH         MIMO-LayersUL          OPTIONAL,
        supportedModulationOrderUL             ModulationOrder        OPTIONAL
    }
FeatureSetUplinkPerCC-v1540 ::=
    SEQUENCE {
```



```

    mimo-NonCB-PUSCH          SEQUENCE {
      maxNumberSRS-ResourcePerSet  INTEGER (1..4),
      maxNumberSimultaneousSRS-ResourceTx  INTEGER (1..4)
    } OPTIONAL
}
-- TAG-FEATURESETUPLINKPERCC-STOP
-- ASN1STOP

```

### – *FeatureSetUplinkPerCC-Id*

The IE *FeatureSetUplinkPerCC-Id* identifies a set of features applicable to one carrier of a feature set. The *FeatureSetUplinkPerCC-Id* of a *FeatureSetUplinkPerCC* is the index position of the *FeatureSetUplinkPerCC* in the *featureSetsUplinkPerCC*. The first element in the list is referred to by *FeatureSetUplinkPerCC-Id* = 1, and so on.

#### ***FeatureSetUplinkPerCC-Id* information element**

```

-- ASN1START
-- TAG-FEATURESETUPLINKPERCC-ID-START
FeatureSetUplinkPerCC-Id ::=  INTEGER (1..maxPerCC-FeatureSets)
-- TAG-FEATURESETUPLINKPERCC-ID-STOP
-- ASN1STOP

```

### – *FreqBandIndicatorEUTRA*

```

-- ASN1START
-- TAG-FREQBANDINDICATOREUTRA-START
FreqBandIndicatorEUTRA ::=  INTEGER (1..maxBandsEUTRA)
-- TAG-FREQBANDINDICATOREUTRA-STOP
-- ASN1STOP

```

### – *FreqBandList*

The IE *FreqBandList* is used by the network to request NR CA and/or MR-DC band combinations for specific NR and/or E-UTRA frequency bands and/or up to a specific number of carriers and/or up to specific aggregated bandwidth. This is also used to request feature sets (for NR) and feature set combinations (for NR and MR-DC).

#### ***FreqBandList* information element**

```

-- ASN1START
-- TAG-FREQBANDLIST-START
FreqBandList ::=  SEQUENCE (SIZE (1..maxBandsMRDC)) OF FreqBandInformation

```

```

FreqBandInformation ::= CHOICE {
    bandInformationEUTRA      FreqBandInformationEUTRA,
    bandInformationNR        FreqBandInformationNR
}

FreqBandInformationEUTRA ::= SEQUENCE {
    bandEUTRA                FreqBandIndicatorEUTRA,
    ca-BandwidthClassDL-EUTRA CA-BandwidthClassEUTRA      OPTIONAL, -- Need N
    ca-BandwidthClassUL-EUTRA CA-BandwidthClassEUTRA      OPTIONAL, -- Need N
}

FreqBandInformationNR ::= SEQUENCE {
    bandNR                   FreqBandIndicatorNR,
    maxBandwidthRequestedDL  AggregatedBandwidth      OPTIONAL, -- Need N
    maxBandwidthRequestedUL  AggregatedBandwidth      OPTIONAL, -- Need N
    maxCarriersRequestedDL   INTEGER (1..maxNrofServingCells) OPTIONAL, -- Need N
    maxCarriersRequestedUL   INTEGER (1..maxNrofServingCells) OPTIONAL, -- Need N
}

AggregatedBandwidth ::= ENUMERATED {mhz50, mhz100, mhz150, mhz200, mhz250, mhz300, mhz350,
    mhz400, mhz450, mhz500, mhz550, mhz600, mhz650, mhz700, mhz750, mhz800}

-- TAG-FREQBANDLIST-STOP
-- ASN1STOP

```

### – *FreqSeparationClass*

The IE *FreqSeparationClass* is used for an intra-band non-contiguous CA band combination to indicate frequency separation between lower edge of lowest CC and upper edge of highest CC in a frequency band.

#### ***FreqSeparationClass* information element**

```

-- ASN1START
-- TAG-FREQSEPARATIONCLASS-START

FreqSeparationClass ::= ENUMERATED {c1, c2, c3, ...}

-- TAG-FREQSEPARATIONCLASS-STOP
-- ASN1STOP

```

### – *IMS-Parameters*

The IE *IMS-Parameters* is used to convey capabilities related to IMS.

**IMS-Parameters information element**

```

-- ASN1START
-- TAG-IMS-PARAMETERS-START

IMS-Parameters ::= SEQUENCE {
    ims-ParametersCommon      IMS-ParametersCommon      OPTIONAL,
    ims-ParametersFRX-Diff    IMS-ParametersFRX-Diff    OPTIONAL,
    ...
}

IMS-ParametersCommon ::= SEQUENCE {
    voiceOverEUTRA-5GC        ENUMERATED {supported}    OPTIONAL,
    ...
    [[
    voiceOverSCG-BearerEUTRA-5GC    ENUMERATED {supported}    OPTIONAL
    ]]
}

IMS-ParametersFRX-Diff ::= SEQUENCE {
    voiceOverNR                ENUMERATED {supported}    OPTIONAL,
    ...
}

-- TAG-IMS-PARAMETERS-STOP
-- ASN1STOP

```

**InterRAT-Parameters**

The IE *InterRAT-Parameters* is used convey UE capabilities related to the other RATs.

**InterRAT-Parameters information element**

```

-- ASN1START
-- TAG-INTERRAT-PARAMETERS-START

InterRAT-Parameters ::= SEQUENCE {
    eutra                      EUTRA-Parameters          OPTIONAL,
    ...
}

EUTRA-Parameters ::= SEQUENCE {
    supportedBandListEUTRA     SEQUENCE (SIZE (1..maxBandsEUTRA)) OF FreqBandIndicatorEUTRA,
    eutra-ParametersCommon     EUTRA-ParametersCommon          OPTIONAL,
    eutra-ParametersXDD-Diff    EUTRA-ParametersXDD-Diff        OPTIONAL,
    ...
}

EUTRA-ParametersCommon ::= SEQUENCE {
    mfbf-EUTRA                 ENUMERATED {supported}    OPTIONAL,
    modifiedMPR-BehaviorEUTRA   BIT STRING (SIZE (32))    OPTIONAL,

```

```

multiNS-Pmax-EUTRA      ENUMERATED {supported}      OPTIONAL,
rs-SINR-MeasEUTRA      ENUMERATED {supported}      OPTIONAL,
...
[[
ne-DC                    ENUMERATED {supported}      OPTIONAL
]]
}

EUTRA-ParametersXDD-Diff ::= SEQUENCE {
  rsrqMeasWidebandEUTRA  ENUMERATED {supported}      OPTIONAL,
  ...
}

-- TAG-INTERRAT-PARAMETERS-STOP
-- ASN1STOP

```

## – MAC-Parameters

The IE *MAC-Parameters* is used to convey capabilities related to MAC.

### MAC-Parameters information element

```

-- ASN1START
-- TAG-MAC-PARAMETERS-START

MAC-Parameters ::= SEQUENCE {
  mac-ParametersCommon    MAC-ParametersCommon    OPTIONAL,
  mac-ParametersXDD-Diff  MAC-ParametersXDD-Diff  OPTIONAL
}

MAC-ParametersCommon ::= SEQUENCE {
  lcp-Restriction          ENUMERATED {supported}      OPTIONAL,
  dummy                    ENUMERATED {supported}      OPTIONAL,
  lch-ToSCellRestriction   ENUMERATED {supported}      OPTIONAL,
  ...
  [[
  recommendedBitRate       ENUMERATED {supported}      OPTIONAL,
  recommendedBitRateQuery  ENUMERATED {supported}      OPTIONAL
  ]]
}

MAC-ParametersXDD-Diff ::= SEQUENCE {
  skipUplinkTxDynamic      ENUMERATED {supported}      OPTIONAL,
  logicalChannelSR-DelayTimer  ENUMERATED {supported}      OPTIONAL,
  longDRX-Cycle            ENUMERATED {supported}      OPTIONAL,
  shortDRX-Cycle           ENUMERATED {supported}      OPTIONAL,
  multipleSR-Configurations  ENUMERATED {supported}      OPTIONAL,
  multipleConfiguredGrants   ENUMERATED {supported}      OPTIONAL,
  ...
}

```

```
-- TAG-MAC-PARAMETERS-STOP
-- ASN1STOP
```

## – *MeasAndMobParameters*

The IE *MeasAndMobParameters* is used to convey UE capabilities related to measurements for radio resource management (RRM), radio link monitoring (RLM) and mobility (e.g. handover).

### *MeasAndMobParameters* information element

```
-- ASN1START
-- TAG-MEASANDMOBPARAMETERS-START
```

```
MeasAndMobParameters ::=
    SEQUENCE {
        measAndMobParametersCommon      MeasAndMobParametersCommon      OPTIONAL,
        measAndMobParametersXDD-Diff     MeasAndMobParametersXDD-Diff     OPTIONAL,
        measAndMobParametersFRX-Diff     MeasAndMobParametersFRX-Diff     OPTIONAL
    }
```

```
MeasAndMobParametersCommon ::=
    SEQUENCE {
        supportedGapPattern              BIT STRING (SIZE (22))          OPTIONAL,
        ssb-RLM                          ENUMERATED {supported}          OPTIONAL,
        ssb-AndCSI-RS-RLM                ENUMERATED {supported}          OPTIONAL,
        . . . ,
        [[
            eventB-MeasAndReport         ENUMERATED {supported}          OPTIONAL,
            handoverFDD-TDD               ENUMERATED {supported}          OPTIONAL,
            eutra-CGI-Reporting           ENUMERATED {supported}          OPTIONAL,
            nr-CGI-Reporting              ENUMERATED {supported}          OPTIONAL
        ]],
        [[
            independentGapConfig          ENUMERATED {supported}          OPTIONAL,
            periodicEUTRA-MeasAndReport   ENUMERATED {supported}          OPTIONAL,
            handoverFR1-FR2               ENUMERATED {supported}          OPTIONAL,
            maxNumberCSI-RS-RRM-RS-SINR   ENUMERATED {n4, n8, n16, n32, n64, n96} OPTIONAL
        ]],
        [[
            nr-CGI-Reporting-ENDC         ENUMERATED {supported}          OPTIONAL
        ]]
```

```
MeasAndMobParametersXDD-Diff ::=
    SEQUENCE {
        intraAndInterF-MeasAndReport     ENUMERATED {supported}          OPTIONAL,
        eventA-MeasAndReport             ENUMERATED {supported}          OPTIONAL,
        . . . ,
        [[
            handoverInterF                ENUMERATED {supported}          OPTIONAL,
            handoverLTE-EPC                ENUMERATED {supported}          OPTIONAL,
            handoverLTE-5GC                ENUMERATED {supported}          OPTIONAL
        ]]
```

```

}
MeasAndMobParametersFRX-Diff ::=
    SEQUENCE {
        ss-SINR-Meas          ENUMERATED {supported}    OPTIONAL,
        csi-RSRP-AndRSRQ-MeasWithSSB  ENUMERATED {supported}    OPTIONAL,
        csi-RSRP-AndRSRQ-MeasWithoutSSB  ENUMERATED {supported}    OPTIONAL,
        csi-SINR-Meas        ENUMERATED {supported}    OPTIONAL,
        csi-RS-RLM           ENUMERATED {supported}    OPTIONAL,
        ...,
        [[
            handoverInterF          ENUMERATED {supported}    OPTIONAL,
            handoverLTE-EPC         ENUMERATED {supported}    OPTIONAL,
            handoverLTE-5GC        ENUMERATED {supported}    OPTIONAL
        ]],
        [[
            maxNumberResource-CSI-RS-RLM  ENUMERATED {n2, n4, n6, n8}    OPTIONAL
        ]],
        [[
            simultaneousRxDataSSB-DiffNumerology  ENUMERATED {supported}    OPTIONAL
        ]]
    }
-- TAG-MEASANDMOBPARAMETERS-STOP
-- ASN1STOP

```

## – *MeasAndMobParametersMRDC*

The IE *MeasAndMobParametersMRDC* is used to convey capability parameters related to RRM measurements and RRC mobility.

### ***MeasAndMobParametersMRDC* information element**

```

-- ASN1START
-- TAG-MEASANDMOBPARAMETERSMRDC-START

MeasAndMobParametersMRDC ::=
    SEQUENCE {
        measAndMobParametersMRDC-Common  MeasAndMobParametersMRDC-Common    OPTIONAL,
        measAndMobParametersMRDC-XDD-Diff MeasAndMobParametersMRDC-XDD-Diff    OPTIONAL,
        measAndMobParametersMRDC-FRX-Diff MeasAndMobParametersMRDC-FRX-Diff    OPTIONAL
    }

MeasAndMobParametersMRDC-v1560 ::=
    SEQUENCE {
        measAndMobParametersMRDC-XDD-Diff-v1560  MeasAndMobParametersMRDC-XDD-Diff-v1560    OPTIONAL
    }

MeasAndMobParametersMRDC-Common ::=
    SEQUENCE {
        independentGapConfig  ENUMERATED {supported}    OPTIONAL
    }

MeasAndMobParametersMRDC-XDD-Diff ::=
    SEQUENCE {
        sftd-MeasPSCell  ENUMERATED {supported}    OPTIONAL,
        sftd-MeasNR-Cell  ENUMERATED {supported}    OPTIONAL
    }

```

```

}
MeasAndMobParametersMRDC-XDD-Diff-v1560 ::= SEQUENCE {
    sftd-MeasPSCell-NEDC          ENUMERATED {supported}      OPTIONAL
}
MeasAndMobParametersMRDC-FRX-Diff ::= SEQUENCE {
    simultaneousRxDataSSB-DiffNumerology  ENUMERATED {supported}      OPTIONAL
}
-- TAG-MEASANDMOBPARAMETERSMRDC-STOP
-- ASN1STOP

```

## – MIMO-Layers

The IE *MIMO-Layers* is used to convey the number of supported MIMO layers.

### **MIMO-Layers information element**

```

-- ASN1START
-- TAG-MIMO-LAYERS-START
MIMO-LayersDL ::= ENUMERATED {twoLayers, fourLayers, eightLayers}
MIMO-LayersUL ::= ENUMERATED {oneLayer, twoLayers, fourLayers}
-- TAG-MIMO-LAYERS-STOP
-- ASN1STOP

```

## – MIMO-ParametersPerBand

The IE *MIMO-ParametersPerBand* is used to convey MIMO related parameters specific for a certain band (not per feature set or band combination).

### **MIMO-ParametersPerBand information element**

```

-- ASN1START
-- TAG-MIMO-PARAMETERSPERBAND-START
MIMO-ParametersPerBand ::= SEQUENCE {
    tci-StatePDSCH          SEQUENCE {
        maximumConfiguredTCIstatesPerCC  ENUMERATED {n4, n8, n16, n32, n64, n128}  OPTIONAL,
        maximumActiveTCI-PerBWP          ENUMERATED {n1, n2, n4, n8}      OPTIONAL,
    }
    additionalActiveTCI-StatePDCCH        ENUMERATED {supported}          OPTIONAL,
    pusch-TransCoherence                  ENUMERATED {nonCoherent, partialCoherent, fullCoherent}  OPTIONAL,
    beamCorrespondenceWithoutUL-BeamSweeping  ENUMERATED {supported}          OPTIONAL,
    periodicBeamReport                    ENUMERATED {supported}          OPTIONAL,
    aperiodicBeamReport                    ENUMERATED {supported}          OPTIONAL,
}

```

|                                 |  |           |
|---------------------------------|--|-----------|
| sp-BeamReportPUCCH              | ENUMERATED {supported}                           | OPTIONAL, |
| sp-BeamReportPUSCH              | ENUMERATED {supported}                           | OPTIONAL, |
| dummy1                          | DummyG   | OPTIONAL, |
| maxNumberRxBeam                 | INTEGER (2..8)                                   | OPTIONAL, |
| maxNumberRxTxBeamSwitchDL       | SEQUENCE {                                       |           |
| scs-15kHz                       | ENUMERATED {n4, n7, n14}                         | OPTIONAL, |
| scs-30kHz                       | ENUMERATED {n4, n7, n14}                         | OPTIONAL, |
| scs-60kHz                       | ENUMERATED {n4, n7, n14}                         | OPTIONAL, |
| scs-120kHz                      | ENUMERATED {n4, n7, n14}                         | OPTIONAL, |
| scs-240kHz                      | ENUMERATED {n4, n7, n14}                         | OPTIONAL, |
| }                               |  | OPTIONAL, |
| maxNumberNonGroupBeamReporting  | ENUMERATED {n1, n2, n4}                          | OPTIONAL, |
| groupBeamReporting              | ENUMERATED {supported}                           | OPTIONAL, |
| uplinkBeamManagement            | SEQUENCE {                                       |           |
| maxNumberSRS-ResourcePerSet-BM  | ENUMERATED {n2, n4, n8, n16},                    |           |
| maxNumberSRS-ResourceSet        | INTEGER (1..8)                                   |           |
| }                               |  | OPTIONAL, |
| maxNumberCSI-RS-BFD             | INTEGER (1..64)                                  | OPTIONAL, |
| maxNumberSSB-BFD                | INTEGER (1..64)                                  | OPTIONAL, |
| maxNumberCSI-RS-SSB-CBD         | INTEGER (1..256)                                 | OPTIONAL, |
| dummy2                          | ENUMERATED {supported}                           | OPTIONAL, |
| twoPortsPTRS-UL                 | ENUMERATED {supported}                           | OPTIONAL, |
| dummy5                          | SRS-Resources                                    | OPTIONAL, |
| dummy3                          | INTEGER (1..4)                                   | OPTIONAL, |
| beamReportTiming                | SEQUENCE {                                       |           |
| scs-15kHz                       | ENUMERATED {sym2, sym4, sym8}                    | OPTIONAL, |
| scs-30kHz                       | ENUMERATED {sym4, sym8, sym14, sym28}            | OPTIONAL, |
| scs-60kHz                       | ENUMERATED {sym8, sym14, sym28}                  | OPTIONAL, |
| scs-120kHz                      | ENUMERATED {sym14, sym28, sym56}                 | OPTIONAL, |
| }                               |  | OPTIONAL, |
| ptrs-DensityRecommendationSetDL | SEQUENCE {                                       |           |
| scs-15kHz                       | PTRS-DensityRecommendationDL                     | OPTIONAL, |
| scs-30kHz                       | PTRS-DensityRecommendationDL                     | OPTIONAL, |
| scs-60kHz                       | PTRS-DensityRecommendationDL                     | OPTIONAL, |
| scs-120kHz                      | PTRS-DensityRecommendationDL                     | OPTIONAL, |
| }                               |  | OPTIONAL, |
| ptrs-DensityRecommendationSetUL | SEQUENCE {                                       |           |
| scs-15kHz                       | PTRS-DensityRecommendationUL                     | OPTIONAL, |
| scs-30kHz                       | PTRS-DensityRecommendationUL                     | OPTIONAL, |
| scs-60kHz                       | PTRS-DensityRecommendationUL                     | OPTIONAL, |
| scs-120kHz                      | PTRS-DensityRecommendationUL                     | OPTIONAL, |
| }                               |  | OPTIONAL, |
| dummy4                          | DummyH   | OPTIONAL, |
| aperiodicTRS                    | ENUMERATED {supported}                           | OPTIONAL, |
| ...                             |  |           |
| [[                              |  |           |
| dummy6                          | ENUMERATED {true}                                | OPTIONAL, |
| beamManagementSSB-CSI-RS        | BeamManagementSSB-CSI-RS                         | OPTIONAL, |
| beamSwitchTiming                | SEQUENCE {                                       |           |
| scs-60kHz                       | ENUMERATED {sym14, sym28, sym48, sym224, sym336} | OPTIONAL, |
| scs-120kHz                      | ENUMERATED {sym14, sym28, sym48, sym224, sym336} | OPTIONAL, |
| }                               |  | OPTIONAL, |
| codebookParameters              | CodebookParameters                               | OPTIONAL, |
| csi-RS-IM-ReceptionForFeedback  | CSI-RS-IM-ReceptionForFeedback                   | OPTIONAL, |



```

csi-RS-ProcFrameworkForSRS          CSI-RS-ProcFrameworkForSRS          OPTIONAL,
csi-ReportFramework                 CSI-ReportFramework                 OPTIONAL,
csi-RS-ForTracking                   CSI-RS-ForTracking                 OPTIONAL,
srs-AssocCSI-RS                     SEQUENCE (SIZE (1.. maxNrofCSI-RS-Resources)) OF SupportedCSI-RS-Resource OPTIONAL,
spatialRelations                     SpatialRelations                     OPTIONAL
]]
}

DummyG ::=
maxNumberSSB-CSI-RS-ResourceOneTx    ENUMERATED {n8, n16, n32, n64},
maxNumberSSB-CSI-RS-ResourceTwoTx    ENUMERATED {n0, n4, n8, n16, n32, n64},
supportedCSI-RS-Density               ENUMERATED {one, three, oneAndThree}
}

BeamManagementSSB-CSI-RS ::=
maxNumberSSB-CSI-RS-ResourceOneTx    ENUMERATED {n0, n8, n16, n32, n64},
maxNumberCSI-RS-Resource              ENUMERATED {n0, n4, n8, n16, n32, n64},
maxNumberCSI-RS-ResourceTwoTx        ENUMERATED {n0, n4, n8, n16, n32, n64},
supportedCSI-RS-Density               ENUMERATED {one, three, oneAndThree}
maxNumberAperiodicCSI-RS-Resource    ENUMERATED {n0, n1, n4, n8, n16, n32, n64}
}

DummyH ::=
burstLength                           INTEGER (1..2),
maxSimultaneousResourceSetsPerCC     INTEGER (1..8),
maxConfiguredResourceSetsPerCC      INTEGER (1..64),
maxConfiguredResourceSetsAllCC       INTEGER (1..128)
}

CSI-RS-ForTracking ::=
maxBurstLength                        INTEGER (1..2),
maxSimultaneousResourceSetsPerCC     INTEGER (1..8),
maxConfiguredResourceSetsPerCC      INTEGER (1..64),
maxConfiguredResourceSetsAllCC       INTEGER (1..256)
}

CSI-RS-IM-ReceptionForFeedback ::=
maxConfigNumberNZP-CSI-RS-PerCC       INTEGER (1..64),
maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC INTEGER (2..256),
maxConfigNumberCSI-IM-PerCC          ENUMERATED {n1, n2, n4, n8, n16, n32},
maxNumberSimultaneousNZP-CSI-RS-PerCC INTEGER (1..64),
totalNumberPortsSimultaneousNZP-CSI-RS-PerCC INTEGER (2..256)
}

CSI-RS-ProcFrameworkForSRS ::=
maxNumberPeriodicSRS-AssocCSI-RS-PerBWP INTEGER (1..4),
maxNumberAperiodicSRS-AssocCSI-RS-PerBWP INTEGER (1..4),
maxNumberSP-SRS-AssocCSI-RS-PerBWP   INTEGER (0..4),
simultaneousSRS-AssocCSI-RS-PerCC    INTEGER (1..8)
}

CSI-ReportFramework ::=
maxNumberPeriodicCSI-PerBWP-ForCSI-Report INTEGER (1..4),
maxNumberAperiodicCSI-PerBWP-ForCSI-Report INTEGER (1..4),

```

```

    maxNumberSemiPersistentCSI-PerBWP-ForCSI-Report INTEGER (0..4),
    maxNumberPeriodicCSI-PerBWP-ForBeamReport      INTEGER (1..4),
    maxNumberAperiodicCSI-PerBWP-ForBeamReport     INTEGER (1..4),
    maxNumberAperiodicCSI-triggeringStatePerCC     ENUMERATED {n3, n7, n15, n31, n63, n128},
    maxNumberSemiPersistentCSI-PerBWP-ForBeamReport INTEGER (0..4),
    simultaneousCSI-ReportsPerCC                   INTEGER (1..8)
}

PTRS-DensityRecommendationDL ::= SEQUENCE {
    frequencyDensity1      INTEGER (1..276),
    frequencyDensity2      INTEGER (1..276),
    timeDensity1           INTEGER (0..29),
    timeDensity2           INTEGER (0..29),
    timeDensity3           INTEGER (0..29)
}

PTRS-DensityRecommendationUL ::= SEQUENCE {
    frequencyDensity1      INTEGER (1..276),
    frequencyDensity2      INTEGER (1..276),
    timeDensity1           INTEGER (0..29),
    timeDensity2           INTEGER (0..29),
    timeDensity3           INTEGER (0..29),
    sampleDensity1         INTEGER (1..276),
    sampleDensity2         INTEGER (1..276),
    sampleDensity3         INTEGER (1..276),
    sampleDensity4         INTEGER (1..276),
    sampleDensity5         INTEGER (1..276)
}

SpatialRelations ::= SEQUENCE {
    maxNumberConfiguredSpatialRelations  ENUMERATED {n4, n8, n16, n32, n64, n96},
    maxNumberActiveSpatialRelations      ENUMERATED {n1, n2, n4, n8, n14},
    additionalActiveSpatialRelationPUCCH ENUMERATED {supported} OPTIONAL,
    maxNumberDL-RS-QCL-TypeD             ENUMERATED {n1, n2, n4, n8, n14}
}

DummyI ::= SEQUENCE {
    supportedSRS-TxPortSwitch      ENUMERATED {t1r2, t1r4, t2r4, t1r4-t2r4, tr-equal},
    txSwitchImpactToRx             ENUMERATED {true} OPTIONAL
}

-- TAG-MIMO-PARAMETERSPERBAND-STOP
-- ASN1STOP

```

#### **MIMO-ParametersPerBand field description**

##### **csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework**

CSI related capabilities which the UE supports on each of the carriers operated on this band. For mixed FR1-FR2 band combinations these values may be further limited by the corresponding fields in *Phy-ParametersFRX-Diff*.

## – *ModulationOrder*

The IE *ModulationOrder* is used to convey the maximum supported modulation order.

### ***ModulationOrder* information element**

```
-- ASN1START
-- TAG-MODULATIONORDER-START

ModulationOrder ::= ENUMERATED {bpsk-halfpi, bpsk, qpsk, qam16, qam64, qam256}

-- TAG-MODULATIONORDER-STOP
-- ASN1STOP
```

## – *MRDC-Parameters*

The IE *MRDC-Parameters* contains the band combination parameters specific to MR-DC for a given MR-DC band combination.

### ***MRDC-Parameters* information element**

```
-- ASN1START
-- TAG-MRDC-PARAMETERS-START

MRDC-Parameters ::= SEQUENCE {
    singleUL-Transmission          ENUMERATED {supported}          OPTIONAL,
    dynamicPowerSharing           ENUMERATED {supported}          OPTIONAL,
    tdm-Pattern                   ENUMERATED {supported}          OPTIONAL,
    ul-SharingEUTRA-NR            ENUMERATED {tdm, fdm, both}      OPTIONAL,
    ul-SwitchingTimeEUTRA-NR      ENUMERATED {type1, type2}      OPTIONAL,
    simultaneousRxTxInterBandENDC ENUMERATED {supported}        OPTIONAL,
    asyncIntraBandENDC           ENUMERATED {supported}        OPTIONAL,
    . . . ,
    [
        dualPA-Architecture        ENUMERATED {supported}          OPTIONAL,
        intraBandENDC-Support-v1540 ENUMERATED {non-contiguous, both} OPTIONAL,
        ul-TimingAlignmentEUTRA-NR ENUMERATED {required}          OPTIONAL
    ]
}

-- TAG-MRDC-PARAMETERS-STOP
-- ASN1STOP
```

## – *NRDC-Parameters*

The IE *NRDC-Parameters* contains parameters specific to NR-DC, i.e., which are not applicable to NR SA.

**NRDC-Parameters information element**

```

-- ASN1START
-- TAG-NRDC-PARAMETERS-START

NRDC-Parameters ::=
    SEQUENCE {
        measAndMobParametersNRDC          MeasAndMobParametersMRDC          OPTIONAL,
        generalParametersNRDC             GeneralParametersMRDC-XDD-Diff    OPTIONAL,
        fdd-Add-UE-NRDC-Capabilities       UE-MRDC-CapabilityAddXDD-Mode    OPTIONAL,
        tdd-Add-UE-NRDC-Capabilities       UE-MRDC-CapabilityAddXDD-Mode    OPTIONAL,
        fr1-Add-UE-NRDC-Capabilities       UE-MRDC-CapabilityAddFRX-Mode    OPTIONAL,
        fr2-Add-UE-NRDC-Capabilities       UE-MRDC-CapabilityAddFRX-Mode    OPTIONAL,
        lateNonCriticalExtension           OCTET STRING                      OPTIONAL,
        nonCriticalExtension                SEQUENCE {}                       OPTIONAL
    }

-- TAG-NRDC-PARAMETERS-STOP
-- ASN1STOP

```

– **PDCP-Parameters**

The IE *PDCP-Parameters* is used to convey capabilities related to PDCP.

**PDCP-Parameters information element**

```

-- ASN1START
-- TAG-PDCP-PARAMETERS-START

PDCP-Parameters ::=
    SEQUENCE {
        supportedROHC-Profiles            SEQUENCE {
            profile0x0000                BOOLEAN,
            profile0x0001                BOOLEAN,
            profile0x0002                BOOLEAN,
            profile0x0003                BOOLEAN,
            profile0x0004                BOOLEAN,
            profile0x0006                BOOLEAN,
            profile0x0101                BOOLEAN,
            profile0x0102                BOOLEAN,
            profile0x0103                BOOLEAN,
            profile0x0104                BOOLEAN
        },
        maxNumberROHC-ContextSessions     ENUMERATED {cs2, cs4, cs8, cs12, cs16, cs24, cs32, cs48, cs64,
            cs128, cs256, cs512, cs1024, cs16384, spare2, spare1},
        uplinkOnlyROHC-Profiles           ENUMERATED {supported}            OPTIONAL,
        continueROHC-Context              ENUMERATED {supported}            OPTIONAL,
        outOfOrderDelivery                ENUMERATED {supported}            OPTIONAL,
        shortSN                           ENUMERATED {supported}            OPTIONAL,
        pdcp-DuplicationSRB                ENUMERATED {supported}            OPTIONAL,
        pdcp-DuplicationMCG-OrSCG-DRB     ENUMERATED {supported}            OPTIONAL,
        ...
    }

```

```
-- TAG-PDCP-PARAMETERS-STOP
-- ASN1STOP
```

## – *PDCP-ParametersMRDC*

The IE *PDCP-ParametersMRDC* is used to convey PDCP related capabilities for MR-DC.

### *PDCP-ParametersMRDC* information element

```
-- ASN1START
-- TAG-PDCP-PARAMETERSMRDC-START

PDCP-ParametersMRDC ::=
    SEQUENCE {
        pdcp-DuplicationSplitSRB      ENUMERATED {supported}      OPTIONAL,
        pdcp-DuplicationSplitDRB      ENUMERATED {supported}      OPTIONAL
    }

-- TAG-PDCP-PARAMETERSMRDC-STOP
-- ASN1STOP
```

## – *Phy-Parameters*

The IE *Phy-Parameters* is used to convey the physical layer capabilities.

### *Phy-Parameters* information element

```
-- ASN1START
-- TAG-PHY-PARAMETERS-START

Phy-Parameters ::=
    SEQUENCE {
        phy-ParametersCommon          Phy-ParametersCommon          OPTIONAL,
        phy-ParametersXDD-Diff        Phy-ParametersXDD-Diff        OPTIONAL,
        phy-ParametersFRX-Diff        Phy-ParametersFRX-Diff        OPTIONAL,
        phy-ParametersFR1              Phy-ParametersFR1              OPTIONAL,
        phy-ParametersFR2              Phy-ParametersFR2              OPTIONAL
    }

Phy-ParametersCommon ::=
    SEQUENCE {
        csi-RS-CFRA-ForHO              ENUMERATED {supported}      OPTIONAL,
        dynamicPRB-BundlingDL          ENUMERATED {supported}      OPTIONAL,
        sp-CSI-ReportPUCCH             ENUMERATED {supported}      OPTIONAL,
        sp-CSI-ReportPUSCH             ENUMERATED {supported}      OPTIONAL,
        nzp-CSI-RS-IntefMgmt           ENUMERATED {supported}      OPTIONAL,
        type2-SP-CSI-Feedback-LongPUCCH ENUMERATED {supported}      OPTIONAL,
        precoderGranularityCORESET     ENUMERATED {supported}      OPTIONAL,
        dynamicCHARQ-ACK-Codebook      ENUMERATED {supported}      OPTIONAL,
        semiStaticCHARQ-ACK-Codebook   ENUMERATED {supported}      OPTIONAL
    }
```

```

    spatialBundlingHARQ-ACK          ENUMERATED {supported}          OPTIONAL,
    dynamicBetaOffsetInd-HARQ-ACK-CSI  ENUMERATED {supported}          OPTIONAL,
    pucch-Repetition-F1-3-4           ENUMERATED {supported}          OPTIONAL,
    ra-Type0-PUSCH                    ENUMERATED {supported}          OPTIONAL,
    dynamicSwitchRA-Type0-1-PDSCH     ENUMERATED {supported}          OPTIONAL,
    dynamicSwitchRA-Type0-1-PUSCH     ENUMERATED {supported}          OPTIONAL,
    pdsch-MappingTypeA                ENUMERATED {supported}          OPTIONAL,
    pdsch-MappingTypeB                ENUMERATED {supported}          OPTIONAL,
    interleavingVRB-ToPRB-PDSCH       ENUMERATED {supported}          OPTIONAL,
    interSlotFreqHopping-PUSCH        ENUMERATED {supported}          OPTIONAL,
    type1-PUSCH-RepetitionMultiSlots  ENUMERATED {supported}          OPTIONAL,
    type2-PUSCH-RepetitionMultiSlots  ENUMERATED {supported}          OPTIONAL,
    pusch-RepetitionMultiSlots        ENUMERATED {supported}          OPTIONAL,
    pdsch-RepetitionMultiSlots        ENUMERATED {supported}          OPTIONAL,
    downlinkSPS                       ENUMERATED {supported}          OPTIONAL,
    configuredUL-GrantType1           ENUMERATED {supported}          OPTIONAL,
    configuredUL-GrantType2           ENUMERATED {supported}          OPTIONAL,
    pre-EmptIndication-DL             ENUMERATED {supported}          OPTIONAL,
    cbg-TransIndication-DL            ENUMERATED {supported}          OPTIONAL,
    cbg-TransIndication-UL            ENUMERATED {supported}          OPTIONAL,
    cbg-FlushIndication-DL            ENUMERATED {supported}          OPTIONAL,
    dynamicHARQ-ACK-CodeB-CBG-Retx-DL  ENUMERATED {supported}          OPTIONAL,
    rateMatchingResrcSetSemi-Static   ENUMERATED {supported}          OPTIONAL,
    rateMatchingResrcSetDynamic       ENUMERATED {supported}          OPTIONAL,
    bwp-SwitchingDelay                 ENUMERATED {type1, type2}       OPTIONAL,
    . . .
  [[
    dummy                             ENUMERATED {supported}          OPTIONAL
  ]],
  [[
    maxNumberSearchSpaces             ENUMERATED {n10}                OPTIONAL,
    rateMatchingCtrlResrcSetDynamic    ENUMERATED {supported}          OPTIONAL,
    maxLayersMIMO-Indication           ENUMERATED {supported}          OPTIONAL
  ]]
}

Phy-ParametersXDD-Diff ::=          SEQUENCE {
    dynamicSFI                        ENUMERATED {supported}          OPTIONAL,
    twoPUCCH-F0-2-ConsecSymbols        ENUMERATED {supported}          OPTIONAL,
    twoDifferentTPC-Loop-PUSCH         ENUMERATED {supported}          OPTIONAL,
    twoDifferentTPC-Loop-PUCCH         ENUMERATED {supported}          OPTIONAL,
    . . .
  [[
    dl-SchedulingOffset-PDSCH-TypeA    ENUMERATED {supported}          OPTIONAL,
    dl-SchedulingOffset-PDSCH-TypeB    ENUMERATED {supported}          OPTIONAL,
    ul-SchedulingOffset                 ENUMERATED {supported}          OPTIONAL
  ]]
}

Phy-ParametersFRX-Diff ::=          SEQUENCE {
    dynamicSFI                        ENUMERATED {supported}          OPTIONAL,
    dummy1                             BIT STRING (SIZE (2))          OPTIONAL,
    twoFL-DMRS                         BIT STRING (SIZE (2))          OPTIONAL,
    dummy2                             BIT STRING (SIZE (2))          OPTIONAL,

```

|  |                                |           |
|--|--------------------------------|-----------|
| dummy3                                 | BIT STRING (SIZE (2))          | OPTIONAL, |
| supportedDMRS-TypeDL                   | ENUMERATED {type1, type1And2}  | OPTIONAL, |
| supportedDMRS-TypeUL                   | ENUMERATED {type1, type1And2}  | OPTIONAL, |
| semiOpenLoopCSI                        | ENUMERATED {supported}         | OPTIONAL, |
| csi-ReportWithoutPMI                   | ENUMERATED {supported}         | OPTIONAL, |
| csi-ReportWithoutCQI                   | ENUMERATED {supported}         | OPTIONAL, |
| onePortsPTRS                           | BIT STRING (SIZE (2))          | OPTIONAL, |
| twoPUCCH-F0-2-ConsecSymbols            | ENUMERATED {supported}         | OPTIONAL, |
| pucch-F2-WithFH                        | ENUMERATED {supported}         | OPTIONAL, |
| pucch-F3-WithFH                        | ENUMERATED {supported}         | OPTIONAL, |
| pucch-F4-WithFH                        | ENUMERATED {supported}         | OPTIONAL, |
| freqHoppingPUCCH-F0-2                  | ENUMERATED {notSupported}      | OPTIONAL, |
| freqHoppingPUCCH-F1-3-4                | ENUMERATED {notSupported}      | OPTIONAL, |
| mux-SR-HARQ-ACK-CSI-PUCCH-MultiPerSlot | ENUMERATED {supported}         | OPTIONAL, |
| uci-CodeBlockSegmentation              | ENUMERATED {supported}         | OPTIONAL, |
| onePUCCH-LongAndShortFormat            | ENUMERATED {supported}         | OPTIONAL, |
| twoPUCCH-AnyOthersInSlot               | ENUMERATED {supported}         | OPTIONAL, |
| intraSlotFreqHopping-PUSCH             | ENUMERATED {supported}         | OPTIONAL, |
| pusch-LBRM                             | ENUMERATED {supported}         | OPTIONAL, |
| pdccch-BlindDetectionCA                | INTEGER (4..16)                | OPTIONAL, |
| tpc-PUSCH-RNTI                         | ENUMERATED {supported}         | OPTIONAL, |
| tpc-PUCCH-RNTI                         | ENUMERATED {supported}         | OPTIONAL, |
| tpc-SRS-RNTI                           | ENUMERATED {supported}         | OPTIONAL, |
| absoluteTPC-Command                    | ENUMERATED {supported}         | OPTIONAL, |
| twoDifferentTPC-Loop-PUSCH             | ENUMERATED {supported}         | OPTIONAL, |
| twoDifferentTPC-Loop-PUCCH             | ENUMERATED {supported}         | OPTIONAL, |
| pusch-HalfPi-BPSK                      | ENUMERATED {supported}         | OPTIONAL, |
| pucch-F3-4-HalfPi-BPSK                 | ENUMERATED {supported}         | OPTIONAL, |
| almostContiguousCP-OFDM-UL             | ENUMERATED {supported}         | OPTIONAL, |
| sp-CSI-RS                              | ENUMERATED {supported}         | OPTIONAL, |
| sp-CSI-IM                              | ENUMERATED {supported}         | OPTIONAL, |
| tdd-MultiDL-UL-SwitchPerSlot           | ENUMERATED {supported}         | OPTIONAL, |
| multipleCORESET                        | ENUMERATED {supported}         | OPTIONAL, |
| ...                                    |                                |           |
| [[                                     |                                |           |
| csi-RS-IM-ReceptionForFeedback         | CSI-RS-IM-ReceptionForFeedback | OPTIONAL, |
| csi-RS-ProcFrameworkForSRS             | CSI-RS-ProcFrameworkForSRS     | OPTIONAL, |
| csi-ReportFramework                    | CSI-ReportFramework            | OPTIONAL, |
| mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot  | SEQUENCE {                     |           |
| sameSymbol                             | ENUMERATED {supported}         | OPTIONAL, |
| diffSymbol                             | ENUMERATED {supported}         | OPTIONAL, |
| } OPTIONAL,                            |                                |           |
| mux-SR-HARQ-ACK-PUCCH                  | ENUMERATED {supported}         | OPTIONAL, |
| mux-MultipleGroupCtrlCH-Overlap        | ENUMERATED {supported}         | OPTIONAL, |
| dl-SchedulingOffset-PDSCH-TypeA        | ENUMERATED {supported}         | OPTIONAL, |
| dl-SchedulingOffset-PDSCH-TypeB        | ENUMERATED {supported}         | OPTIONAL, |
| ul-SchedulingOffset                    | ENUMERATED {supported}         | OPTIONAL, |
| dl-64QAM-MCS-TableAlt                  | ENUMERATED {supported}         | OPTIONAL, |
| ul-64QAM-MCS-TableAlt                  | ENUMERATED {supported}         | OPTIONAL, |
| cqi-TableAlt                           | ENUMERATED {supported}         | OPTIONAL, |
| oneFL-DMRS-TwoAdditionalDMRS-UL        | ENUMERATED {supported}         | OPTIONAL, |
| twoFL-DMRS-TwoAdditionalDMRS-UL        | ENUMERATED {supported}         | OPTIONAL, |
| oneFL-DMRS-ThreeAdditionalDMRS-UL      | ENUMERATED {supported}         | OPTIONAL, |
| ]],                                    |                                |           |

```

[[
  pdcch-BlindDetectionNRDC          SEQUENCE {
    pdcch-BlindDetectionMCG-UE      INTEGER (1..15),
    pdcch-BlindDetectionSCG-UE      INTEGER (1..15)
  }
  mux-HARQ-ACK-PUSCH-DiffSymbol     ENUMERATED {supported}
]]
}

Phy-ParametersFR1 ::=
  pdcch-MonitoringSingleOccasion    ENUMERATED {supported}          OPTIONAL,
  scs-60kHz                          ENUMERATED {supported}          OPTIONAL,
  pdsch-256QAM-FR1                   ENUMERATED {supported}          OPTIONAL,
  pdsch-RE-MappingFR1-PerSymbol      ENUMERATED {n10, n20}          OPTIONAL,
  . . . ,
  [[
  pdsch-RE-MappingFR1-PerSlot        ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,
    n144, n160, n176, n192, n208, n224, n240, n256}          OPTIONAL
  ]]
}

Phy-ParametersFR2 ::=
  dummy                               ENUMERATED {supported}          OPTIONAL,
  pdsch-RE-MappingFR2-PerSymbol      ENUMERATED {n6, n20}          OPTIONAL,
  . . . ,
  [[
  pCell-FR2                          ENUMERATED {supported}          OPTIONAL,
  pdsch-RE-MappingFR2-PerSlot        ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,
    n144, n160, n176, n192, n208, n224, n240, n256}          OPTIONAL
  ]]
}

-- TAG-PHY-PARAMETERS-STOP
-- ASN1STOP

```

#### ***Phy-ParametersFRX-Diff field description***

##### ***csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework***

These fields are optionally present in *fr1-fr2-Add-UE-NR-Capabilities* in *UE-NR-Capability*. For a band combination comprised of FR1 and FR2 bands, these parameters, if present, limit the corresponding parameters in *MIMO-ParametersPerBand*.

#### – ***Phy-ParametersMRDC***

The IE *Phy-ParametersMRDC* is used to convey physical layer capabilities for MR-DC.

#### ***Phy-ParametersMRDC information element***

```

-- ASN1START
-- TAG-PHY-PARAMETERSMRDC-START

```



```

Phy-ParametersMRDC ::=
  naics-Capability-List      SEQUENCE {
    ...                      SEQUENCE (SIZE (1..maxNrofNAICS-Entries)) OF NAICS-Capability-Entry
  }                          OPTIONAL,

NAICS-Capability-Entry ::= SEQUENCE {
  numberOfNAICS-CapableCC    INTEGER(1..5),
  numberOfAggregatedPRB     ENUMERATED {n50, n75, n100, n125, n150, n175, n200, n225,
    ...                       n250, n275, n300, n350, n400, n450, n500, spare},
  ...
}

-- TAG-PHY-PARAMETERSMRDC-STOP
-- ASN1STOP

```

| <i>PHY-ParametersMRDC</i> field descriptions  |
|---|
| <b><i>naics-Capability-List</i></b><br>Indicates that UE in MR-DC supports NAICS as defined in defined in TS 36.331 [10]. |

## – *ProcessingParameters*

The IE *ProcessingParameters* is used to indicate PDSCH/PUSCH processing capabilities supported by the UE.

### ***ProcessingParameters* information element**

```

-- ASN1START
-- TAG-PROCESSINGPARAMETERS-START

ProcessingParameters ::= SEQUENCE {
  fallback                ENUMERATED {sc, cap1-only},
  differentTB-PerSlot    SEQUENCE {
    upto1                 NumberOfCarriers      OPTIONAL,
    upto2                 NumberOfCarriers      OPTIONAL,
    upto4                 NumberOfCarriers      OPTIONAL,
    upto7                 NumberOfCarriers      OPTIONAL
  } OPTIONAL
}

NumberOfCarriers ::= INTEGER (1..16)

-- TAG-PROCESSINGPARAMETERS-STOP
-- ASN1STOP

```

## – *RAT-Type*

The IE *RAT-Type* is used to indicate the radio access technology (RAT), including NR, of the requested/transferred UE capabilities.

**RAT-Type information element**

```

-- ASN1START
-- TAG-RAT-TYPE-START

RAT-Type ::= ENUMERATED {nr, eutra-nr, eutra, spare1, ...}

-- TAG-RAT-TYPE-STOP
-- ASN1STOP

```

**RF-Parameters**

The IE *RF-Parameters* is used to convey RF-related capabilities for NR operation.

**RF-Parameters information element**

```

-- ASN1START
-- TAG-RF-PARAMETERS-START

RF-Parameters ::=
    SEQUENCE {
        supportedBandListNR
            SEQUENCE (SIZE (1..maxBands)) OF BandNR,
        supportedBandCombinationList
            BandCombinationList
            OPTIONAL,
        appliedFreqBandListFilter
            FreqBandList
            OPTIONAL,
        . . . ,
        [[
            supportedBandCombinationList-v1540
                BandCombinationList-v1540
                OPTIONAL,
            srs-SwitchingTimeRequested
                ENUMERATED {true}
                OPTIONAL
        ]],
        [[
            supportedBandCombinationList-v1550
                BandCombinationList-v1550
                OPTIONAL
        ]],
        [[
            supportedBandCombinationList-v1560
                BandCombinationList-v1560
                OPTIONAL
        ]]]
    }

BandNR ::=
    SEQUENCE {
        bandNR
            FreqBandIndicatorNR,
        modifiedMPR-Behaviour
            BIT STRING (SIZE (8))
            OPTIONAL,
        mimo-ParametersPerBand
            MIMO-ParametersPerBand
            OPTIONAL,
        extendedCP
            ENUMERATED {supported}
            OPTIONAL,
        multipleTCI
            ENUMERATED {supported}
            OPTIONAL,
        bwp-WithoutRestriction
            ENUMERATED {supported}
            OPTIONAL,
        bwp-SameNumerology
            ENUMERATED {upto2, upto4}
            OPTIONAL,
        bwp-DiffNumerology
            ENUMERATED {upto4}
            OPTIONAL,
        crossCarrierScheduling-SameSCS
            ENUMERATED {supported}
            OPTIONAL,
        pdsch-256QAM-FR2
            ENUMERATED {supported}
            OPTIONAL,
        pusch-256QAM
            ENUMERATED {supported}
            OPTIONAL,
        ue-PowerClass
            ENUMERATED {pc1, pc2, pc3, pc4}
            OPTIONAL,
        rateMatchingLTE-CRS
            ENUMERATED {supported}
            OPTIONAL,
        channelBWs-DL-v1530
            CHOICE {

```

```

fr1          SEQUENCE {
  scs-15kHz  BIT STRING (SIZE (10))      OPTIONAL,
  scs-30kHz  BIT STRING (SIZE (10))      OPTIONAL,
  scs-60kHz  BIT STRING (SIZE (10))      OPTIONAL
},
fr2          SEQUENCE {
  scs-60kHz  BIT STRING (SIZE (3))       OPTIONAL,
  scs-120kHz BIT STRING (SIZE (3))       OPTIONAL
}
}
channelBWs-UL-v1530 CHOICE {
  fr1          SEQUENCE {
    scs-15kHz  BIT STRING (SIZE (10))      OPTIONAL,
    scs-30kHz  BIT STRING (SIZE (10))      OPTIONAL,
    scs-60kHz  BIT STRING (SIZE (10))      OPTIONAL
  },
  fr2          SEQUENCE {
    scs-60kHz  BIT STRING (SIZE (3))       OPTIONAL,
    scs-120kHz BIT STRING (SIZE (3))       OPTIONAL
  }
}
...
[[
maxUplinkDutyCycle-PC2-FR1          ENUMERATED {n60, n70, n80, n90, n100}      OPTIONAL
]],
[[
pucch-SpatialRelInfoMAC-CE          ENUMERATED {supported}                  OPTIONAL,
powerBoosting-pi2BPSK                ENUMERATED {supported}                  OPTIONAL
]],
[[
maxUplinkDutyCycle-FR2              ENUMERATED {n15, n20, n25, n30, n40, n50, n60, n70, n80, n90, n100}      OPTIONAL
]]
}
-- TAG-RF-PARAMETERS-STOP
-- ASN1STOP

```

### **RF-Parameters field descriptions**

#### ***appliedFreqBandListFilter***

In this field the UE mirrors the *FreqBandList* that the NW provided in the capability enquiry, if any. The UE filtered the band combinations in the *supportedBandCombinationList* in accordance with this *appliedFreqBandListFilter*. The UE does not include this field if the UE capability is requested by E-UTRAN and the network request includes the field *eutra-nr-only* [10].

#### ***supportedBandCombinationList***

A list of band combinations that the UE supports for NR (without MR-DC). The *FeatureSetCombinationId*s in this list refer to the *FeatureSetCombination* entries in the *featureSetCombinations* list in the *UE-NR-Capability* IE. The UE does not include this field if the UE capability is requested by E-UTRAN and the network request includes the field *eutra-nr-only* [10].

– *RF-ParametersMRDC*

The IE *RF-ParametersMRDC* is used to convey RF related capabilities for MR-DC.

***RF-ParametersMRDC* information element**

```
-- ASN1START
-- TAG-RF-PARAMETERSMRDC-START

RF-ParametersMRDC ::=
    SEQUENCE {
        supportedBandCombinationList      BandCombinationList      OPTIONAL,
        appliedFreqBandListFilter          FreqBandList              OPTIONAL,
        . . .
        [[
            srs-SwitchingTimeRequested     ENUMERATED {true}         OPTIONAL,
            supportedBandCombinationList-v1540 BandCombinationList-v1540 OPTIONAL
        ]],
        [[
            supportedBandCombinationList-v1550 BandCombinationList-v1550 OPTIONAL
        ]],
        [[
            supportedBandCombinationList-v1560 BandCombinationList-v1560 OPTIONAL,
            supportedBandCombinationListNEDC-Only BandCombinationList      OPTIONAL
        ]]
    }

-- TAG-RF-PARAMETERSMRDC-STOP
-- ASN1STOP
```

***RF-ParametersMRDC* field descriptions**

***appliedFreqBandListFilter***

In this field the UE mirrors the *FreqBandList* that the NW provided in the capability enquiry, if any. The UE filtered the band combinations in the *supportedBandCombinationList* in accordance with this *appliedFreqBandListFilter*.

***supportedBandCombinationList***

A list of band combinations that the UE supports for MR-DC. The *FeatureSetCombinationId*s in this list refer to the *FeatureSetCombination* entries in the *featureSetCombinations* list in the *UE-MRDC-Capability* IE.

***supportedBandCombinationListNEDC-Only***

A list of band combinations that the UE supports only for NE-DC. The *FeatureSetCombinationId*s in this list refer to the *FeatureSetCombination* entries in the *featureSetCombinations* list in the *UE-MRDC-Capability* IE.

– *RLC-Parameters*

The IE *RLC-Parameters* is used to convey capabilities related to RLC.

***RLC-Parameters* information element**

```
-- ASN1START
```

```

-- TAG-RLC-PARAMETERS-START
RLC-Parameters ::= SEQUENCE {
    am-WithShortSN          ENUMERATED {supported} OPTIONAL,
    um-WithShortSN          ENUMERATED {supported} OPTIONAL,
    um-WithLongSN           ENUMERATED {supported} OPTIONAL,
    ...
}
-- TAG-RLC-PARAMETERS-STOP
-- ASN1STOP

```

## – SDAP-Parameters

The IE *SDAP-Parameters* is used to convey capabilities related to SDAP.

### **SDAP-Parameters information element**

```

-- ASN1START
-- TAG-SDAP-PARAMETERS-START
SDAP-Parameters ::= SEQUENCE {
    as-ReflectiveQoS        ENUMERATED {true}          OPTIONAL,
    ...
}
-- TAG-SDAP-PARAMETERS-STOP
-- ASN1STOP

```

## – SRS-SwitchingTimeNR

The IE *SRS-SwitchingTimeNR* is used to indicate the SRS carrier switching time supported by the UE for one NR band pair.

### **SRS-SwitchingTimeNR information element**

```

-- ASN1START
-- TAG-SRS-SWITCHINGTIMENR-START
SRS-SwitchingTimeNR ::= SEQUENCE {
    switchingTimeDL          ENUMERATED {n0us, n30us, n100us, n140us, n200us, n300us, n500us, n900us} OPTIONAL,
    switchingTimeUL          ENUMERATED {n0us, n30us, n100us, n140us, n200us, n300us, n500us, n900us} OPTIONAL,
}
-- TAG-SRS-SWITCHINGTIMENR-STOP
-- ASN1STOP

```

– ***SRS-SwitchingTimeEUTRA***

The IE *SRS-SwitchingTimeEUTRA* is used to indicate the SRS carrier switching time supported by the UE for one E-UTRA band pair.

***SRS-SwitchingTimeEUTRA* information element**

```
-- ASN1START
-- TAG-SRS-SWITCHINGTIMEEUTRA-START

SRS-SwitchingTimeEUTRA ::= SEQUENCE {
    switchingTimeDL      ENUMERATED {n0, n0dot5, n1, n1dot5, n2, n2dot5, n3, n3dot5, n4, n4dot5, n5, n5dot5, n6, n6dot5, n7}
                        OPTIONAL,
    switchingTimeUL      ENUMERATED {n0, n0dot5, n1, n1dot5, n2, n2dot5, n3, n3dot5, n4, n4dot5, n5, n5dot5, n6, n6dot5, n7}
                        OPTIONAL
}
-- TAG-SRS-SWITCHINGTIMEEUTRA-STOP
-- ASN1STOP
```

– ***SupportedBandwidth***

The IE *SupportedBandwidth* is used to indicate the maximum channel bandwidth supported by the UE on one carrier of a band of a band combination.

***SupportedBandwidth* information element**

```
-- ASN1START
-- TAG-SUPPORTEDBANDWIDTH-START

SupportedBandwidth ::= CHOICE {
    fr1      ENUMERATED {mhz5, mhz10, mhz15, mhz20, mhz25, mhz30, mhz40, mhz50, mhz60, mhz80, mhz100},
    fr2      ENUMERATED {mhz50, mhz100, mhz200, mhz400}
}
-- TAG-SUPPORTEDBANDWIDTH-STOP
-- ASN1STOP
```

– ***UE-CapabilityRAT-ContainerList***

The IE *UE-CapabilityRAT-ContainerList* contains a list of radio access technology specific capability containers.

***UE-CapabilityRAT-ContainerList* information element**

```
-- ASN1START
-- TAG-UE-CAPABILITYRAT-CONTAINERLIST-START

UE-CapabilityRAT-ContainerList ::= SEQUENCE (SIZE (0..maxRAT-CapabilityContainers)) OF UE-CapabilityRAT-Container
```

```

UE-CapabilityRAT-Container ::=      SEQUENCE {
    rat-Type
    ue-CapabilityRAT-Container      OCTET STRING
}

-- TAG-UE-CAPABILITYRAT-CONTAINERLIST-STOP
-- ASN1STOP

```

#### **UE-CapabilityRAT-ContainerList field descriptions**

##### **ue-CapabilityRAT-Container**

Container for the UE capabilities of the indicated RAT. The encoding is defined in the specification of each RAT:

For *rat-Type* set to *nr*: the encoding of UE capabilities is defined in *UE-NR-Capability*.

For *rat-Type* set to *eutra-nr*: the encoding of UE capabilities is defined in *UE-MRDC-Capability*.

For *rat-Type* set to *eutra*: the encoding of UE capabilities is defined in *UE-EUTRA-Capability* specified in TS 36.331 [10].

## – UE-CapabilityRAT-RequestList

The IE *UE-CapabilityRAT-RequestList* is used to request UE capabilities for one or more RATs from the UE.

#### **UE-CapabilityRAT-RequestList information element**

```

-- ASN1START
-- TAG-UE-CAPABILITYRAT-REQUESTLIST-START

UE-CapabilityRAT-RequestList ::=      SEQUENCE (SIZE (1..maxRAT-CapabilityContainers)) OF UE-CapabilityRAT-Request

UE-CapabilityRAT-Request ::=          SEQUENCE {
    rat-Type
    capabilityRequestFilter            OCTET STRING
    ...
}

-- TAG-UE-CAPABILITYRAT-REQUESTLIST-STOP
-- ASN1STOP

```

#### **UE-CapabilityRAT-Request field descriptions**

##### **capabilityRequestFilter**

Information by which the network requests the UE to filter the UE capabilities.

For *rat-Type* set to *nr* or *eutra-nr*: the encoding of the *capabilityRequestFilter* is defined in *UE-CapabilityRequestFilterNR*.

For *rat-Type* set to *eutra*: the encoding of the *capabilityRequestFilter* is defined by *UECapabilityEnquiry* message defined in TS36.331 [10], in which *RAT-Type* in *UE-CapabilityRequest* includes only '*eutra*'.

##### **rat-Type**

The RAT type for which the NW requests UE capabilities.

## – *UE-CapabilityRequestFilterCommon*

The IE *UE-CapabilityRequestFilterCommon* is used to request filtered UE capabilities. The filter is common for all capability containers that are requested.

### *UE-CapabilityRequestFilterCommon* information element

```
-- ASN1START
-- TAG-UE-CAPABILITYREQUESTFILTERCOMMON-START

UE-CapabilityRequestFilterCommon ::=
    mrdc-Request          SEQUENCE {
        omitEN-DC        ENUMERATED {true}          OPTIONAL,  -- Need N
        includeNR-DC     ENUMERATED {true}          OPTIONAL,  -- Need N
        includeNE-DC     ENUMERATED {true}          OPTIONAL,  -- Need N
    }
    ...
}

-- TAG-UE-CAPABILITYREQUESTFILTERCOMMON-STOP
-- ASN1STOP
```

### *UE-CapabilityRequestFilterCommon* field descriptions

#### ***includeNE-DC***

If this field is present, the UE shall include band combinations, feature set combinations, feature sets and feature sets per CC which are applicable to NE-DC. Band combinations supporting both NE-DC and (NG)EN-DC shall be included in *supportedBandCombinationList*, band combinations supporting only NE-DC shall be included in *supportedBandCombinationListNE-DC-Only*.

#### ***includeNR-DC***

Only if this field is present, the UE supporting NR-DC shall indicate support for NR-DC in band combinations and feature set combinations which are applicable to NR-DC.

#### ***omitEN-DC***

Only if this field is present, the UE supporting NE-DC shall indicate support for NE-DC in band combinations and feature set combinations which are applicable to EN-DC. Band combinations supporting both NE-DC and (NG)EN-DC shall be included in *supportedBandCombinationList*, band combinations supporting only NE-DC shall be included in *supportedBandCombinationListNE-DC-Only*.

## – *UE-CapabilityRequestFilterNR*

The IE *UE-CapabilityRequestFilterNR* is used to request filtered UE capabilities.

### *UE-CapabilityRequestFilterNR* information element

```
-- ASN1START
-- TAG-UE-CAPABILITYREQUESTFILTERNR-START

UE-CapabilityRequestFilterNR ::=
    frequencyBandListFilter  FreqBandList          OPTIONAL,  -- Need N
    nonCriticalExtension      UE-CapabilityRequestFilterNR-v1540  OPTIONAL
}

-- TAG-UE-CAPABILITYREQUESTFILTERNR-STOP
-- ASN1STOP
```



```

UE-CapabilityRequestFilterNR-v1540 ::= SEQUENCE {
    srs-SwitchingTimeRequest      ENUMERATED {true}          OPTIONAL, -- Need N
    nonCriticalExtension          SEQUENCE {}                     OPTIONAL
}

-- TAG-UE-CAPABILITYREQUESTFILTERNR-STOP
-- ASN1STOP

```

## – *UE-MRDC-Capability*

The IE *UE-MRDC-Capability* is used to convey the UE Radio Access Capability Parameters for MR-DC, see TS 38.306 [26].

### *UE-MRDC-Capability* information element

```

-- ASN1START
-- TAG-UE-MRDC-CAPABILITY-START

UE-MRDC-Capability ::= SEQUENCE {
    measAndMobParametersMRDC      MeasAndMobParametersMRDC          OPTIONAL,
    phy-ParametersMRDC-v1530      Phy-ParametersMRDC                OPTIONAL,
    rf-ParametersMRDC              RF-ParametersMRDC,
    generalParametersMRDC          GeneralParametersMRDC-XDD-Diff    OPTIONAL,
    fdd-Add-UE-MRDC-Capabilities   UE-MRDC-CapabilityAddXDD-Mode  OPTIONAL,
    tdd-Add-UE-MRDC-Capabilities   UE-MRDC-CapabilityAddXDD-Mode  OPTIONAL,
    fr1-Add-UE-MRDC-Capabilities   UE-MRDC-CapabilityAddFRX-Mode  OPTIONAL,
    fr2-Add-UE-MRDC-Capabilities   UE-MRDC-CapabilityAddFRX-Mode  OPTIONAL,
    featureSetCombinations         SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination OPTIONAL,
    pdcp-ParametersMRDC-v1530      PDCP-ParametersMRDC          OPTIONAL,
    lateNonCriticalExtension        OCTET STRING                  OPTIONAL,
    nonCriticalExtension            UE-MRDC-Capability-v1560      OPTIONAL
}

UE-MRDC-Capability-v1560 ::= SEQUENCE {
    receivedFilters                OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs)    OPTIONAL,
    measAndMobParametersMRDC-v1560 MeasAndMobParametersMRDC-v1560          OPTIONAL,
    fdd-Add-UE-MRDC-Capabilities-v1560 UE-MRDC-CapabilityAddXDD-Mode-v1560    OPTIONAL,
    tdd-Add-UE-MRDC-Capabilities-v1560 UE-MRDC-CapabilityAddXDD-Mode-v1560    OPTIONAL,
    nonCriticalExtension            SEQUENCE {}                               OPTIONAL
}

UE-MRDC-CapabilityAddXDD-Mode ::= SEQUENCE {
    measAndMobParametersMRDC-XDD-Diff MeasAndMobParametersMRDC-XDD-Diff    OPTIONAL,
    generalParametersMRDC-XDD-Diff     GeneralParametersMRDC-XDD-Diff        OPTIONAL
}

UE-MRDC-CapabilityAddXDD-Mode-v1560 ::= SEQUENCE {
    measAndMobParametersMRDC-XDD-Diff-v1560 MeasAndMobParametersMRDC-XDD-Diff-v1560    OPTIONAL
}

UE-MRDC-CapabilityAddFRX-Mode ::= SEQUENCE {
    measAndMobParametersMRDC-FRX-Diff MeasAndMobParametersMRDC-FRX-Diff
}

```

```

}

GeneralParametersMRDC-XDD-Diff ::= SEQUENCE {
    splitSRB-WithOneUL-Path      ENUMERATED {supported}          OPTIONAL,
    splitDRB-withUL-Both-MCG-SCG  ENUMERATED {supported}          OPTIONAL,
    srb3                          ENUMERATED {supported}          OPTIONAL,
    v2x-EUTRA                     ENUMERATED {supported}          OPTIONAL,
    ...
}

-- TAG-UE-MRDC-CAPABILITY-STOP
-- ASN1STOP

```

### **UE-MRDC-Capability field descriptions**

#### **featureSetCombinations**

A list of *FeatureSetCombination*:s for MR-DC. The *FeatureSetDownlink*:s and *FeatureSetUplink*:s referred to from these *FeatureSetCombination*:s are defined in the *featureSets* list in *UE-NR-Capability*.

## – *UE-NR-Capability*

The IE *UE-NR-Capability* is used to convey the NR UE Radio Access Capability Parameters, see TS 38.306 [26].

### **UE-NR-Capability information element**

```

-- ASN1START
-- TAG-UE-NR-CAPABILITY-START

UE-NR-Capability ::=
    SEQUENCE {
        accessStratumRelease      AccessStratumRelease,
        pdcp-Parameters           PDCP-Parameters,
        rlc-Parameters            RLC-Parameters          OPTIONAL,
        mac-Parameters            MAC-Parameters          OPTIONAL,
        phy-Parameters            Phy-Parameters,
        rf-Parameters             RF-Parameters,
        measAndMobParameters      MeasAndMobParameters    OPTIONAL,
        fdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode  OPTIONAL,
        tdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode  OPTIONAL,
        fr1-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode  OPTIONAL,
        fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode  OPTIONAL,
        featureSets               FeatureSets            OPTIONAL,
        featureSetCombinations    SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination  OPTIONAL,

        lateNonCriticalExtension  OCTET STRING          OPTIONAL,
        nonCriticalExtension       UE-NR-Capability-v1530    OPTIONAL
    }

UE-NR-Capability-v1530 ::=
    SEQUENCE {
        fdd-Add-UE-NR-Capabilities-v1530    UE-NR-CapabilityAddXDD-Mode-v1530    OPTIONAL,

```

```

tdd-Add-UE-NR-Capabilities-v1530      UE-NR-CapabilityAddXDD-Mode-v1530  OPTIONAL,
dummy                                ENUMERATED {supported}              OPTIONAL,
interRAT-Parameters                  InterRAT-Parameters                 OPTIONAL,
inactiveState                         ENUMERATED {supported}              OPTIONAL,
delayBudgetReporting                  ENUMERATED {supported}              OPTIONAL,
nonCriticalExtension                   UE-NR-Capability-v1540              OPTIONAL
}

UE-NR-Capability-v1540 ::=            SEQUENCE {
  sdap-Parameters                     SDAP-Parameters                     OPTIONAL,
  overheatingInd                       ENUMERATED {supported}              OPTIONAL,
  ims-Parameters                       IMS-Parameters                       OPTIONAL,
  fr1-Add-UE-NR-Capabilities-v1540    UE-NR-CapabilityAddFRX-Mode-v1540  OPTIONAL,
  fr2-Add-UE-NR-Capabilities-v1540    UE-NR-CapabilityAddFRX-Mode-v1540  OPTIONAL,
  fr1-fr2-Add-UE-NR-Capabilities      UE-NR-CapabilityAddFRX-Mode        OPTIONAL,
  nonCriticalExtension                   UE-NR-Capability-v1550              OPTIONAL
}

UE-NR-Capability-v1550 ::=            SEQUENCE {
  reducedCP-Latency                    ENUMERATED {supported}              OPTIONAL,
  nonCriticalExtension                   UE-NR-Capability-v1560              OPTIONAL
}

UE-NR-Capability-v1560 ::=            SEQUENCE {
  nrdc-Parameters                      NRDC-Parameters                     OPTIONAL,
  receivedFilters                       OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs)  OPTIONAL,
  nonCriticalExtension                   SEQUENCE {}                          OPTIONAL
}

UE-NR-CapabilityAddXDD-Mode ::=       SEQUENCE {
  phy-ParametersXDD-Diff                Phy-ParametersXDD-Diff              OPTIONAL,
  mac-ParametersXDD-Diff                MAC-ParametersXDD-Diff              OPTIONAL,
  measAndMobParametersXDD-Diff          MeasAndMobParametersXDD-Diff        OPTIONAL
}

UE-NR-CapabilityAddXDD-Mode-v1530 ::= SEQUENCE {
  eutra-ParametersXDD-Diff              EUTRA-ParametersXDD-Diff
}

UE-NR-CapabilityAddFRX-Mode ::= SEQUENCE {
  phy-ParametersFRX-Diff                Phy-ParametersFRX-Diff              OPTIONAL,
  measAndMobParametersFRX-Diff          MeasAndMobParametersFRX-Diff        OPTIONAL
}

UE-NR-CapabilityAddFRX-Mode-v1540 ::= SEQUENCE {
  ims-ParametersFRX-Diff                IMS-ParametersFRX-Diff              OPTIONAL
}

-- TAG-UE-NR-CAPABILITY-STOP
-- ASN1STOP

```

**UE-NR-Capability field descriptions****featureSetCombinations**

A list of *FeatureSetCombination*:s for NR (not for MR-DC). The *FeatureSetDownlink*:s and *FeatureSetUplink*:s referred to from these *FeatureSetCombination*:s are defined in the *featureSets* list in *UE-NR-Capability*.

## 6.3.4 Other information elements

### – *EUTRA-AllowedMeasBandwidth*

The IE *EUTRA-AllowedMeasBandwidth* is used to indicate the maximum allowed measurement bandwidth on a carrier frequency as defined by the parameter Transmission Bandwidth Configuration "N<sub>RB</sub>" in TS 36.104 [33]. The values *mbw6*, *mbw15*, *mbw25*, *mbw50*, *mbw75*, *mbw100* indicate 6, 15, 25, 50, 75 and 100 resource blocks, respectively.

#### ***EUTRA-AllowedMeasBandwidth* information element**

```
-- ASN1START
-- TAG-EUTRA-ALLOWEDMEASBANDWIDTH-START

EUTRA-AllowedMeasBandwidth ::=          ENUMERATED {mbw6, mbw15, mbw25, mbw50, mbw75, mbw100}

-- TAG-EUTRA-ALLOWEDMEASBANDWIDTH-STOP
-- ASN1STOP
```

### – *EUTRA-MBSFN-SubframeConfigList*

The IE *EUTRA-MBSFN-SubframeConfigList* is used to define an E-UTRA MBSFN subframe pattern (for the purpose of NR rate matching).

#### ***EUTRA-MBSFN-SubframeConfigList* information element**

```
-- ASN1START
-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-START

EUTRA-MBSFN-SubframeConfigList ::= SEQUENCE (SIZE (1..maxMBSFN-Allocations)) OF EUTRA-MBSFN-SubframeConfig

EUTRA-MBSFN-SubframeConfig ::= SEQUENCE {
    radioframeAllocationPeriod      ENUMERATED {n1, n2, n4, n8, n16, n32},
    radioframeAllocationOffset      INTEGER (0..7),
    subframeAllocation1             CHOICE {
        oneFrame                    BIT STRING (SIZE(6)),
        fourFrames                   BIT STRING (SIZE(24))
    },
    subframeAllocation2             CHOICE {
        oneFrame                    BIT STRING (SIZE(2)),
        fourFrames                   BIT STRING (SIZE(8))
    }
}

OPTIONAL, -- Need R
```

```

}
...
-- TAG-EUTRA-MBSFN-SUBFRAMECONFIGLIST-STOP
-- ASN1STOP

```

| <i>EUTRA-MBSFN-SubframeConfig</i> field descriptions  |
|---|
| <p><b>radioframeAllocationOffset</b><br/>Field as defined in <i>MBSFN-SubframeConfig</i> in TS 36.331 [10].</p>   |
| <p><b>radioframeAllocationPeriod</b><br/>Field as defined in <i>MBSFN-SubframeConfig</i> in TS 36.331 [10], where <i>SFN</i> refers to the SFN of the NR serving cell.</p>  |
| <p><b>subframeAllocation1</b><br/>Field as defined in <i>MBSFN-SubframeConfig</i> in TS 36.331 [10], where the UE assumes the duplex mode (FDD or TDD) of the NR cell for which the <i>E-UTRA-MBSFN-SubframeConfig</i> is provided.</p>       |
| <p><b>subframeAllocation2</b><br/>Field as defined in <i>MBSFN-SubframeConfig-v1430</i> in TS 36.331 [10], where the UE assumes the duplex mode (FDD or TDD) of the NR cell for which the <i>E-UTRA-MBSFN-SubframeConfig</i> is provided.</p> |

### – *EUTRA-MultiBandInfoList*

The IE *EUTRA-MultiBandInfoList* indicates the list of frequency bands in addition to the band represented by *CarrierFreq* for which cell reselection parameters are common, and a list of *additionalPmax* and *additionalSpectrumEmission*.

#### *EUTRA-MultiBandInfoList* information element

```

-- ASN1START
-- TAG-EUTRA-MULTIBANDINFOLIST-START

EUTRA-MultiBandInfoList ::= SEQUENCE (SIZE (1..maxMultiBands)) OF EUTRA-MultiBandInfo

EUTRA-MultiBandInfo ::= SEQUENCE {
    eutra-FreqBandIndicator    FreqBandIndicatorEUTRA,
    eutra-NS-PmaxList          EUTRA-NS-PmaxList          OPTIONAL  -- Need R
}

-- TAG-EUTRA-MULTIBANDINFOLIST-STOP
-- ASN1STOP

```

### – *EUTRA-NS-PmaxList*

The IE *EUTRA-NS-PmaxList* concerns a list of *additionalPmax* and *additionalSpectrumEmission*, as defined in TS 36.101 [22], table 6.2.4-1 for UEs neither in CE nor BL UEs and TS 36.101 [22], table 6.2.4E-1 for UEs in CE or BL UEs, for a given frequency band.

***EUTRA-NS-PmaxList* information element**

```

-- ASN1START
-- TAG-EUTRA-NS-PMAXLIST-START

EUTRA-NS-PmaxList ::=
    SEQUENCE (SIZE (1..maxEUTRA-NS-Pmax)) OF EUTRA-NS-PmaxValue

EUTRA-NS-PmaxValue ::=
    SEQUENCE {
        additionalPmax          INTEGER (-30..33)          OPTIONAL, -- Need R
        additionalSpectrumEmission  INTEGER (1..288)        OPTIONAL  -- Need R
    }

-- TAG-EUTRA-NS-PMAXLIST-STOP
-- ASN1STOP

```

– ***EUTRA-PhysCellId***

The IE *EUTRA-PhysCellId* is used to indicate the physical layer identity of the cell, as defined in TS 36.211 [31].

***EUTRA-PhysCellId* information element**

```

-- ASN1START
-- TAG-EUTRA-PHYSCELLID-START

EUTRA-PhysCellId ::=
    INTEGER (0..503)

-- TAG-EUTRA-PHYSCELLID-STOP
-- ASN1STOP

```

– ***EUTRA-PhysCellIdRange***

The IE *EUTRA-PhysCellIdRange* is used to encode either a single or a range of physical cell identities. The range is encoded by using a *start* value and by indicating the number of consecutive physical cell identities (including *start*) in the range. For fields comprising multiple occurrences of *EUTRA-PhysCellIdRange*, NW may configure overlapping ranges of physical cell identities.

***EUTRA-PhysCellIdRange* information element**

```

-- ASN1START
-- TAG-EUTRA-PHYSCELLIDRANGE-START

EUTRA-PhysCellIdRange ::=
    SEQUENCE {
        start          EUTRA-PhysCellId,
        range          ENUMERATED {n4, n8, n12, n16, n24, n32, n48, n64, n84, n96,
                                   n128, n168, n252, n504, spare2, spare1}
    }
    OPTIONAL  -- Need N

-- TAG-EUTRA-PHYSCELLIDRANGE-STOP

```

```
-- ASN1STOP
```

## – *EUTRA-PresenceAntennaPort1*

The IE *EUTRA-PresenceAntennaPort1* is used to indicate whether all the neighbouring cells use Antenna Port 1. When set to *true*, the UE may assume that at least two cell-specific antenna ports are used in all neighbouring cells.

### ***EUTRA-PresenceAntennaPort1* information element**

```
-- ASN1START
-- TAG-EUTRA-PRESENCEANTENNA-PORT1-START

EUTRA-PresenceAntennaPort1 ::=          BOOLEAN

-- TAG-EUTRA-PRESENCEANTENNA-PORT1-STOP
-- ASN1STOP
```

## – *EUTRA-Q-OffsetRange*

The IE *EUTRA-Q-OffsetRange* is used to indicate a cell, or frequency specific offset to be applied when evaluating candidates for cell re-selection or when evaluating triggering conditions for measurement reporting. The value in dB. Value *dB-24* corresponds to -24 dB, value *dB-22* corresponds to -22 dB and so on.

### ***EUTRA-Q-OffsetRange* information element**

```
-- ASN1START
-- TAG-EUTRA-Q-OFFSETRANGE-START

EUTRA-Q-OffsetRange ::=          ENUMERATED {
    dB-24, dB-22, dB-20, dB-18, dB-16, dB-14,
    dB-12, dB-10, dB-8, dB-6, dB-5, dB-4, dB-3,
    dB-2, dB-1, dB0, dB1, dB2, dB3, dB4, dB5,
    dB6, dB8, dB10, dB12, dB14, dB16, dB18,
    dB20, dB22, dB24}

-- TAG-EUTRA-Q-OFFSETRANGE-STOP
-- ASN1STOP
```

## – *OtherConfig*

The IE *OtherConfig* contains configuration related to miscellaneous other configurations.

### ***OtherConfig* information element**

```
-- ASN1START
```

```

-- TAG-OTHERCONFIG-START

OtherConfig ::=
    SEQUENCE {
        delayBudgetReportingConfig CHOICE {
            release NULL,
            setup SEQUENCE {
                delayBudgetReportingProhibitTimer ENUMERATED {s0, s0dot4, s0dot8, s1dot6, s3, s6, s12, s30}
            }
        }
    }
    OPTIONAL -- Need M

OtherConfig-v1540 ::=
    SEQUENCE {
        overheatingAssistanceConfig SetupRelease {OverheatingAssistanceConfig}
        ...
    }
    OPTIONAL, -- Need M

OverheatingAssistanceConfig ::= SEQUENCE {
    overheatingIndicationProhibitTimer ENUMERATED {s0, s0dot5, s1, s2, s5, s10, s20, s30,
    s60, s90, s120, s300, s600, spare3, spare2, spare1}
}

-- TAG-OTHERCONFIG-STOP
-- ASN1STOP

```

| <b>OtherConfig field descriptions</b>  |
|--|
| <b>delayBudgetReportingProhibitTimer</b><br>Prohibit timer for delay budget reporting. Value in seconds. Value <i>s0</i> means prohibit timer is set to 0 seconds, value <i>s0dot4</i> means prohibit timer is set to 0.4 seconds, and so on.  |
| <b>overheatingAssistanceConfig</b><br>Configuration for the UE to report assistance information to inform the gNB about UE detected internal overheating.  |
| <b>overheatingIndicationProhibitTimer</b><br>Prohibit timer for overheating assistance information reporting. Value in seconds. Value <i>s0</i> means prohibit timer is set to 0 seconds, value <i>s0dot5</i> means prohibit timer is set to 0.5 seconds, value <i>s1</i> means prohibit timer is set to 1 second and so on. |

## – RRC-TransactionIdentifier

The IE *RRC-TransactionIdentifier* is used, together with the message type, for the identification of an RRC procedure (transaction).

### **RRC-TransactionIdentifier information element**

```

-- ASN1START
-- TAG-RRC-TRANSACTIONIDENTIFIER-START

RRC-TransactionIdentifier ::=
    INTEGER (0..3)

-- TAG-RRC-TRANSACTIONIDENTIFIER-STOP
-- ASN1STOP

```



## 6.4 RRC multiplicity and type constraint values

### – Multiplicity and type constraint definitions

```

-- ASN1START
-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-START

maxBandComb                INTEGER ::= 65536  -- Maximum number of DL band combinations
maxCellBlack                INTEGER ::= 16    -- Maximum number of NR blacklisted cell ranges in SIB3, SIB4
maxCellInter                INTEGER ::= 16    -- Maximum number of inter-Freq cells listed in SIB4
maxCellIntra                INTEGER ::= 16    -- Maximum number of intra-Freq cells listed in SIB3
maxCellMeaseEUTRA          INTEGER ::= 32    -- Maximum number of cells in E-UTRAN
maxEARFCN                   INTEGER ::= 262143 -- Maximum value of E-UTRA carrier frequency
maxEUTRA-CellBlack          INTEGER ::= 16    -- Maximum number of E-UTRA blacklisted physical cell identity ranges
-- in SIB5
maxEUTRA-NS-Pmax            INTEGER ::= 8     -- Maximum number of NS and P-Max values per band
maxMultiBands               INTEGER ::= 8     -- Maximum number of additional frequency bands that a cell belongs to
maxNARFCN                   INTEGER ::= 3279165 -- Maximum value of NR carrier frequency
maxNR-NS-Pmax               INTEGER ::= 8     -- Maximum number of NS and P-Max values per band
maxNrofServingCells         INTEGER ::= 32    -- Max number of serving cells (SpCells + SCells)
maxNrofServingCells-1       INTEGER ::= 31    -- Max number of serving cells (SpCell + SCells) per cell group
maxNrofAggregatedCellsPerCellGroup INTEGER ::= 16
maxNrofSCells                INTEGER ::= 31    -- Max number of secondary serving cells per cell group
maxNrofCellMeas             INTEGER ::= 32    -- Maximum number of entries in each of the cell lists in a measurement
-- object
maxNrofSS-BlocksToAverage   INTEGER ::= 16    -- Max number for the (max) number of SS blocks to average to determine cell
-- measurement
maxNrofCSI-RS-ResourcesToAverage INTEGER ::= 16
-- Max number for the (max) number of CSI-RS to average to determine cell
-- measurement
maxNrofDL-Allocations        INTEGER ::= 16    -- Maximum number of PDSCH time domain resource allocations
maxNrofSR-ConfigPerCellGroup INTEGER ::= 8     -- Maximum number of SR configurations per cell group
maxLCG-ID                   INTEGER ::= 7     -- Maximum value of LCG ID
maxLC-ID                     INTEGER ::= 32    -- Maximum value of Logical Channel ID
maxNrofTAGs                  INTEGER ::= 4     -- Maximum number of Timing Advance Groups
maxNrofTAGs-1                INTEGER ::= 3     -- Maximum number of Timing Advance Groups minus 1
maxNrofBWPs                  INTEGER ::= 4     -- Maximum number of BWPs per serving cell
maxNrofCombIDC               INTEGER ::= 128   -- Maximum number of reported MR-DC combinations for IDC
maxNrofSymbols-1             INTEGER ::= 13    -- Maximum index identifying a symbol within a slot (14 symbols, indexed
-- from 0..13)
maxNrofSlots                 INTEGER ::= 320   -- Maximum number of slots in a 10 ms period
maxNrofSlots-1               INTEGER ::= 319   -- Maximum number of slots in a 10 ms period minus 1
maxNrofPhysicalResourceBlocks INTEGER ::= 275   -- Maximum number of PRBs
maxNrofPhysicalResourceBlocks-1 INTEGER ::= 274 -- Maximum number of PRBs minus 1
maxNrofPhysicalResourceBlocksPlus1 INTEGER ::= 276 -- Maximum number of PRBs plus 1
maxNrofControlResourceSets-1 INTEGER ::= 11   -- Max number of CoReSets configurable on a serving cell minus 1
maxCoReSetDuration           INTEGER ::= 3     -- Max number of OFDM symbols in a control resource set
maxNrofSearchSpaces-1        INTEGER ::= 39   -- Max number of Search Spaces minus 1
maxSFI-DCI-PayloadSize       INTEGER ::= 128  -- Max number payload of a DCI scrambled with SFI-RNTI
maxSFI-DCI-PayloadSize-1     INTEGER ::= 127 -- Max number payload of a DCI scrambled with SFI-RNTI minus 1
maxINT-DCI-PayloadSize       INTEGER ::= 126  -- Max number payload of a DCI scrambled with INT-RNTI
maxINT-DCI-PayloadSize-1     INTEGER ::= 125 -- Max number payload of a DCI scrambled with INT-RNTI minus 1
maxNrofRateMatchPatterns     INTEGER ::= 4     -- Max number of rate matching patterns that may be configured

```

|   |                 |   |
|---|-----------------|---|
| maxNrofRateMatchPatterns-1              | INTEGER ::= 3   | -- Max number of rate matching patterns that may be configured minus 1                |
| maxNrofRateMatchPatternsPerGroup        | INTEGER ::= 8   | -- Max number of rate matching patterns that may be configured in one group           |
| maxNrofCSI-ReportConfigurations         | INTEGER ::= 48  | -- Maximum number of report configurations  |
| maxNrofCSI-ReportConfigurations-1       | INTEGER ::= 47  | -- Maximum number of report configurations minus 1                                    |
| maxNrofCSI-ResourceConfigurations       | INTEGER ::= 112 | -- Maximum number of resource configurations  |
| maxNrofCSI-ResourceConfigurations-1     | INTEGER ::= 111 | -- Maximum number of resource configurations minus 1                                  |
| maxNrofAP-CSI-RS-ResourcesPerSet        | INTEGER ::= 16  |   |
| maxNrOfCSI-AperiodicTriggers            | INTEGER ::= 128 | -- Maximum number of triggers for aperiodic CSI reporting                             |
| maxNrofReportConfigPerAperiodicTrigger  | INTEGER ::= 16  | -- Maximum number of report configurations per trigger state for aperiodic reporting  |
| maxNrofNWP-CSI-RS-Resources             | INTEGER ::= 192 | -- Maximum number of Non-Zero-Power (NWP) CSI-RS resources                            |
| maxNrofNWP-CSI-RS-Resources-1           | INTEGER ::= 191 | -- Maximum number of Non-Zero-Power (NWP) CSI-RS resources minus 1                    |
| maxNrofNWP-CSI-RS-ResourcesPerSet       | INTEGER ::= 64  | -- Maximum number of NWP CSI-RS resources per resource set                            |
| maxNrofNWP-CSI-RS-ResourceSets          | INTEGER ::= 64  | -- Maximum number of NWP CSI-RS resources per cell                                    |
| maxNrofNWP-CSI-RS-ResourceSets-1        | INTEGER ::= 63  | -- Maximum number of NWP CSI-RS resources per cell minus 1                            |
| maxNrofNWP-CSI-RS-ResourceSetsPerConfig | INTEGER ::= 16  | -- Maximum number of resource sets per resource configuration                         |
| maxNrofNWP-CSI-RS-ResourcesPerConfig    | INTEGER ::= 128 | -- Maximum number of resources per resource configuration                             |
| maxNrofZP-CSI-RS-Resources              | INTEGER ::= 32  | -- Maximum number of Zero-Power (ZP) CSI-RS resources                                 |
| maxNrofZP-CSI-RS-Resources-1            | INTEGER ::= 31  | -- Maximum number of Zero-Power (ZP) CSI-RS resources minus 1                         |
| maxNrofZP-CSI-RS-ResourceSets-1         | INTEGER ::= 15  |   |
| maxNrofZP-CSI-RS-ResourcesPerSet        | INTEGER ::= 16  |   |
| maxNrofZP-CSI-RS-ResourceSets           | INTEGER ::= 16  |   |
| maxNrofCSI-IM-Resources                 | INTEGER ::= 32  | -- Maximum number of CSI-IM resources. See CSI-IM-ResourceMax in 38.214.              |
| maxNrofCSI-IM-Resources-1               | INTEGER ::= 31  | -- Maximum number of CSI-IM resources minus 1. See CSI-IM-ResourceMax in 38.214.      |
| maxNrofCSI-IM-ResourcesPerSet           | INTEGER ::= 8   | -- Maximum number of CSI-IM resources per set. See CSI-IM-ResourcePerSetMax in 38.214 |
| maxNrofCSI-IM-ResourceSets              | INTEGER ::= 64  | -- Maximum number of NWP CSI-IM resources per cell                                    |
| maxNrofCSI-IM-ResourceSets-1            | INTEGER ::= 63  | -- Maximum number of NWP CSI-IM resources per cell minus 1                            |
| maxNrofCSI-IM-ResourceSetsPerConfig     | INTEGER ::= 16  | -- Maximum number of CSI IM resource sets per resource configuration                  |
| maxNrofCSI-SSB-ResourcePerSet           | INTEGER ::= 64  | -- Maximum number of SSB resources in a resource set                                  |
| maxNrofCSI-SSB-ResourceSets             | INTEGER ::= 64  | -- Maximum number of CSI SSB resource sets per cell                                   |
| maxNrofCSI-SSB-ResourceSets-1           | INTEGER ::= 63  | -- Maximum number of CSI SSB resource sets per cell minus 1                           |
| maxNrofCSI-SSB-ResourceSetsPerConfig    | INTEGER ::= 1   | -- Maximum number of CSI SSB resource sets per resource configuration                 |
| maxNrofFailureDetectionResources        | INTEGER ::= 10  | -- Maximum number of failure detection resources                                      |
| maxNrofFailureDetectionResources-1      | INTEGER ::= 9   | -- Maximum number of failure detection resources minus 1                              |
| maxNrofObjectId                         | INTEGER ::= 64  | -- Maximum number of measurement objects  |
| maxNrofPageRec                          | INTEGER ::= 32  | -- Maximum number of page records   |
| maxNrofPCI-Ranges                       | INTEGER ::= 8   | -- Maximum number of PCI ranges   |
| maxPLMN                                 | INTEGER ::= 12  | -- Maximum number of PLMNs broadcast and reported by UE at establishment              |
| maxNrofCSI-RS-ResourcesRRM              | INTEGER ::= 96  | -- Maximum number of CSI-RS resources for an RRM measurement object                   |
| maxNrofCSI-RS-ResourcesRRM-1            | INTEGER ::= 95  | -- Maximum number of CSI-RS resources for an RRM measurement object minus 1           |
| maxNrofMeasId                           | INTEGER ::= 64  | -- Maximum number of configured measurements  |
| maxNrofQuantityConfig                   | INTEGER ::= 2   | -- Maximum number of quantity configurations  |
| maxNrofCSI-RS-CellsRRM                  | INTEGER ::= 96  | -- Maximum number of cells with CSI-RS resources for an RRM measurement object        |
| maxNrofSRS-ResourceSets                 | INTEGER ::= 16  | -- Maximum number of SRS resource sets in a BWP.                                      |
| maxNrofSRS-ResourceSets-1               | INTEGER ::= 15  | -- Maximum number of SRS resource sets in a BWP minus 1.                              |
| maxNrofSRS-Resources                    | INTEGER ::= 64  | -- Maximum number of SRS resources.   |
| maxNrofSRS-Resources-1                  | INTEGER ::= 63  | -- Maximum number of SRS resources in an SRS resource set minus 1.                    |
| maxNrofSRS-ResourcesPerSet              | INTEGER ::= 16  | -- Maximum number of SRS resources in an SRS resource set                             |
| maxNrofSRS-TriggerStates-1              | INTEGER ::= 3   | -- Maximum number of SRS trigger states minus 1, i.e., the largest code point.        |
| maxNrofSRS-TriggerStates-2              | INTEGER ::= 2   | -- Maximum number of SRS trigger states minus 2.                                      |

|                                       |                  |  |
|---------------------------------------|------------------|--|
| maxRAT-CapabilityContainers           | INTEGER ::= 8    | -- Maximum number of interworking RAT containers (incl NR and MRDC)                  |
| maxSimultaneousBands                  | INTEGER ::= 32   | -- Maximum number of simultaneously aggregated bands                                 |
| maxNrofSlotFormatCombinationsPerSet   | INTEGER ::= 512  | -- Maximum number of Slot Format Combinations in a SF-Set.                           |
| maxNrofSlotFormatCombinationsPerSet-1 | INTEGER ::= 511  | -- Maximum number of Slot Format Combinations in a SF-Set minus 1.                   |
| maxNrofPUCCH-Resources                | INTEGER ::= 128  |  |
| maxNrofPUCCH-Resources-1              | INTEGER ::= 127  |  |
| maxNrofPUCCH-ResourceSets             | INTEGER ::= 4    | -- Maximum number of PUCCH Resource Sets   |
| maxNrofPUCCH-ResourceSets-1           | INTEGER ::= 3    | -- Maximum number of PUCCH Resource Sets minus 1.                                    |
| maxNrofPUCCH-ResourcesPerSet          | INTEGER ::= 32   | -- Maximum number of PUCCH Resources per PUCCH-ResourceSet                           |
| maxNrofPUCCH-P0-PerSet                | INTEGER ::= 8    | -- Maximum number of P0-pucch present in a p0-pucch set                              |
| maxNrofPUCCH-PathlossReferenceRSs     | INTEGER ::= 4    | -- Maximum number of RSs used as pathloss reference for PUCCH power control.         |
| maxNrofPUCCH-PathlossReferenceRSs-1   | INTEGER ::= 3    | -- Maximum number of RSs used as pathloss reference for PUCCH power control minus 1. |
|                                       |                  | -- Maximum number of P0-pusch-alpha-sets (see 38,213, clause 7.1)                    |
| maxNrofP0-PUSCH-AlphaSets             | INTEGER ::= 30   |  |
| maxNrofP0-PUSCH-AlphaSets-1           | INTEGER ::= 29   | -- Maximum number of P0-pusch-alpha-sets minus 1 (see 38,213, clause 7.1)            |
| maxNrofPUSCH-PathlossReferenceRSs     | INTEGER ::= 4    | -- Maximum number of RSs used as pathloss reference for PUSCH power control.         |
| maxNrofPUSCH-PathlossReferenceRSs-1   | INTEGER ::= 3    | -- Maximum number of RSs used as pathloss reference for PUSCH power control minus 1. |
|                                       |                  | -- Maximum number of supported NAICS capability set                                  |
| maxNrofNAICS-Entries                  | INTEGER ::= 8    |  |
| maxBands                              | INTEGER ::= 1024 | -- Maximum number of supported bands in UE capability.                               |
| maxBandsMRDC                          | INTEGER ::= 1280 |  |
| maxBandsEUTRA                         | INTEGER ::= 256  |  |
| maxCellReport                         | INTEGER ::= 8    |  |
| maxDRB                                | INTEGER ::= 29   | -- Maximum number of DRBs (that can be added in DRB-ToAddModList).                   |
| maxFreq                               | INTEGER ::= 8    | -- Max number of frequencies.  |
| maxFreqIDC-MRDC                       | INTEGER ::= 32   | -- Maximum number of candidate NR frequencies for MR-DC IDC indication               |
| maxNrofCandidateBeams                 | INTEGER ::= 16   | -- Max number of PRACH-ResourceDedicatedBFR that in BFR config.                      |
| maxNrofPCIsPerSMTC                    | INTEGER ::= 64   | -- Maximum number of PCIs per SMTC.  |
| maxNrofQFIs                           | INTEGER ::= 64   |  |
| maxNrofSemiPersistentPUSCH-Triggers   | INTEGER ::= 64   | -- Maximum number of triggers for semi persistent reporting on PUSCH                 |
| maxNrofSR-Resources                   | INTEGER ::= 8    | -- Maximum number of SR resources per BWP in a cell.                                 |
| maxNrofSlotFormatsPerCombination      | INTEGER ::= 256  |  |
| maxNrofSpatialRelationInfos           | INTEGER ::= 8    |  |
| maxNrofIndexesToReport                | INTEGER ::= 32   |  |
| maxNrofIndexesToReport2               | INTEGER ::= 64   |  |
| maxNrofSSBs-1                         | INTEGER ::= 63   | -- Maximum number of SSB resources in a resource set minus 1.                        |
| maxNrofS-NSSAI                        | INTEGER ::= 8    | -- Maximum number of S-NSSAI.  |
| maxNrofTCI-StatesPDCCH                | INTEGER ::= 64   |  |
| maxNrofTCI-States                     | INTEGER ::= 128  | -- Maximum number of TCI states.   |
| maxNrofTCI-States-1                   | INTEGER ::= 127  | -- Maximum number of TCI states minus 1.   |
| maxNrofUL-Allocations                 | INTEGER ::= 16   | -- Maximum number of PUSCH time domain resource allocations.                         |
| maxQFI                                | INTEGER ::= 63   |  |
| maxRA-CSIRS-Resources                 | INTEGER ::= 96   |  |
| maxRA-OccasionsPerCSIRS               | INTEGER ::= 64   | -- Maximum number of RA occasions for one CSI-RS                                     |
| maxRA-Occasions-1                     | INTEGER ::= 511  | -- Maximum number of RA occasions in the system                                      |
| maxRA-SSB-Resources                   | INTEGER ::= 64   |  |
| maxSCSs                               | INTEGER ::= 5    |  |
| maxSecondaryCellGroups                | INTEGER ::= 3    |  |
| maxNrofServingCellsEUTRA              | INTEGER ::= 32   |  |
| maxMBSFN-Allocations                  | INTEGER ::= 8    |  |
| maxNrofMultiBands                     | INTEGER ::= 8    |  |
| maxCellsSFTD                          | INTEGER ::= 3    | -- Maximum number of cells for SFTD reporting  |
| maxReportConfigId                     | INTEGER ::= 64   |  |
| maxNrofCodebooks                      | INTEGER ::= 16   | -- Maximum number of codebooks supported by the UE                                   |

```

maxNrofCSI-RS-Resources      INTEGER ::= 7      -- Maximum number of codebook resources supported by the UE
maxNrofSRI-PUSCH-Mappings    INTEGER ::= 16
maxNrofSRI-PUSCH-Mappings-1  INTEGER ::= 15
maxSIB                       INTEGER ::= 32      -- Maximum number of SIBs
maxSI-Message                INTEGER ::= 32      -- Maximum number of SI messages
maxPO-perPF                  INTEGER ::= 4      -- Maximum number of paging occasion per paging frame
maxAccessCat-1               INTEGER ::= 63      -- Maximum number of Access Categories minus 1
maxBarringInfoSet            INTEGER ::= 8      -- Maximum number of Access Categories
maxCelleUTRA                 INTEGER ::= 8      -- Maximum number of E-UTRA cells in SIB list
maxEUTRA-Carrier              INTEGER ::= 8      -- Maximum number of E-UTRA carriers in SIB list
maxPLMNIdentities            INTEGER ::= 8      -- Maximum number of PLMN identities in RAN area configurations
maxDownlinkFeatureSets       INTEGER ::= 1024    -- (for NR DL) Total number of FeatureSets (size of the pool)
maxUplinkFeatureSets         INTEGER ::= 1024    -- (for NR UL) Total number of FeatureSets (size of the pool)
maxEUTRA-DL-FeatureSets      INTEGER ::= 256    -- (for E-UTRA) Total number of FeatureSets (size of the pool)
maxEUTRA-UL-FeatureSets      INTEGER ::= 256    -- (for E-UTRA) Total number of FeatureSets (size of the pool)
maxFeatureSetsPerBand        INTEGER ::= 128    -- (for NR) The number of feature sets associated with one band.
maxPerCC-FeatureSets         INTEGER ::= 1024    -- (for NR) Total number of CC-specific FeatureSets (size of the pool)
maxFeatureSetCombinations    INTEGER ::= 1024    -- (for MR-DC/NR) Total number of Feature set combinations (size of the
-- pool)

maxInterRAT-RSTD-Freq        INTEGER ::= 3

-- TAG-MULTIPLICITY-AND-TYPE-CONSTRAINT-DEFINITIONS-STOP
-- ASN1STOP

```

## — End of NR-RRC-Definitions

```

-- ASN1START
END
-- ASN1STOP

```

## 6.5 Short Message

Short Messages can be transmitted on PDCCH using P-RNTI with or without associated *Paging* message using Short Message field in DCI format 1\_0 (see TS 38.212 [17], clause 7.3.1.2.1).

Table 6.5-1 defines Short Messages. Bit 1 is the most significant bit.

Table 6.5-1: Short Messages

| Bit   | Short Message  |
|-------|--|
| 1     | <b><i>systemInfoModification</i></b><br>If set to 1: indication of a BCCH modification other than SIB6, SIB7 and SIB8.   |
| 2     | <b><i>etwsAndCmasIndication</i></b><br>If set to 1: indication of an ETWS primary notification and/or an ETWS secondary notification and/or a CMAS notification. |
| 3 – 8 | Not used in this release of the specification, and shall be ignored by UE if received.   |

## 7 Variables and constants

### 7.1 Timers

#### 7.1.1 Timers (Informative)

| Timer | Start  | Stop  | At expiry   |
|-------|--|---|---|
| T300  | Upon transmission of <i>RRCSetupRequest</i> .  | Upon reception of <i>RRCSetup</i> or <i>RRCReject</i> message, cell re-selection and upon abortion of connection establishment by upper layers.   | Perform the actions as specified in 5.3.3.7.  |
| T301  | Upon transmission of <i>RRCReestablishmentRequest</i>  | Upon reception of <i>RRCReestablishment</i> or <i>RRCSetup</i> message as well as when the selected cell becomes unsuitable   | Go to RRC_IDLE  |
| T302  | Upon reception of <i>RRCReject</i> while performing RRC connection establishment or resume, upon reception of <i>RRCRelease</i> with <i>waitTime</i> . | Upon entering RRC_CONNECTED or RRC_IDLE, upon cell re-selection and upon reception of <i>RRCReject</i> message.   | Inform upper layers about barring alleviation as specified in 5.3.14.4  |
| T304  | Upon reception of <i>RRCReconfiguration</i> message including <i>reconfigurationWithSync</i>   | Upon successful completion of random access on the corresponding SpCell<br>For T304 of SCG, upon SCG release  | For T304 of MCG, in case of the handover from NR or intra-NR handover, initiate the RRC re-establishment procedure; In case of handover to NR, perform the actions defined in the specifications applicable for the source RAT.<br><br>For T304 of SCG, inform network about the reconfiguration with sync failure by initiating the SCG failure information procedure as specified in 5.7.3. |
| T310  | Upon detecting physical layer problems for the SpCell i.e. upon receiving N310 consecutive out-of-sync indications from lower layers.                  | Upon receiving N311 consecutive in-sync indications from lower layers for the SpCell, upon receiving <i>RRCReconfiguration</i> with <i>reconfigurationWithSync</i> for that cell group, and upon initiating the connection re-establishment procedure.<br>Upon SCG release, if the T310 is kept in SCG. | If the T310 is kept in MCG: If AS security is not activated: go to RRC_IDLE else: initiate the connection re-establishment procedure.<br>If the T310 is kept in SCG, Inform E-UTRAN/NR about the SCG radio link failure by initiating the SCG failure information procedure as specified in 5.7.3.  |

| Timer | Start  | Stop  | At expiry   |
|-------|--|---|---|
| T311  | Upon initiating the RRC connection re-establishment procedure  | Upon selection of a suitable NR cell or a cell using another RAT.   | Enter RRC_IDLE  |
| T319  | Upon transmission of <i>RRCResumeRequest</i> or <i>RRCResumeRequest1</i> .   | Upon reception of <i>RRCResume</i> , <i>RRCSetup</i> , <i>RRCRelease</i> , <i>RRCRelease with suspendConfig</i> or <i>RRCReject</i> message, cell re-selection and upon abortion of connection establishment by upper layers.   | Perform the actions as specified in 5.3.13.5.   |
| T320  | Upon reception of <i>t320</i> or upon cell (re)selection to NR from another RAT with validity time configured for dedicated priorities (in which case the remaining validity time is applied). | Upon entering RRC_CONNECTED, upon reception of <i>RRCRelease</i> , when PLMN selection is performed on request by NAS, when the UE enters RRC_IDLE from RRC_INACTIVE, or upon cell (re)selection to another RAT (in which case the timer is carried on to the other RAT). | Discard the cell reselection priority information provided by dedicated signalling.     |
| T321  | Upon receiving <i>measConfig</i> including a <i>reportConfig</i> with the purpose set to <i>reportCGI</i>  | Upon acquiring the information needed to set all fields of <i>cgi-info</i> , upon receiving <i>measConfig</i> that includes removal of the <i>reportConfig</i> with the purpose set to <i>reportCGI</i> and upon detecting that a cell is not broadcasting SIB1.          | Initiate the measurement reporting procedure, stop performing the related measurements. |
| T325  | Upon reception of <i>RRCRelease</i> message with <i>deprioritisationTimer</i> .  |   | Stop deprioritisation of all frequencies or NR signalled by <i>RRCRelease</i> .         |
| T342  | Upon transmitting <i>UEAssistanceInformation</i> message with <i>DelayBudgetReport</i> .   | Upon initiating the connection re-establishment/resume procedures, and upon receiving <i>delayBudgetReportingConfig</i> set to <i>release</i> .   | No action.  |
| T345  | Upon transmitting <i>UEAssistanceInformation</i> message with <i>overheatingAssistance</i>   | Upon initiating the connection re-establishment procedure and upon initiating the connection resumption procedure   | No action.  |
| T380  | Upon reception of <i>t380</i> in <i>RRCRelease</i> .   | Upon reception of <i>RRCResume</i> , <i>RRCSetup</i> or <i>RRCRelease</i> .   | Perform the actions as specified in 5.3.13.   |



| Timer | Start   | Stop  | At expiry                                     |
|-------|---|---|---|
| T390  | When access attempt is barred at access barring check for an Access Category. The UE shall maintain one instance of this timer per Access Category. | Upon cell (re)selection, upon entering RRC_CONNECTED, upon reception of <i>RRCReconfiguration</i> including <i>reconfigurationWithSync</i> , upon change of PCell while in RRC_CONNECTED, upon reception of <i>MobilityFromNRCommand</i> , or upon reception of <i>RRCRelease</i> . | Perform the actions as specified in 5.3.14.4. |

## 7.1.2 Timer handling

When the UE applies zero value for a timer, the timer shall be started and immediately expire unless explicitly stated otherwise.

## 7.2 Counters

| Counter | Reset  | Incremented   | When reaching max value |
|---------|--|---|-------------------------|
| N310    | Upon reception of "in-sync" indication from lower layers;<br>upon receiving <i>RRCReconfiguration</i> with <i>reconfigurationWithSync</i> for that cell group;<br>upon initiating the connection re-establishment procedure.     | Upon reception of "out-of-sync" from lower layer while the timer T310 is stopped. | Start timer T310        |
| N311    | Upon reception of "out-of-sync" indication from lower layers;<br>upon receiving <i>RRCReconfiguration</i> with <i>reconfigurationWithSync</i> for that cell group;<br>upon initiating the connection re-establishment procedure. | Upon reception of the "in-sync" from lower layer while the timer T310 is running. | Stop the timer T310.    |

## 7.3 Constants

| Constant | Usage   |
|----------|---|
| N310     | Maximum number of consecutive "out-of-sync" indications for the SpCell received from lower layers |
| N311     | Maximum number of consecutive "in-sync" indications for the SpCell received from lower layers     |

## 7.4 UE variables

NOTE: To facilitate the specification of the UE behavioural requirements, UE variables are represented using ASN.1. Unless explicitly specified otherwise, it is however up to UE implementation how to store the variables. The optionality of the IEs in ASN.1 is used only to indicate that the values may not always be available.

### – *NR-UE-Variables*

This ASN.1 segment is the start of the NR UE variable definitions.

```
-- ASN1START
-- NR-UE-VARIABLES-START

NR-UE-Variables DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    CellIdentity,
    EUTRA-PhysCellId,
    MeasId,
    MeasIdToAddModList,
    MeasObjectToAddModList,
    PhysCellId,
    RNTI-Value,
    ReportConfigToAddModList,
    RSRP-Range,
    QuantityConfig,
    maxNrofCellMeas,
    maxNrofMeasId
FROM NR-RRC-Definitions;

-- NR-UE-VARIABLES-STOP
-- ASN1STOP
```

### – *VarPendingRNA-Update*

The UE variable *VarPendingRNA-Update* indicates whether there is a pending RNA update procedure or not. The setting of this BOOLEAN variable to *true* means that there is a pending RNA Update procedure.

#### ***VarPendingRNA-Update UE variable***

```
-- ASN1START
-- TAG-VARPENDINGRNA-UPDATE-START

VarPendingRNA-Update ::=
    pendingRNA-Update          SEQUENCE {
                                BOOLEAN          OPTIONAL
    }

-- TAG-VARPENDINGRNA-UPDATE-STOP
-- ASN1STOP
```

### – *VarMeasConfig*

The UE variable *VarMeasConfig* includes the accumulated configuration of the measurements to be performed by the UE, covering intra-frequency, inter-frequency and inter-RAT mobility related measurements.

#### ***VarMeasConfig UE variable***

```
-- ASN1START
-- TAG-VARMEASCONFIG-START

VarMeasConfig ::=
    SEQUENCE {
        -- Measurement identities
        measIdList          MeasIdToAddModList          OPTIONAL,
        -- Measurement objects
        measObjectList      MeasObjectToAddModList      OPTIONAL,
        -- Reporting configurations
        reportConfigList    ReportConfigToAddModList    OPTIONAL,
        -- Other parameters
        quantityConfig      QuantityConfig              OPTIONAL,

        s-MeasureConfig     CHOICE {
            ssb-RSRP        RSRP-Range,
            csi-RSRP        RSRP-Range
        } OPTIONAL
    }

-- TAG-VARMEASCONFIG-STOP
-- ASN1STOP
```

– *VarMeasReportList*

The UE variable *VarMeasReportList* includes information about the measurements for which the triggering conditions have been met.

***VarMeasReportList UE variable***

```
-- ASN1START
-- TAG-VARMEASREPORTLIST-START

VarMeasReportList ::=          SEQUENCE (SIZE (1..maxNrofMeasId)) OF VarMeasReport

VarMeasReport ::=             SEQUENCE {
  -- List of measurement that have been triggered
  measId                      MeasId,
  cellsTriggeredList           CellsTriggeredList          OPTIONAL,
  numberOfReportsSent          INTEGER
}

CellsTriggeredList ::=        SEQUENCE (SIZE (1..maxNrofCellMeas)) OF CHOICE {
  physCellId                   PhysCellId,
  physCellIdEUTRA              EUTRA-PhysCellId
}

-- TAG-VARMEASREPORTLIST-STOP
-- ASN1STOP
```

– *VarResumeMAC-Input*

The UE variable *VarResumeMAC-Input* specifies the input used to generate the *resumeMAC-I* during RRC Connection Resume procedure.

***VarResumeMAC-Input variable***

```
-- ASN1START
-- TAG-VARRESUMEMAC-INPUT-START

VarResumeMAC-Input ::=        SEQUENCE {
  sourcePhysCellId             PhysCellId,
  targetCellIdentity           CellIdentity,
  source-c-RNTI                RNTI-Value
}

-- TAG-VARRESUMEMAC-INPUT-STOP
-- ASN1STOP
```

| <i>VarResumeMAC-Input</i> field descriptions   |
|--|
| <p><b>targetCellIdentity</b><br/>An input variable used to calculate the <i>resumeMAC-I</i>. Set to the <i>cellIdentity</i> of the first <i>PLMN-Identity</i> included in the <i>PLMN-IdentityInfoList</i> broadcasted in <i>SIB1</i> of the target cell i.e. the cell the UE is trying to resume.</p> |
| <p><b>source-c-RNTI</b><br/>Set to C-RNTI that the UE had in the PCell it was connected to prior to suspension of the RRC connection.</p>  |
| <p><b>sourcePhysCellId</b><br/>Set to the physical cell identity of the PCell the UE was connected to prior to suspension of the RRC connection.</p>   |

– *VarShortMAC-Input*

The UE variable *VarShortMAC-Input* specifies the input used to generate the *shortMAC-I* during RRC Connection Reestablishment procedure.

***VarShortMAC-Input* variable**

```
-- ASN1START
-- TAG-VARSHORTMAC-INPUT-START

VarShortMAC-Input ::=
    sourcePhysCellId
    targetCellIdentity
    source-c-RNTI
}

-- TAG-VARSHORTMAC-INPUT-STOP
-- ASN1STOP
```

```
SEQUENCE {
    PhysCellId,
    CellIdentity,
    RNTI-Value
}
```

| <i>VarShortMAC-Input</i> field descriptions  |
|--|
| <p><b>targetCellIdentity</b><br/>An input variable used to calculate the <i>shortMAC-I</i>. Set to the <i>cellIdentity</i> of the first <i>PLMN-Identity</i> in the <i>PLMN-IdentityInfoList</i> broadcasted in <i>SIB1</i> of the target cell i.e. the cell the UE is trying to reestablish the connection.</p> |
| <p><b>source-c-RNTI</b><br/>Set to C-RNTI that the UE had in the PCell it was connected to prior to the reestablishment.</p>   |
| <p><b>sourcePhysCellId</b><br/>Set to the physical cell identity of the PCell the UE was connected to prior to the RRC connection.</p>   |

– End of *NR-UE-Variables*

```
-- ASN1START

END

-- ASN1STOP
```

---

## 8 Protocol data unit abstract syntax

### 8.1 General

The RRC PDU contents in clause 6 and clause 10 are described using abstract syntax notation one (ASN.1) as specified in ITU-T Rec. X.680 [6] and X.681 [7]. Transfer syntax for RRC PDUs is derived from their ASN.1 definitions by use of Packed Encoding Rules, unaligned as specified in ITU-T Rec. X.691 [8].

The following encoding rules apply in addition to what has been specified in X.691:

- When a bit string value is placed in a bit-field as specified in 15.6 to 15.11 in X.691, the leading bit of the bit string value shall be placed in the leading bit of the bit-field, and the trailing bit of the bit string value shall be placed in the trailing bit of the bit-field;

NOTE: The terms 'leading bit' and 'trailing bit' are defined in ITU-T Rec. X.680. When using the 'bstring' notation, the leading bit of the bit string value is on the left, and the trailing bit of the bit string value is on the right.

- When decoding types constrained with the ASN.1 Contents Constraint ("CONTAINING"), automatic decoding of the contained type should not be performed because errors in the decoding of the contained type should not cause the decoding of the entire RRC message PDU to fail. It is recommended that the decoder first decodes the outer PDU type that contains the OCTET STRING or BIT STRING with the Contents Constraint, and then decodes the contained type that is nested within the OCTET STRING or BIT STRING as a separate step;
- When decoding a) RRC message PDUs, b) BIT STRING constrained with a Contents Constraint, or c) OCTET STRING constrained with a Contents Constraint, PER decoders are required to never report an error if there are extraneous zero or non-zero bits at the end of the encoded RRC message PDU, BIT STRING or OCTET STRING.

### 8.2 Structure of encoded RRC messages

An RRC PDU, which is the bit string that is exchanged between peer entities/across the radio interface contains the basic production as defined in X.691.

RRC PDUs shall be mapped to and from PDCP SDUs (in case of DCCH) or RLC SDUs (in case of PCCH, BCCH or CCCH) upon transmission and reception as follows:

- when delivering an RRC PDU as an PDCP SDU to the PDCP layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the PDCP SDU and onwards; and
- when delivering an RRC PDU as an RLC SDU to the RLC layer for transmission, the first bit of the RRC PDU shall be represented as the first bit in the RLC SDU and onwards; and
- upon reception of an PDCP SDU from the PDCP layer, the first bit of the PDCP SDU shall represent the first bit of the RRC PDU and onwards; and
- upon reception of an RLC SDU from the RLC layer, the first bit of the RLC SDU shall represent the first bit of the RRC PDU and onwards.

### 8.3 Basic production

The 'basic production' is obtained by applying UNALIGNED PER to the abstract syntax value (the ASN.1 description) as specified in X.691. It always contains a multiple of 8 bits.

### 8.4 Extension

The following rules apply with respect to the use of protocol extensions:

- A transmitter compliant with this version of the specification shall, unless explicitly indicated otherwise on a PDU type basis, set the extension part empty. Transmitters compliant with a later version may send non-empty extensions;
- A transmitter compliant with this version of the specification shall set spare bits to zero.

## 8.5 Padding

If the encoded RRC message does not fill a transport block, the RRC layer shall add padding bits. This applies to PCCH and BCCH.

Padding bits shall be set to 0 and the number of padding bits is a multiple of 8.

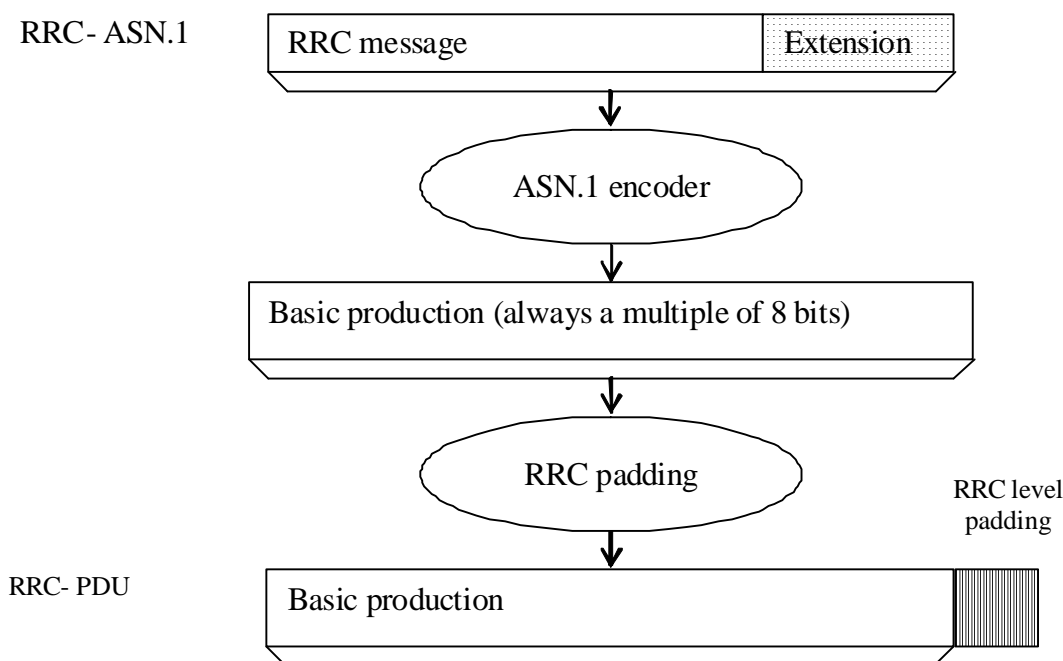


Figure 8.5-1: RRC level padding

## 9 Specified and default radio configurations

Specified and default configurations are configurations of which the details are specified in the standard. Specified configurations are fixed while default configurations can be modified using dedicated signalling. The default value for the parameters not listed in following subclauses shall be set such as the corresponding features are not configured, i.e. *release* or *false* unless explicitly stated otherwise.

NOTE: The UE applies the default values specified in the field description of ASN.1 parameters only when the parent IE is present. Hence, the UE does not apply all default values in field descriptions when it applies the "default radio configuration" in accordance with this clause.

### 9.1 Specified configurations

#### 9.1.1 Logical channel configurations

##### 9.1.1.1 BCCH configuration

Parameters

| Name                          | Value    | Semantics description | Ver |
|-------------------------------|----------|-----------------------|-----|
| SDAP configuration            | Not used |                       |     |
| PDCP configuration            | Not used |                       |     |
| RLC configuration             | TM       |                       |     |
| Logical channel configuration | Not used |                       |     |

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

### 9.1.1.2 CCCH configuration

Parameters

| Name                          | Value    | Semantics description | Ver |
|-------------------------------|----------|-----------------------|-----|
| SDAP configuration            | Not used |                       |     |
| PDCP configuration            | Not used |                       |     |
| RLC configuration             | TM       |                       |     |
| Logical channel configuration |          |                       |     |
| >priority                     | 1        | Highest priority      |     |
| >prioritisedBitRate           | infinity |                       |     |
| >bucketSizeDuration           | ms1000   |                       |     |
| >logicalChannelGroup          | 0        |                       |     |

### 9.1.1.3 PCCH configuration

Parameters

| Name                          | Value    | Semantics description | Ver |
|-------------------------------|----------|-----------------------|-----|
| SDAP configuration            | Not used |                       |     |
| PDCP configuration            | Not used |                       |     |
| RLC configuration             | TM       |                       |     |
| Logical channel configuration | Not used |                       |     |

NOTE: RRC will perform padding, if required due to the granularity of the TF signalling, as defined in 8.5.

## 9.1.2 Void

## 9.2 Default radio configurations

The following clauses only list default values for REL-15 parameters included in protocol version v15.3.0. For all fields introduced in a later protocol version, the default value is "released" or "false" unless explicitly specified otherwise. If the UE is to apply default configuration while it is configured with some critically extended fields, the UE shall apply the original version of those fields with only default values.

NOTE 1: In general, the signalling should preferably support a "release" option for fields introduced after v15.3.0. The "value not applicable" should be used restrictively, mainly limited to for fields which value is relevant only if another field is set to a value other than its default.

NOTE 2: For parameters in *ServingCellConfig*, the default values are specified in the corresponding specification.

### 9.2.1 Default SRB configurations

Parameters



| Name                          | Value    |      |      | Semantics description | Ver |
|-------------------------------|----------|------|------|-----------------------|-----|
|                               | SRB1     | SRB2 | SRB3 |                       |     |
| <i>PDCP-Config</i>            |          |      |      |                       |     |
| > <i>t-Reordering</i>         | infinity |      |      |                       |     |
| <i>RLC-Config CHOICE</i>      | Am       |      |      |                       |     |
| <i>ul-RLC-Config</i>          |          |      |      |                       |     |
| > <i>sn-FieldLength</i>       | size12   |      |      |                       |     |
| > <i>t-PollRetransmit</i>     | ms45     |      |      |                       |     |
| > <i>pollPDU</i>              | infinity |      |      |                       |     |
| > <i>pollByte</i>             | infinity |      |      |                       |     |
| > <i>maxRetxThreshold</i>     | t8       |      |      |                       |     |
| <i>dl-RLC-Config</i>          |          |      |      |                       |     |
| > <i>sn-FieldLength</i>       | size12   |      |      |                       |     |
| > <i>t-Reassembly</i>         | ms35     |      |      |                       |     |
| > <i>t-StatusProhibit</i>     | ms0      |      |      |                       |     |
| <i>logicalChannelIdentity</i> | 1        | 2    | 3    |                       |     |
| <i>LogicalChannelConfig</i>   |          |      |      |                       |     |
| > <i>priority</i>             | 1        | 3    | 1    |                       |     |
| > <i>prioritisedBitRate</i>   | infinity |      |      |                       |     |
| > <i>logicalChannelGroup</i>  | 0        |      |      |                       |     |

## 9.2.2 Default MAC Cell Group configuration

Parameters

| Name                              | Value | Semantics description | Ver |
|-----------------------------------|-------|-----------------------|-----|
| MAC Cell Group configuration      |       |                       |     |
| <i>bsr-Config</i>                 |       |                       |     |
| > <i>periodicBSR-Timer</i>        | sf10  |                       |     |
| > <i>retxBSR-Timer</i>            | sf80  |                       |     |
| <i>phr-Config</i>                 |       |                       |     |
| > <i>phr-PeriodicTimer</i>        | sf10  |                       |     |
| > <i>phr-ProhibitTimer</i>        | sf10  |                       |     |
| > <i>phr-Tx-PowerFactorChange</i> | dB1   |                       |     |

## 9.2.3 Default values timers and constants

Parameters

| Name | Value   | Semantics description | Ver |
|------|---------|-----------------------|-----|
| t310 | ms1000  |                       |     |
| n310 | n1      |                       |     |
| t311 | ms30000 |                       |     |
| n311 | n1      |                       |     |

---

# 10 Generic error handling

## 10.1 General

The generic error handling defined in the subsequent sub-clauses applies unless explicitly specified otherwise e.g. within the procedure specific error handling.

The UE shall consider a value as not comprehended when it is set:

- to an extended value that is not defined in the version of the transfer syntax supported by the UE;

- to a spare or reserved value unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved value.

The UE shall consider a field as not comprehended when it is defined:

- as spare or reserved unless the specification defines specific behaviour that the UE shall apply upon receiving the concerned spare/reserved field.

## 10.2 ASN.1 violation or encoding error

The UE shall:

- 1> when receiving an RRC message on the BCCH, CCCH or PCCH for which the abstract syntax is invalid [6]:
  - 2> ignore the message.

NOTE: This clause applies in case one or more fields is set to a value, other than a spare, reserved or extended value, not defined in this version of the transfer syntax. E.g. in the case the UE receives value 12 for a field defined as INTEGER (1..11). In cases like this, it may not be possible to reliably detect which field is in the error hence the error handling is at the message level.

## 10.3 Field set to a not comprehended value

The UE shall, when receiving an RRC message on any logical channel:

- 1> if the message includes a field that has a value that the UE does not comprehend:
  - 2> if a default value is defined for this field:
    - 3> treat the message while using the default value defined for this field;
  - 2> else if the concerned field is optional:
    - 3> treat the message as if the field were absent and in accordance with the need code for absence of the concerned field;
  - 2> else:
    - 3> treat the message as if the field were absent and in accordance with sub-clause 10.4.

## 10.4 Mandatory field missing

The UE shall:

- 1> if the message includes a field that is mandatory to include in the message (e.g. because conditions for mandatory presence are fulfilled) and that field is absent or treated as absent:
- 2> if the RRC message was not received on DCCH or CCCH:
  - 3> if the field concerns a (sub-field of) an entry of a list (i.e. a SEQUENCE OF):
    - 4> treat the list as if the entry including the missing or not comprehended field was absent;
  - 3> else if the field concerns a sub-field of another field, referred to as the 'parent' field i.e. the field that is one nesting level up compared to the erroneous field:
    - 4> consider the 'parent' field to be set to a not comprehended value;
    - 4> apply the generic error handling to the subsequent 'parent' field(s), until reaching the top nesting level i.e. the message level;
  - 3> else (field at message level):

4> ignore the message.

NOTE 1: The error handling defined in these sub-clauses implies that the UE ignores a message with the message type or version set to a not comprehended value.

NOTE 2: The nested error handling for messages received on logical channels other than DCCH and CCCH applies for errors in extensions also, even for errors that can be regarded as invalid network operation e.g. the network not observing conditional presence.

NOTE 3: UE behaviour on receipt of an RRC message on DCCH or CCCH that does not include a field that is mandatory (e.g. because conditions for mandatory presence are fulfilled) is unspecified.

The following ASN.1 further clarifies the levels applicable in case of nested error handling for errors in extension fields.

```
-- /example/ ASN1START
-- Example with extension addition group
ItemInfoList ::= SEQUENCE (SIZE (1..max)) OF ItemInfo
ItemInfo ::= SEQUENCE {
    itemIdentity      INTEGER (1..max),
    field1            Field1,
    field2            Field2                OPTIONAL,           -- Need N
    ...
    [[
    field3-r9         Field3-r9            OPTIONAL,           -- Cond Cond1
    field4-r9         Field4-r9            OPTIONAL             -- Need N
    ]]
}
-- Example with traditional non-critical extension (empty sequence)
BroadcastInfoBlock1 ::= SEQUENCE {
    itemIdentity      INTEGER (1..max),
    field1            Field1,
    field2            Field2                OPTIONAL,           -- Need N
    nonCriticalExtension BroadcastInfoBlock1-v940-IEs OPTIONAL
}
BroadcastInfoBlock1-v940-IEs ::= SEQUENCE {
    field3-r9         Field3-r9            OPTIONAL,           -- Cond Cond1
    field4-r9         Field4-r9            OPTIONAL,           -- Need N
    nonCriticalExtension SEQUENCE {}      OPTIONAL             -- Need S
}
-- ASN1STOP
```

The UE shall, apply the following principles regarding the levels applicable in case of nested error handling:

- an extension addition group is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, a error regarding the conditionality of *field3* would result in the entire *itemInfo* entry to be ignored (rather than just the extension addition group containing *field3* and *field4*);
- a traditional *nonCriticalExtension* is not regarded as a level on its own. E.g. in the ASN.1 extract in the previous, an error regarding the conditionality of *field3* would result in the entire *BroadcastInfoBlock1* to be ignored (rather than just the non-critical extension containing *field3* and *field4*).

## 10.5 Not comprehended field

The UE shall, when receiving an RRC message on any logical channel:

- 1> if the message includes a field that the UE does not comprehend:
  - 2> treat the rest of the message as if the field was absent.

NOTE: This clause does not apply to the case of an extension to the value range of a field. Such cases are addressed instead by the requirements in clause 10.3.

---

# 11 Radio information related interactions between network nodes

## 11.1 General

This clause specifies RRC messages that are transferred between network nodes. These RRC messages may be transferred to or from the UE via another Radio Access Technology. Consequently, these messages have similar characteristics as the RRC messages that are transferred across the NR radio interface, i.e. the same transfer syntax and protocol extension mechanisms apply.

## 11.2 Inter-node RRC messages

### 11.2.1 General

This clause specifies RRC messages that are sent either across the X2-, Xn- or the NG-interface, either to or from the gNB, i.e. a single 'logical channel' is used for all RRC messages transferred across network nodes. The information could originate from or be destined for another RAT.

```
-- ASN1START
-- TAG-NR-INTER-NODE-DEFINITIONS-START

NR-InterNodeDefinitions DEFINITIONS AUTOMATIC TAGS ::=

BEGIN

IMPORTS
    ARFCN-ValueNR,
    ARFCN-ValueEUTRA,
    CellIdentity,
    CGI-InfoEUTRA,
    CGI-InfoNR,
    CSI-RS-Index,
    DRX-Config,
    EUTRA-PhysCellId,
    FreqBandIndicatorNR,
    GapConfig,
    maxBandComb,
    maxBands,
    maxCellSFTD,
    maxFeatureSetsPerBand,
    maxFreqIDC-MRDC,
    maxNrofCombIDC,
    maxNrofSCells,
    maxNrofServingCells,
    maxNrofServingCells-1,
    maxNrofServingCellsEUTRA,
    maxNrofIndexesToReport,
```

```

maxSimultaneousBands,
MeasQuantityResults,
MeasResultCellListSFTD-EUTRA,
MeasResultCellListSFTD-NR,
MeasResultList2NR,
MeasResultSCG-Failure,
MeasResultServFreqListEUTRA-SCG,
P-Max,
PhysCellId,
RadioBearerConfig,
RAN-NotificationAreaInfo,
RRCReconfiguration,
ServCellIndex,
SetupRelease,
SSB-Index,
SSB-MTC,
SSB-ToMeasure,
SS-RSSI-Measurement,
ShortMAC-I,
SubcarrierSpacing,
UEAssistanceInformation,
UE-CapabilityRAT-ContainerList
FROM NR-RRC-Definitions;

-- TAG-NR-INTER-NODE-DEFINITIONS-STOP
-- ASN1STOP

```

## 11.2.2 Message definitions

### – *HandoverCommand*

This message is used to transfer the handover command as generated by the target gNB.

Direction: target gNB to source gNB/source RAN.

#### ***HandoverCommand* message**

```

-- ASN1START
-- TAG-HANDOVER-COMMAND-START

HandoverCommand ::=
    SEQUENCE {
        criticalExtensions
            CHOICE {
                c1
                    CHOICE {
                        handoverCommand
                            HandoverCommand-IEs,
                        spare3 NULL, spare2 NULL, spare1 NULL
                    },
                criticalExtensionsFuture
                    SEQUENCE {}
            }
    }
}

```

```

HandoverCommand-IEs ::= SEQUENCE {
    handoverCommandMessage OCTET STRING (CONTAINING RRCReconfiguration),
    nonCriticalExtension    SEQUENCE {} OPTIONAL
}

-- TAG-HANDOVER-COMMAND-STOP
-- ASN1STOP

```

#### **HandoverCommand field descriptions**

##### **handoverCommandMessage**

Contains the *RRCReconfiguration* message used to perform handover within NR or handover to NR, as generated (entirely) by the target gNB.

### – *HandoverPreparationInformation*

This message is used to transfer the NR RRC information used by the target gNB during handover preparation, including UE capability information. This message is also used for transferring the information between the CU and DU.

Direction: source gNB/source RAN to target gNB or CU to DU.

#### **HandoverPreparationInformation message**

```

-- ASN1START
-- TAG-HANDOVER-PREPARATION-INFORMATION-START

HandoverPreparationInformation ::= SEQUENCE {
    criticalExtensions CHOICE {
        c1 CHOICE {
            handoverPreparationInformation HandoverPreparationInformation-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

HandoverPreparationInformation-IEs ::= SEQUENCE {
    ue-CapabilityRAT-List UE-CapabilityRAT-ContainerList,
    sourceConfig          AS-Config OPTIONAL, -- Cond HO
    rrm-Config            RRM-Config  OPTIONAL,
    as-Context            AS-Context  OPTIONAL,
    nonCriticalExtension  SEQUENCE {}  OPTIONAL
}

AS-Config ::= SEQUENCE {
    rrcReconfiguration OCTET STRING (CONTAINING RRCReconfiguration),
    ...,
    [[
    sourceRB-SN-Config  OCTET STRING (CONTAINING RadioBearerConfig) OPTIONAL,
    sourceSCG-NR-Config OCTET STRING (CONTAINING RRCReconfiguration) OPTIONAL,

```

```

    sourceSCG-EUTRA-Config          OCTET STRING          OPTIONAL
    ]]
}

AS-Context ::=
    reestablishmentInfo              SEQUENCE {
    configRestrictInfo                ReestablishmentInfo          OPTIONAL,
    ...,                              ConfigRestrictInfoSCG         OPTIONAL,
    [[ ran-NotificationAreaInfo      RAN-NotificationAreaInfo     OPTIONAL
    ]],
    [[ ueAssistanceInformation         OCTET STRING (CONTAINING UEAssistanceInformation) OPTIONAL -- Cond HO2
    ]],
    [[
    selectedBandCombinationSN         BandCombinationInfoSN        OPTIONAL
    ]]]
}

ReestablishmentInfo ::=
    sourcePhysCellId                 SEQUENCE {
    targetCellShortMAC-I              PhysCellId,
    additionalReestabInfoList         ShortMAC-I,
                                      ReestabNCellInfoList          OPTIONAL
}

ReestabNCellInfoList ::=           SEQUENCE ( SIZE (1..maxCellPrep) ) OF ReestabNCellInfo

ReestabNCellInfo ::= SEQUENCE {
    cellIdentity                      CellIdentity,
    key-gNodeB-Star                   BIT STRING (SIZE (256)),
    shortMAC-I                         ShortMAC-I
}

RRM-Config ::=
    ue-InactiveTime                   SEQUENCE {
    ...,                               ENUMERATED {
    candidateCellInfoList             s1, s2, s3, s5, s7, s10, s15, s20,
    MeasResultList2NR                s25, s30, s40, s50, min1, min1s20, min1s40,
    ...,                               min2, min2s30, min3, min3s30, min4, min5, min6,
    [[ candidateCellInfoListSN-EUTRA  min7, min8, min9, min10, min12, min14, min17, min20,
    MeasResultServFreqListEUTRA-SCG min24, min28, min33, min38, min44, min50, hr1,
                                        hr1min30, hr2, hr2min30, hr3, hr3min30, hr4, hr5, hr6,
                                        hr8, hr10, hr13, hr16, hr20, day1, day1hr12, day2,
                                        day2hr12, day3, day4, day5, day7, day10, day14, day19,
                                        day24, day30, dayMoreThan30}
    ]]]
    }

-- TAG-HANDOVER-PREPARATION-INFORMATION-STOP
-- ASN1STOP

```

| <b>HandoverPreparationInformation field descriptions</b>   |
|--|
| <p><b>as-Context</b><br/>Local RAN context required by the target gNB.</p>   |
| <p><b>rrm-Config</b><br/>Local RAN context used mainly for RRM purposes.</p>   |
| <p><b>sourceConfig</b><br/>The radio resource configuration as used in the source cell.</p>  |
| <p><b>ue-CapabilityRAT-List</b><br/>The UE radio access related capabilities concerning RATs supported by the UE.</p>  |
| <p><b>ue-InactiveTime</b><br/>Duration while UE has not received or transmitted any user data. Thus the timer is still running in case e.g., UE measures the neighbour cells for the HO purpose. Value <i>s1</i> corresponds to 1 second, <i>s2</i> corresponds to 2 seconds and so on. Value <i>min1</i> corresponds to 1 minute, value <i>min1s20</i> corresponds to 1 minute and 20 seconds, value <i>min1s40</i> corresponds to 1 minute and 40 seconds and so on. Value <i>hr1</i> corresponds to 1 hour, <i>hr1min30</i> corresponds to 1 hour and 30 minutes and so on.</p> |

| <b>AS-Config field descriptions</b>   |
|---|
| <p><b>rrcReconfiguration</b><br/>Contains the <i>RRCReconfiguration</i> configuration as generated entirely by the MN.</p>  |
| <p><b>sourceRB-SN-Config</b><br/>Contains the IE <i>RadioBearerConfig</i> as generated entirely by the SN. This field is only used in NE-DC and NR-DC.</p>  |
| <p><b>sourceSCG-EUTRA-Config</b><br/>Contains the current dedicated SCG configuration in <i>RRCConnectionReconfiguration</i> message as specified in TS 36.331 [10] and generated entirely by the SN. In this version of the specification, the E-UTRA <i>RRCConnectionReconfiguration</i> message can only include the field <i>scg-Configuration</i>. This field is only used in NE-DC.</p> |
| <p><b>sourceSCG-NR-Config</b><br/>Contains the current dedicated SCG configuration in <i>RRCReconfiguration</i> message as generated entirely by the SN. In this version of the specification, the <i>RRCReconfiguration</i> message can only include fields <i>CellGroupConfig</i> and <i>measConfig</i>. This field is only used in NR-DC.</p>  |

| <b>AS-Context field descriptions</b>  |
|---|
| <p><b>selectedBandCombinationSN</b><br/>Indicates the band combination selected by SN in (NG)EN-DC, NE-DC, and NR-DC.</p> |

| <b>RRM-Config field descriptions</b>   |
|--|
| <p><b>candidateCellInfoList</b><br/>A list of the best cells on each frequency for which measurement information was available</p>   |
| <p><b>candidateCellInfoListSN-EUTRA</b><br/>Includes the <i>MeasResultList3EUTRA</i> as specified in TS 36.331 [10]. A list of EUTRA cells including serving cells and best neighbour cells on each serving frequency, for which measurement results were available. This field is only used in NE-DC.</p> |

| <b>Conditional Presence</b> | <b>Explanation</b>   |
|-----------------------------|--|
| <i>HO</i>                   | The field is mandatory present in case of handover within NR; The field is optionally present in case of handover from E-UTRA connected to 5GC; otherwise the field is absent. |
| <i>HO2</i>                  | The field is optionally present in case of handover within NR; otherwise the field is absent.  |



NOTE 1: The following table indicates per source RAT whether RAT capabilities are included or not.

| Source RAT | NR capabilities | E-UTRA capabilities | MR-DC capabilities |
|------------|-----------------|---------------------|--------------------|
| NR         | Included        | May be included     | May be included    |
| E-UTRAN    | Included        | May be included     | May be included    |

NOTE 2: The following table indicates, in case of inter-RAT handover from E-UTRA, which additional IEs are included or not:

| Source system | sourceConfig  | rrm-Config      | as-Context   |
|---------------|---|-----------------|--------------|
| E-UTRA/EPC    | Not included  | May be included | Not included |
| E-UTRA/5GC    | May be included, but only <i>radioBearerConfig</i> is included in the <i>RRCReconfiguration</i> . | May be included | Not included |

## – CG-Config

This message is used to transfer the SCG radio configuration as generated by the SgNB or SeNB.

Direction: Secondary gNB or eNB to master gNB or eNB.

### CG-Config message

```
-- ASN1START
-- TAG-CG-CONFIG-START

CG-Config ::=
    criticalExtensions
        CHOICE {
            c1
                CHOICE {
                    cg-Config
                    CG-Config-IEs,
                    spare3 NULL, spare2 NULL, spare1 NULL
                },
            criticalExtensionsFuture
                SEQUENCE {}
        }
}

CG-Config-IEs ::=
    SEQUENCE {
        scg-CellGroupConfig
            OCTET STRING (CONTAINING RRCReconfiguration)
            OPTIONAL,
        scg-RB-Config
            OCTET STRING (CONTAINING RadioBearerConfig)
            OPTIONAL,
        configRestrictModReq
            ConfigRestrictModReqSCG
            OPTIONAL,
        drx-InfoSCG
            DRX-Info
            OPTIONAL,
        candidateCellInfoListSN
            OCTET STRING (CONTAINING MeasResultList2NR)
            OPTIONAL,
        measConfigSN
            MeasConfigSN
            OPTIONAL,
        selectedBandCombination
            BandCombinationInfoSN
            OPTIONAL,
        fr-InfoListSCG
            FR-InfoList
            OPTIONAL,
        candidateServingFreqListNR
            CandidateServingFreqListNR
            OPTIONAL,
        nonCriticalExtension
            CG-Config-v1540-IEs
            OPTIONAL
    }
}
```

```

CG-Config-v1540-IEs ::=          SEQUENCE {
    pSCellFrequency                ARFCN-ValueNR                OPTIONAL,
    reportCGI-RequestNR           SEQUENCE {
        requestedCellInfo         SEQUENCE {
            ssbFrequency           ARFCN-ValueNR,
            cellForWhichToReportCGI PhysCellId
        }
    }
    ph-InfoSCG                    PH-TypeListSCG
    nonCriticalExtension           CG-Config-v1560-IEs
}

CG-Config-v1560-IEs ::=          SEQUENCE {
    pSCellFrequencyEUTRA          ARFCN-ValueEUTRA          OPTIONAL,
    scg-CellGroupConfigEUTRA     OCTET STRING              OPTIONAL,
    candidateCellInfoListSN-EUTRA OCTET STRING              OPTIONAL,
    candidateServingFreqListEUTRA CandidateServingFreqListEUTRA OPTIONAL,
    needForGaps                   ENUMERATED {true}         OPTIONAL,
    drx-ConfigSCG                 DRX-Config                OPTIONAL,
    reportCGI-RequestEUTRA        SEQUENCE {
        requestedCellInfoEUTRA    SEQUENCE {
            eutraFrequency         ARFCN-ValueEUTRA,
            cellForWhichToReportCGI-EUTRA EUTRA-PhysCellId
        }
    }
    nonCriticalExtension          SEQUENCE {}
}

PH-TypeListSCG ::=              SEQUENCE (SIZE (1..maxNrofServingCells)) OF PH-InfoSCG

PH-InfoSCG ::=                  SEQUENCE {
    servCellIndex                 ServCellIndex,
    ph-Uplink                     PH-UplinkCarrierSCG,
    ph-SupplementaryUplink        PH-UplinkCarrierSCG      OPTIONAL,
    ...
}

PH-UplinkCarrierSCG ::=         SEQUENCE{
    ph-Type1or3                   ENUMERATED {type1, type3},
    ...
}

MeasConfigSN ::=               SEQUENCE {
    measuredFrequenciesSN         SEQUENCE (SIZE (1..maxMeasFreqsSN)) OF NR-FreqInfo OPTIONAL,
    ...
}

NR-FreqInfo ::=                 SEQUENCE {
    measuredFrequency             ARFCN-ValueNR                OPTIONAL,
    ...
}

ConfigRestrictModReqSCG ::=     SEQUENCE {

```

```

    requestedBC-MRDC                BandCombinationInfoSN      OPTIONAL,
    requestedP-MaxFR1                P-Max                  OPTIONAL,
    . . . ,
    [[
    requestedPDCCH-BlindDetectionSCG  INTEGER (1..15)      OPTIONAL,
    requestedP-MaxEUTRA              P-Max                  OPTIONAL
    ]]
}

BandCombinationIndex ::= INTEGER (1..maxBandComb)

BandCombinationInfoSN ::= SEQUENCE {
    bandCombinationIndex      BandCombinationIndex,
    requestedFeatureSets      FeatureSetEntryIndex
}

FR-InfoList ::= SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF FR-Info

FR-Info ::= SEQUENCE {
    servCellIndex      ServCellIndex,
    fr-Type            ENUMERATED {fr1, fr2}
}

CandidateServingFreqListNR ::= SEQUENCE (SIZE (1.. maxFreqIDC-MRDC)) OF ARFCN-ValueNR

CandidateServingFreqListEUTRA ::= SEQUENCE (SIZE (1.. maxFreqIDC-MRDC)) OF ARFCN-ValueEUTRA

-- TAG-CG-CONFIG-STOP
-- ASN1STOP

```

| <b>CG-Config field descriptions</b>  |
|--|
| <p><b>candidateCellInfoListSN</b><br/>Contains information regarding cells that the source secondary node suggests the target secondary gNB to consider configuring.</p>   |
| <p><b>candidateCellInfoListSN-EUTRA</b><br/>Includes the <i>MeasResultList3EUTRA</i> as specified in TS 36.331 [10]. Contains information regarding cells that the source secondary node suggests the target secondary eNB to consider configuring. This field is only used in NE-DC.</p>  |
| <p><b>candidateServingFreqListNR, candidateServingFreqListEUTRA</b><br/>Indicates frequencies of candidate serving cells for In-Device Co-existence Indication (see TS 36.331 [10]).</p>   |
| <p><b>configRestrictModReq</b><br/>Used by SN to request changes to SCG configuration restrictions previously set by MN to ensure UE capabilities are respected. E.g. can be used to request configuring an NR band combination whose use MN has previously forbidden.</p>   |
| <p><b>drx-ConfigSCG</b><br/>This field contains the complete DRX configuration of the SCG. This field is only used in NR-DC.</p>   |
| <p><b>drx-InfoSCG</b><br/>This field contains the DRX long and short cycle configuration of the SCG. This field is used in (NG)EN-DC and NE-DC.</p>  |
| <p><b>fr-InfoListSCG</b><br/>Contains information of FR information of serving cells that include PSCell and Scells configured in SCG.</p>   |
| <p><b>measuredFrequenciesSN</b><br/>Used by SN to indicate a list of frequencies measured by the UE.</p>   |
| <p><b>needForGaps</b><br/>In NE-DC, indicates whether the SN requests gNB to configure measurements gaps.</p>  |
| <p><b>ph-InfoSCG</b><br/>Power headroom information in SCG that is needed in the reception of PHR MAC CE of MCG</p>  |
| <p><b>ph-SupplementaryUplink</b><br/>Power headroom information for supplementary uplink. In the case of (NG)EN-DC and NR-DC, this field is only present when two UL carriers are configured for a serving cell and one UL carrier reports type1 PH while the other reports type 3 PH.</p>   |
| <p><b>ph-Type1or3</b><br/>Type of power headroom for a certain serving cell in SCG (PSCell and activated SCells). Value <i>type1</i> refers to type 1 power headroom, value <i>type3</i> refers to type 3 power headroom. (See TS 38.321 [3]).</p>   |
| <p><b>ph-Uplink</b><br/>Power headroom information for uplink.</p>   |
| <p><b>pSCellFrequency, pSCellFrequencyEUTRA</b><br/>Indicates the frequency of PSCell in NR (i.e., <i>pSCellFrequency</i>) or E-UTRA (i.e., <i>pSCellFrequencyEUTRA</i>). In this version of the specification, <i>pSCellFrequency</i> is not used in NE-DC whereas <i>pSCellFrequencyEUTRA</i> is only used in NE-DC.</p>   |
| <p><b>reportCGI-RequestNR, reportCGI-RequestEUTRA</b><br/>Used by SN to indicate to MN about configuring <i>reportCGI</i> procedure. The request may optionally contain information about the cell for which SN intends to configure <i>reportCGI</i> procedure. In this version of the specification, the <i>reportCGI-RequestNR</i> is used in (NG)EN-DC and NR-DC whereas <i>reportCGI-RequestEUTRA</i> is used only for NE-DC.</p> |
| <p><b>requestedBC-MRDC</b><br/>Used to request configuring an NR band combination and corresponding feature sets which are forbidden to use by MN.</p>   |
| <p><b>requestedPDCCH-BlindDetectionSCG</b><br/>Requested value of the reference number of cells for PDCCH blind detection allowed to be configured for the SCG.</p>  |
| <p><b>requestedP-MaxEUTRA</b><br/>Requested value for the maximum power for the serving cells the UE can use in E-UTRA SCG. This field is only used in NE-DC.</p>  |
| <p><b>requestedP-MaxFR1</b><br/>Requested value for the maximum power for the serving cells on frequency range 1 (FR1) in this secondary cell group (see TS 38.104 [12]) the UE can use in NR SCG.</p>   |

|   |
|---|
| <p><b>scg-CellGroupConfig</b><br/>Contains the <i>RRCReconfiguration</i> message:</p> <ul style="list-style-type: none"> <li>- to be sent to the UE, used upon SCG establishment or modification, as generated (entirely) by the (target) SgNB. In this case, the SN sets the <i>RRCReconfiguration</i> message in accordance with clause 6 e.g. regarding the "Need" or "Cond" statements.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>- including the current SCG configuration of the UE, when provided in response to a query from MN, or in SN triggered SN change in order to enable delta signaling by the target SN. In this case, the SN sets the <i>RRCReconfiguration</i> message in accordance with clause 11.2.3.</li> </ul> <p>The field is absent if neither SCG (re)configuration nor SCG configuration query nor SN triggered SN change is performed, e.g. at inter-node capability/configuration coordination which does not result in SCG (re)configuration towards the UE. This field is not applicable in NE-DC.</p> |
| <p><b>scg-CellGroupConfigEUTRA</b><br/>Includes the E-UTRA <i>RRCConnectionReconfiguration</i> message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field <i>scg-Configuration</i>. Used to (re-)configure the SCG configuration upon SCG establishment or modification, as generated (entirely) by the (target) SeNB. This field is absent when master gNB uses full configuration option. This field is only used in NE-DC.</p>  |
| <p><b>scg-RB-Config</b><br/>Contains the IE <i>RadioBearerConfig</i>:</p> <ul style="list-style-type: none"> <li>- to be sent to the UE, used to (re-)configure the SCG RB configuration upon SCG establishment or modification, as generated (entirely) by the (target) SgNB or SeNB. In this case, the SN sets the <i>RadioBearerConfig</i> in accordance with section 6, e.g. regarding the "Need" or "Cond" statements.</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>- including the current SCG RB configuration of the UE, when provided in response to a query from MN or in SN triggered SN change in order to enable delta signaling by the target SN. In this case, the SN sets the <i>RRCReconfiguration</i> message in accordance with section 11.2.3.</li> </ul> <p>The field is absent if neither SCG (re)configuration nor SCG configuration query nor SN triggered SN change is performed, e.g. at inter-node capability/configuration coordination which does not result in SCG RB (re)configuration.</p>                 |
| <p><b>selectedBandCombination</b><br/>Indicates the band combination selected by SN in (NG)EN-DC, NE-DC, and NR-DC.</p>   |

| <b>BandCombinationInfoSN field descriptions</b>  |
|--|
| <p><b>bandCombinationIndex</b><br/>The position of a band combination in the <i>supportedBandCombinationList</i></p>   |
| <p><b>requestedFeatureSets</b><br/>The position in the <i>FeatureSetCombination</i> which identifies one <i>FeatureSetUplink/Downlink</i> for each band entry in the associated band combination</p> |

## – CG-ConfigInfo

This message is used by master eNB or gNB to request the SgNB or SeNB to perform certain actions e.g. to establish, modify or release an SCG. The message may include additional information e.g. to assist the SgNB or SeNB to set the SCG configuration. It can also be used by a CU to request a DU to perform certain actions, e.g. to establish, modify or release an MCG or SCG.

Direction: Master eNB or gNB to secondary gNB or eNB, alternatively CU to DU.

**CG-ConfigInfo message**

```
-- ASN1START
-- TAG-CG-CONFIG-INFO-START
```

```
CG-ConfigInfo ::= SEQUENCE {
    criticalExtensions      CHOICE {
        c1                  CHOICE {
            cg-ConfigInfo  CG-ConfigInfo-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

CG-ConfigInfo-IEs ::= SEQUENCE {
    ue-CapabilityInfo      OCTET STRING (CONTAINING UE-CapabilityRAT-ContainerList)      OPTIONAL, -- Cond SN-AddMod
    candidateCellInfoListMN MeasResultList2NR                      OPTIONAL,
    candidateCellInfoListSN OCTET STRING (CONTAINING MeasResultList2NR)  OPTIONAL,
    measResultCellListSFTD-NR MeasResultCellListSFTD-NR      OPTIONAL,
    scgFailureInfo         SEQUENCE {
        failureType        ENUMERATED { t310-Expiry, randomAccessProblem,
                                        rlc-MaxNumRetx, synchReconfigFailure-SCG,
                                        scg-reconfigFailure,
                                        srb3-IntegrityFailure},
        measResultSCG      OCTET STRING (CONTAINING MeasResultSCG-Failure)
    }
    configRestrictInfo     ConfigRestrictInfoSCG                      OPTIONAL,
    drx-InfoMCG            DRX-Info                                OPTIONAL,
    measConfigMN           MeasConfigMN                            OPTIONAL,
    sourceConfigSCG       OCTET STRING (CONTAINING RRCReconfiguration)  OPTIONAL,
    scg-RB-Config         OCTET STRING (CONTAINING RadioBearerConfig)  OPTIONAL,
    mcg-RB-Config         OCTET STRING (CONTAINING RadioBearerConfig)  OPTIONAL,
    mrdc-AssistanceInfo   MRDC-AssistanceInfo                      OPTIONAL,
    nonCriticalExtension   CG-ConfigInfo-v1540-IEs                 OPTIONAL
}

CG-ConfigInfo-v1540-IEs ::= SEQUENCE {
    ph-InfoMCG            PH-TypeListMCG                          OPTIONAL,
    measResultReportCGI   SEQUENCE {
        ssbFrequency      ARFCN-ValueNR,
        cellForWhichToReportCGI PhysCellId,
        cgi-Info          CGI-InfoNR
    }
    nonCriticalExtension   CG-ConfigInfo-v1560-IEs                 OPTIONAL,
}

CG-ConfigInfo-v1560-IEs ::= SEQUENCE {
    candidateCellInfoListMN-EUTRA OCTET STRING      OPTIONAL,
    candidateCellInfoListSN-EUTRA OCTET STRING      OPTIONAL,
    sourceConfigSCG-EUTRA        OCTET STRING      OPTIONAL,
    scgFailureInfoEUTRA          SEQUENCE {
        failureTypeEUTRA    ENUMERATED { t313-Expiry, randomAccessProblem,
                                        rlc-MaxNumRetx, scg-ChangeFailure},
    }
}
```

```

    measResultSCG-EUTRA          OCTET STRING
  }
  drx-ConfigMCG                  DRX-Config
  measResultReportCGI-EUTRA      SEQUENCE {
    eutraFrequency                ARFCN-ValueEUTRA,
    cellForWhichToReportCGI-EUTRA EUTRA-PhysCellId,
    cgi-InfoEUTRA                 CGI-InfoEUTRA
  }
  measResultCellListSFTD-EUTRA   MeasResultCellListSFTD-EUTRA
  fr-InfoListMCG                 FR-InfoList
  nonCriticalExtension           SEQUENCE {}
}

ConfigRestrictInfoSCG ::= SEQUENCE {
  allowedBC-ListMRDC             BandCombinationInfoList
  powerCoordination-FR1          SEQUENCE {
    p-maxNR-FR1                  P-Max
    p-maxEUTRA                   P-Max
    p-maxUE-FR1                  P-Max
  }
  servCellIndexRangeSCG         SEQUENCE {
    lowBound                      ServCellIndex,
    upBound                       ServCellIndex
  }
  maxMeasFreqsSCG               INTEGER(1..maxMeasFreqsMN)
-- TBD Late Drop: If maxMeasIdentitiesSCG is used needs to be decided after RAN4 replies to the LS on measurement requirements for MR-DC.
  maxMeasIdentitiesSCG-NR       INTEGER(1..maxMeasIdentitiesMN)
  ...
  [[
  selectedBandEntriesMN          SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandEntryIndex
  pdcch-BlindDetectionSCG        INTEGER (1..15)
  maxNumberROHC-ContextSessionsSN INTEGER(0.. 16384)
  ]]
}

BandEntryIndex ::= INTEGER (0.. maxNrofServingCells)

PH-TypeListMCG ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF PH-InfoMCG

PH-InfoMCG ::= SEQUENCE {
  servCellIndex                  ServCellIndex,
  ph-Uplink                      PH-UplinkCarrierMCG,
  ph-SupplementaryUplink         PH-UplinkCarrierMCG
  ...
}

PH-UplinkCarrierMCG ::= SEQUENCE{
  ph-Type1or3                    ENUMERATED {type1, type3},
  ...
}

BandCombinationInfoList ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombinationInfo

BandCombinationInfo ::= SEQUENCE {

```

```

    bandCombinationIndex      BandCombinationIndex,
    allowedFeatureSetsList    SEQUENCE (SIZE (1..maxFeatureSetsPerBand)) OF FeatureSetEntryIndex
}

FeatureSetEntryIndex ::=      INTEGER (1.. maxFeatureSetsPerBand)

DRX-Info ::=                  SEQUENCE {
    drx-LongCycleStartOffset  CHOICE {
        ms10                  INTEGER(0..9),
        ms20                  INTEGER(0..19),
        ms32                  INTEGER(0..31),
        ms40                  INTEGER(0..39),
        ms60                  INTEGER(0..59),
        ms64                  INTEGER(0..63),
        ms70                  INTEGER(0..69),
        ms80                  INTEGER(0..79),
        ms128                 INTEGER(0..127),
        ms160                 INTEGER(0..159),
        ms256                 INTEGER(0..255),
        ms320                 INTEGER(0..319),
        ms512                 INTEGER(0..511),
        ms640                 INTEGER(0..639),
        ms1024                INTEGER(0..1023),
        ms1280                INTEGER(0..1279),
        ms2048                INTEGER(0..2047),
        ms2560                INTEGER(0..2559),
        ms5120                INTEGER(0..5119),
        ms10240               INTEGER(0..10239)
    },
    shortDRX                  SEQUENCE {
        drx-ShortCycle        ENUMERATED {
            ms2, ms3, ms4, ms5, ms6, ms7, ms8, ms10, ms14, ms16, ms20, ms30, ms32,
            ms35, ms40, ms64, ms80, ms128, ms160, ms256, ms320, ms512, ms640, spare9,
            spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1 },
        drx-ShortCycleTimer  INTEGER (1..16)
    }
}

MeasConfigMN ::= SEQUENCE {
    measuredFrequenciesMN    SEQUENCE (SIZE (1..maxMeasFreqsMN)) OF NR-FreqInfo      OPTIONAL,
    measGapConfig            SetupRelease { GapConfig }                          OPTIONAL,
    gapPurpose               ENUMERATED {perUE, perFR1}                          OPTIONAL,
    ...,
    [[ measGapConfigFR2      SetupRelease { GapConfig }                          OPTIONAL
]]

}

MRDC-AssistanceInfo ::= SEQUENCE {
    affectedCarrierFreqCombInfoListMRDC SEQUENCE (SIZE (1..maxNrofCombIDC)) OF AffectedCarrierFreqCombInfoMRDC,
    ...
}

AffectedCarrierFreqCombInfoMRDC ::= SEQUENCE {

```



```

victimSystemType          VictimSystemType,
interferenceDirectionMRDC ENUMERATED {eutra-nr, nr, other, ultra-nr-other, nr-other, spare3, spare2, spare1},
affectedCarrierFreqCombMRDC SEQUENCE {
  affectedCarrierFreqCombEUTRA AffectedCarrierFreqCombEUTRA OPTIONAL,
  affectedCarrierFreqCombNR     AffectedCarrierFreqCombNR   OPTIONAL,
}
}

VictimSystemType ::= SEQUENCE {
  gps          ENUMERATED {true} OPTIONAL,
  glonass      ENUMERATED {true} OPTIONAL,
  bds          ENUMERATED {true} OPTIONAL,
  galileo     ENUMERATED {true} OPTIONAL,
  wlan        ENUMERATED {true} OPTIONAL,
  bluetooth   ENUMERATED {true} OPTIONAL,
}

AffectedCarrierFreqCombEUTRA ::= SEQUENCE (SIZE (1..maxNrofServingCellsEUTRA)) OF ARFCN-ValueEUTRA

AffectedCarrierFreqCombNR ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF ARFCN-ValueNR

-- TAG-CG-CONFIG-INFO-STOP
-- ASN1STOP

```

| <b>CG-ConfigInfo field descriptions</b>   |
|---|
| <p><b>allowedBC-ListMRDC</b><br/>A list of indices referring to band combinations in MR-DC capabilities from which SN is allowed to select the SCG band combination. Each entry refers to a band combination numbered according to <i>supportedBandCombinationList</i> in the <i>UE-MRDC-Capability</i> (in case of (NG)EN-DC or NE-DC) or <i>UE-NR-Capability</i> (in case of NR-DC) and the Feature Sets allowed for each band entry. All MR-DC band combinations indicated by this field comprise the MCG band combination, which is a superset of the MCG band(s) selected by MN.</p> |
| <p><b>candidateCellInfoListMN, candidateCellInfoListSN</b><br/>Contains information regarding cells that the master node or the source node suggests the target gNB to consider configuring.<br/>For (NG)EN-DC, including CSI-RS measurement results in <i>candidateCellInfoListMN</i> is not supported in this version of the specification. For NR-DC, including SSB and/or CSI-RS measurement results in <i>candidateCellInfoListMN</i> is supported.</p>  |
| <p><b>candidateCellInfoListMN-EUTRA, candidateCellInfoListSN-EUTRA</b><br/>Includes the <i>MeasResultList3EUTRA</i> as specified in TS 36.331 [10]. Contains information regarding cells that the master node or the source node suggests the target secondary eNB to consider configuring. These fields are only used in NE-DC.</p>  |
| <p><b>configRestrictInfo</b><br/>Includes fields for which SgNB is explicitly indicated to observe a configuration restriction.</p>   |
| <p><b>drx-ConfigMCG</b><br/>This field contains the complete DRX configuration of the MCG. This field is only used in NR-DC.</p>  |
| <p><b>drx-InfoMCG</b><br/>This field contains the DRX long and short cycle configuration of the MCG. This field is used in (NG)EN-DC and NE-DC.</p>   |
| <p><b>fr-InfoListMCG</b><br/>Contains information of FR information of serving cells that include PCell and SCell(s) configured in MCG.</p>   |
| <p><b>maxMeasFreqsSCG</b><br/>Indicates the maximum number of NR inter-frequency carriers the SN is allowed to configure with PSCell for measurements.</p>  |
| <p><b>maxMeasIdentitiesSCG-NR</b><br/>Indicates the maximum number of allowed measurement identities that the SCG is allowed to configure.</p>  |
| <p><b>maxNumberROHC-ContextSessionsSN</b><br/>Indicates the maximum number of context sessions allowed to SN terminated bearer, excluding context sessions that leave all headers uncompressed.</p>   |
| <p><b>measuredFrequenciesMN</b><br/>Used by MN to indicate a list of frequencies measured by the UE.</p>  |
| <p><b>measGapConfig</b><br/>Indicates the FR1 and perUE measurement gap configuration configured by MN.</p>   |
| <p><b>measGapConfigFR2</b><br/>Indicates the FR2 measurement gap configuration configured by MN.</p>  |
| <p><b>mcb-RB-Config</b><br/>Contains all of the fields in the IE <i>RadioBearerConfig</i> used in MCG, used by the SN to support delta configuration to UE, for bearer type change between MN terminated bearer with NR PDCP to SN terminated bearer. It is also used to indicate the PDCP duplication related information for MN terminated split bearer (whether duplication is configured and if so, whether it is initially activated) in SN Addition/Modification procedure. Otherwise, this field is absent.</p>  |
| <p><b>measResultReportCGI, measResultReportCGI-EUTRA</b><br/>Used by MN to provide SN with CGI-Info for the cell as per SN's request. In this version of the specification, the <i>measResultReportCGI</i> is used for (NG)EN-DC and NR-DC and the <i>measResultReportCGI-EUTRA</i> is used only for NE-DC.</p>   |
| <p><b>measResultSCG-EUTRA</b><br/>This field includes the <i>MeasResultSCG-FailureMRDC</i> IE as specified in TS 36.331 [10]. This field is only used in NE-DC.</p>   |
| <p><b>measResultSFTD-EUTRA</b><br/>SFTD measurement results between the PCell and the E-UTRA PScell in NE-DC. This field is only used in NE-DC.</p>   |
| <p><b>mrhc-AssistanceInfo</b><br/>Contains the IDC assistance information for MR-DC reported by the UE (see TS 36.331 [10]).</p>  |

|   |
|---|
| <b>p-maxEUTRA</b><br>Indicates the maximum total transmit power to be used by the UE in the E-UTRA cell group (see TS 36.104 [33]). This field is used in (NG)EN-DC and NE-DC.  |
| <b>p-maxNR-FR1</b><br>Indicates the maximum total transmit power to be used by the UE in the NR cell group across all serving cells in frequency range 1 (FR1) (see TS 38.104 [12]) the UE can use in NR SCG.   |
| <b>p-maxUE-FR1</b><br>Indicates the maximum total transmit power to be used by the UE across all serving cells in frequency range 1 (FR1).  |
| <b>pdccch-BlindDetectionSCG</b><br>Indicates the maximum value of the reference number of cells for PDCCH blind detection allowed to be configured for the SCG.   |
| <b>ph-InfoMCG</b><br>Power headroom information in MCG that is needed in the reception of PHR MAC CE in SCG.  |
| <b>ph-SupplementaryUplink</b><br>Power headroom information for supplementary uplink. For UE in (NG)EN-DC, this field is absent.  |
| <b>ph-Type1or3</b><br>Type of power headroom for a serving cell in MCG (PCell and activated SCells). <i>type1</i> refers to type 1 power headroom, <i>type3</i> refers to type 3 power headroom. (See TS 38.321 [3]).   |
| <b>ph-Uplink</b><br>Power headroom information for uplink.  |
| <b>powerCoordination-FR1</b><br>Indicates the maximum power that the UE can use in FR1.   |
| <b>scgFailureInfo</b><br>Contains SCG failure type and measurement results. In case the sender has no measurement results available, the sender may include one empty entry (i.e. without any optional fields present) in <i>measResultsPerMOList</i> . This field is used in (NG)EN-DC and NR-DC.  |
| <b>scgFailureInfoEUTRA</b><br>Contains SCG failure type and measurement results of the EUTRA secondary cell group. This field is only used in NE-DC.  |
| <b>scg-RB-Config</b><br>Contains all of the fields in the IE RadioBearerConfig used in SCG, used to allow the target SN to use delta configuration to the UE, e.g. during SN change. The field is signalled upon change of SN. Otherwise, the field is absent. This field is also absent when master eNB uses full configuration option.  |
| <b>selectedBandEntiesMN</b><br>Indicates the position of a band entry selected by the MN, in the first band combination entry in <i>allowedBC-ListMRDC</i> IE. Each band entry in the subset is identified by its position in the bandlist of this <i>BandCombination</i> . The SN uses this information to determine which bands out of the NR band combinations in <i>allowedBC-ListMRDC</i> it can configure in SCG. This field is only used in NR-DC. |
| <b>servCellIndexRangeSCG</b><br>Range of serving cell indices that SN is allowed to configure for SCG serving cells.  |
| <b>sourceConfigSCG</b><br>Includes all of the current SCG configurations used by the target SN to build delta configuration to be sent to UE, e.g. during SN change. The field contains the <i>RRCReconfiguration</i> message, i.e. including <i>CellGroupConfig</i> and <i>measConfig</i> . The field is signalled upon change of SN, unless MN uses full configuration option. Otherwise, the field is absent.  |
| <b>sourceConfigSCG-EUTRA</b><br>Includes the E-UTRA <i>RRCConnectionReconfiguration</i> message as specified in TS 36.331 [10]. In this version of the specification, the E-UTRA RRC message can only include the field <i>scg-Configuration</i> . In this version of the specification, this field is absent when master gNB uses full configuration option. This field is only used in NE-DC.   |
| <b>ue-CapabilityInfo</b><br>Contains the IE <i>UE-CapabilityRAT-ContainerList</i> supported by the UE (see NOTE 3). The field is signalled upon addition, modification or change of SN.   |

| <b><i>BandCombinationInfo</i> field descriptions</b>   |
|--|
| <b><i>allowedFeatureSetsList</i></b><br>Defines a subset of the entries in a <i>FeatureSetCombination</i> . Each index identifies a position in the <i>FeatureSetCombination</i> , which corresponds to one <i>FeatureSetUplink/Downlink</i> for each band entry in the associated band combination. |
| <b><i>bandCombinationIndex</i></b><br>The position of a band combination in the <i>supportedBandCombinationList</i>  |

| <b>Conditional Presence</b> | <b>Explanation</b>  |
|-----------------------------|---|
| <i>SN-AddMod</i>            | The field is mandatory present upon SN addition and SN change. It is optionally present upon SN modification. Otherwise, the field is absent. |

NOTE 3: The following table indicates per source RAT whether RAT capabilities are included or not in *ue-CapabilityInfo*.

| <b>Source RAT</b> | <b>NR capabilities</b> | <b>E-UTRA capabilities</b> | <b>MR-DC capabilities</b> |
|-------------------|------------------------|----------------------------|---------------------------|
| E-UTRA            | Included               | Not included               | Included                  |

## – *MeasurementTimingConfiguration*

The *MeasurementTimingConfiguration* message is used to convey assistance information for measurement timing.

Direction: en-gNB to eNB, eNB to en-gNB, gNB to gNB, gNB DU to gNB CU, and gNB CU to gNB DU.

### ***MeasurementTimingConfiguration* message**

```
-- ASN1START
-- TAG-MEASUREMENT-TIMING-CONFIGURATION-START

MeasurementTimingConfiguration ::= SEQUENCE {
    criticalExtensions          CHOICE {
        cl                     CHOICE{
            measTimingConf     MeasurementTimingConfiguration-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

MeasurementTimingConfiguration-IEs ::= SEQUENCE {
    measTiming                MeasTimingList OPTIONAL,
    nonCriticalExtension       MeasurementTimingConfiguration-v1550-IEs OPTIONAL
}

MeasurementTimingConfiguration-v1550-IEs ::= SEQUENCE {
    campOnFirstSSB            BOOLEAN,
    psCellOnlyOnFirstSSB     BOOLEAN,
    nonCriticalExtension       SEQUENCE {} OPTIONAL
}
```

```

}
MeasTimingList ::= SEQUENCE (SIZE (1..maxMeasFreqsMN)) OF MeasTiming
MeasTiming ::= SEQUENCE {
    frequencyAndTiming          SEQUENCE {
        carrierFreq              ARFCN-ValueNR,
        ssbSubcarrierSpacing     SubcarrierSpacing,
        ssb-MeasurementTimingConfiguration  SSB-MTC,
        ss-RSSI-Measurement      SS-RSSI-Measurement          OPTIONAL
    }
    ...,
    [[
        ssb-ToMeasure-v1540      SSB-ToMeasure              OPTIONAL,
        physCellId               PhysCellId                 OPTIONAL
    ]]
}
-- TAG-MEASUREMENT-TIMING-CONFIGURATION-STOP
-- ASN1STOP

```

#### ***MeasTiming* field descriptions**

##### ***carrierFreq, ssbSubcarrierSpacing***

Indicates the frequency and subcarrier spacing of the SS block of the cell for which this message is included, or of other SS blocks within the same carrier.

##### ***ssb-MeasurementTimingConfiguration***

Indicates the SMTC which can be used to search for SSB of the cell for which the message is included. When the message is included in "Served NR Cell Information" (see TS 36.423 [37]), "Served Cell Information NR" (see TS 38.423 [35]), or "Served Cell Information" (see TS 38.473 [36]), the timing is based on the cell for which the message is included. When the message is included in "NR Neighbour Information" (see TS 36.423 [37]), or "Served Cell Information" (see TS 38.423 [35]), the timing is based on the cell indicated in the "Served NR Cell Information" or "Served Cell Information NR" with which the "NR Neighbour Information" or "Neighbour Information NR" is provided. When the message is included in "CU to DU RRC Information", the timing is based on the cell indicated by SpCell ID with which the message is included.

##### ***ss-RSSI-Measurement***

Provides the configuration which can be used for RSSI measurements of the cell for which the message is included.

| <i>MeasurementTimingConfiguration</i> field descriptions  |
|---|
| <b><i>campOnFirstSSB</i></b><br>Value <i>true</i> indicates that the SSB indicated in the first instance of <i>MeasTiming</i> in the <i>measTiming</i> list can be used for camping and for a PCell configuration (i.e. in <i>spCellConfigCommon</i> of the <i>masterCellGroup</i> ). |
| <b><i>measTiming</i></b><br>A list of SMTC information, SSB RSSI measurement information and associated NR frequency exchanged via EN-DC X2 Setup, EN-DC Configuration Update, Xn Setup and NG-RAN Node Configuration Update procedures, or F1 messages between gNB DU and gNB CU.    |
| <b><i>physCellId</i></b><br>Physical Cell Identity of the SSB on the ARFCN indicated by <i>carrierFreq</i> .  |
| <b><i>psCellOnlyOnFirstSSB</i></b><br>Value <i>true</i> indicates that only the SSB indicated in the first instance of <i>MeasTiming</i> in the <i>measTiming</i> list can be used for a PSCell configuration (i.e. in <i>spCellConfigCommon</i> of the <i>secondaryCellGroup</i> ).  |
| <b><i>ssb-ToMeasure</i></b><br>The set of SS blocks to be measured within the SMTC measurement duration (see TS 38.215 [9]).  |

## – *UERadioPagingInformation*

This message is used to transfer radio paging information, covering both upload to and download from the AMF.

Direction: gNB to/ from AMF and gNB to/from gNB

### ***UERadioPagingInformation* message**

```
-- ASN1START
-- TAG-UE-RADIO-PAGING-INFORMATION-START

UERadioPagingInformation ::= SEQUENCE {
    criticalExtensions          CHOICE {
        c1                     CHOICE {
            ueRadioPagingInformation          UERadioPagingInformation-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture          SEQUENCE {}
    }
}

UERadioPagingInformation-IEs ::= SEQUENCE {
    supportedBandListNRForPaging          SEQUENCE (SIZE (1..maxBands)) OF FreqBandIndicatorNR          OPTIONAL,
    nonCriticalExtension                   SEQUENCE {}          OPTIONAL
}

-- TAG-UE-RADIO-PAGING-INFORMATION-STOP
-- ASN1STOP
```

**UERadioPagingInformation field descriptions****supportedBandListNRForPaging**

Indicates the UE supported NR frequency bands which is derived by the gNB from *UE-NR-Capability*.

– **UERadioAccessCapabilityInformation**

This message is used to transfer UE radio access capability information, covering both upload to and download from the 5GC.

Direction: ng-eNB or gNB to/ from 5GC

**UERadioAccessCapabilityInformation message**

```
-- ASN1START
-- TAG-UE-RADIO-ACCESS-CAPABILITY-INFORMATION-START

UERadioAccessCapabilityInformation ::= SEQUENCE {
    criticalExtensions          CHOICE {
        c1                     CHOICE {
            ueRadioAccessCapabilityInformation  UERadioAccessCapabilityInformation-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture          SEQUENCE {}
    }
}

UERadioAccessCapabilityInformation-IEs ::= SEQUENCE {
    ue-RadioAccessCapabilityInfo      OCTET STRING (CONTAINING UE-CapabilityRAT-ContainerList),
    nonCriticalExtension              SEQUENCE {} OPTIONAL
}

-- TAG-UE-RADIO-ACCESS-CAPABILITY-INFORMATION-STOP
-- ASN1STOP
```

**UERadioAccessCapabilityInformation-IEs field descriptions****ue-RadioAccessCapabilityInfo**

Including NR, MR-DC, E-UTRA radio access capabilities.

### 11.2.3 Mandatory information in inter-node RRC messages

For the *AS-Config* transferred within the *HandoverPreparationInformation*:

- The source node shall include all fields necessary to reflect the AS configuration of the UE. For *RRCReconfiguration* included in the field *rrcReconfiguration*, *ReconfigurationWithSync* is included with only the mandatory subfields (e.g. *newUE-Identity* and *t304*) and *ServingCellConfigCommon*;

- Need codes or conditions specified for subfields according to IEs defined in section 6 do not apply. I.e. some fields shall be included regardless of the "Need" or "Cond" e.g. *discardTimer*;
- Based on the received AS configuration, the target node can indicate the delta (difference) to the UE's AS configuration (as included in *HandoverCommand*). The fields *newUE-Identity* and *t304* included in *ReconfigurationWithSync* are not used for delta configuration purpose.

For a field that conveys the UE configuration in *CG-Config* (SN initiated change of SN configuration, or SCG configuration query) and in *CG-ConfigInfo* upon change of SN (i.e. *mcg-RB-Config*, *scg-RB-Config* and *sourceConfigSCG*):

- The source node shall include all fields necessary to reflect the AS configuration of the UE, unless stated otherwise in the field description or in this sub-clause. For *RRCReconfiguration* included in the field *scg-CellGroupConfig* in *CG-Config*, *ReconfigurationWithSync* is included with only the mandatory subfields (e.g. *newUE-Identity* and *t304*) and *ServingCellConfigCommon*;
- Need codes or conditions specified for subfields according to IEs defined in section 6 do not apply;
- Based on the received AS configuration, the target node can indicate the delta (difference) to the UE's AS configuration (as included in *CG-Config*). The fields *newUE-Identity* and *t304* included in *ReconfigurationWithSync* are not used for delta configuration purpose.

For the other fields in *CG-Config* and *CG-ConfigInfo*, the sender shall always signal the appropriate value even if same as indicated in the previous RRC INM, unless explicitly stated otherwise. As an exception to this general rule, the absence of the below listed fields means that the receiver maintains the values informed via the previous message. Note that every time there is a change in the configuration covered by a listed field, the MN shall include the field and it shall provide the full configuration provided by that field. Otherwise, if there is no change, the field can be omitted:

- *configRestrictInfo*;
- *measGapConfig* (for which delta signaling applies);
- *measGapConfigFR2* (for which delta signaling applies);
- *measResultCellListSFTD*.
- *measResultSFTD-EUTRA*;
- *ue-CapabilityInfo*;

### 11.3 Inter-node RRC information element definitions

-



## 11.4 Inter-node RRC multiplicity and type constraint values

### – Multiplicity and type constraints definitions

```
-- ASN1START
-- TAG-NR-MULTIPLICITY-AND-CONSTRAINTS-START

maxMeasFreqsMN          INTEGER ::= 32 -- Maximum number of MN-configured measurement frequencies
maxMeasFreqsSN          INTEGER ::= 32 -- Maximum number of SN-configured measurement frequencies
maxMeasIdentitiesMN     INTEGER ::= 62 -- Maximum number of measurement identities that a UE can be configured with
maxCellPrep             INTEGER ::= 32 -- Maximum number of cells prepared for handover

-- TAG-NR-MULTIPLICITY-AND-CONSTRAINTS-STOP
-- ASN1STOP
```

### – *End of NR-InterNodeDefinitions*

```
-- ASN1START
-- TAG-NR-INTER-NODE-DEFINITIONS-END-START

END

-- TAG-NR-INTER-NODE-DEFINITIONS-END-STOP
-- ASN1STOP
```

## 12 Processing delay requirements for RRC procedures

The UE performance requirements for RRC procedures are specified in the following tables. The performance requirement is expressed as the time in [ms] from the end of reception of the network -> UE message on the UE physical layer up to when the UE shall be ready for the reception of uplink grant for the UE -> network response message with no access delay other than the TTI-alignment (e.g. excluding delays caused by scheduling, the random access procedure or physical layer synchronisation). In case the RRC procedure triggers BWP switching, the RRC procedure delay is the value defined in the following table plus the BWP switching delay defined in TS 38.133 [14], clause 8.6.3.

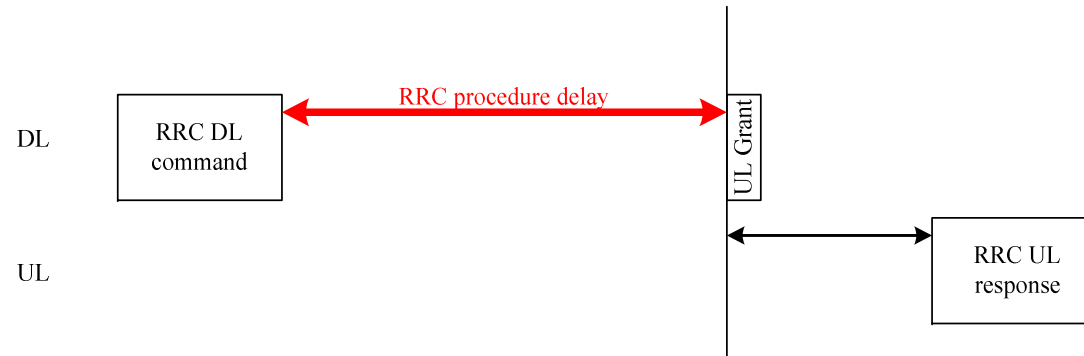


Figure 12.1-1: Illustration of RRC procedure delay

**Table 12.1-1: UE performance requirements for RRC procedures for UEs**

| Procedure title:   | Network -> UE              | UE -> Network                                   | Value [ms] | Notes   |
|--|----------------------------|---|------------|---|
| <b>RRC Connection Control Procedures</b>                       |                            |   |            |   |
| RRC reconfiguration  | <i>RRCReconfiguration</i>  | <i>RRCReconfigurationComplete</i>               | 10         |   |
| RRC reconfiguration (scell addition/release)                   | <i>RRCReconfiguration</i>  | <i>RRCReconfigurationComplete</i>               | 16         |   |
| RRC reconfiguration (SCG establishment/ modification/ release) | <i>RRCReconfiguration</i>  | <i>RRCReconfigurationComplete</i>               | 16         |   |
| RRC setup  | <i>RRCSetup</i>            | <i>RRCSetupComplete</i>                         | 10         |   |
| RRC Release  | <i>RRCRelease</i>          |   | NA         |   |
| RRC re-establishment   | <i>RRCReestablishment</i>  | <i>RRCReestablishmentComplete</i>               | 10         |   |
| RRC resume   | <i>RRCResume</i>           | <i>RRCResumeComplete</i>                        | 6 or 10    | Value=6 applies for a UE supporting reduced CP latency for the case of RRCResume message only including MAC and PHY configuration, and no DRX, SPS, configured grant, CA or MIMO re-configuration will be triggered by this message. Further, the UL grant for transmission of <i>RRCResumeComplete</i> and the data is transmitted over common search space with DCI format 0_0. In this scenario, the RRC procedure delay [ms] can extend beyond the reception of the UL grant, up to 7 ms.<br><br>For other cases, Value = 10 applies. |
| RRC resume (scell addition/release)                            | <i>RRCResume</i>           | <i>RRCResumeComplete</i>                        | 16         |   |
| Initial AS security activation                                 | <i>SecurityModeCommand</i> | <i>SecurityModeComplete/SecurityModeFailure</i> | 5          |   |
| Other procedures   |                            |   |            |   |
| UE assistance information                                      |                            | <i>UEAssistanceInformation</i>                  | NA         |   |

| <b>Procedure title:</b> | <b>Network -&gt; UE</b>    | <b>UE -&gt; Network</b>        | <b>Value<br/>[ms]</b> | <b>Notes</b> |
|-------------------------|----------------------------|--------------------------------|-----------------------|--------------|
| UE capability transfer  | <i>UECapabilityEnquiry</i> | <i>UECapabilityInformation</i> | 80                    |              |
| Counter check           | <i>CounterCheck</i>        | <i>CounterCheckResponse</i>    | 5                     |              |

---

## Annex A (informative): Guidelines, mainly on use of ASN.1

### A.1 Introduction

The following clauses contain guidelines for the specification of RRC protocol data units (PDUs) with ASN.1.

---

### A.2 Procedural specification

#### A.2.1 General principles

The procedural specification provides an overall high level description regarding the UE behaviour in a particular scenario.

It should be noted that most of the UE behaviour associated with the reception of a particular field is covered by the applicable parts of the PDU specification. The procedural specification may also include specific details of the UE behaviour upon reception of a field, but typically this should be done only for cases that are not easy to capture in the PDU section e.g. general actions, more complicated actions depending on the value of multiple fields.

Likewise, the procedural specification need not specify the UE requirements regarding the setting of fields within the messages that are sent to the network i.e. this may also be covered by the PDU specification.

#### A.2.2 More detailed aspects

The following more detailed conventions should be used:

- Bullets:
  - Capitals should be used in the same manner as in other parts of the procedural text i.e. in most cases no capital applies since the bullets are part of the sentence starting with 'The UE shall:'
  - All bullets, including the last one in a sub-clause, should end with a semi-colon i.e. an ';'.
- Conditions:
  - Whenever multiple conditions apply, a semi-colon should be used at the end of each conditions with the exception of the last one, i.e. as in 'if cond1, or cond2.'

## A.3 PDU specification

### A.3.1 General principles

#### A.3.1.1 ASN.1 sections

The RRC PDU contents are formally and completely described using abstract syntax notation (ASN.1), see X.680 [6], X.681 [7].

The complete ASN.1 code is divided into a number of ASN.1 sections in the specifications. In order to facilitate the extraction of the complete ASN.1 code from the specification, each ASN.1 section begins with the following:

- a first text paragraph consisting entirely of an *ASN.1 start tag*, which consists of a double hyphen followed by a single space and the text string "ASN1START" (in all upper case letters);
- a second text paragraph consisting entirely of a *block start tag* is included, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-START" (in all upper case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters).

Similarly, each ASN.1 section ends with the following:

- a first text paragraph consisting entirely of a *blockstop tag*, which consists of a double hyphen followed by a single space and the text string "TAG-NAME-STOP" (in all upper-case letters), where the "NAME" refers to the main name of the paragraph (in all upper-case letters);
- a second text paragraph consisting entirely of an *ASN.1 stop tag*, which consists of a double hyphen followed by a singlespace and the text "ASN1STOP" (in all upper case letters).

This results in the following tags:

```
-- ASN1START
-- TAG-NAME-START

-- TAG-NAME-STOP
-- ASN1STOP
```

The text paragraphs containing either of the start and stop tags should not contain any ASN.1 code significant for the complete description of the RRC PDU contents. The complete ASN.1 code may be extracted by copying all the text paragraphs between an ASN.1 start tag and the following ASN.1 stop tag in the order they appear, throughout the specification.

**NOTE:** A typical procedure for extraction of the complete ASN.1 code consists of a first step where the entire RRC PDU contents description (ultimately the entire specification) is saved into a plain text (ASCII) file format, followed by a second step where the actual extraction takes place, based on the occurrence of the ASN.1 start and stop tags.

### A.3.1.2 ASN.1 identifier naming conventions

The naming of identifiers (i.e., the ASN.1 field and type identifiers) should be based on the following guidelines:

- Message (PDU) identifiers should be ordinary mixed case without hyphenation. These identifiers, *e.g.*, the *RRCCConnectionModificationCommand*, should be used for reference in the procedure text. Abbreviations should be avoided in these identifiers and abbreviated forms of these identifiers should not be used.
- Type identifiers other than PDU identifiers should be ordinary mixed case, with hyphenation used to set off acronyms only where an adjacent letter is a capital, *e.g.*, *EstablishmentCause*, *SelectedPLMN* (not *Selected-PLMN*, since the "d" in "Selected" is lowercase), *InitialUE-Identity* and *MeasSFN-SFN-TimeDifference*.
- Field identifiers shall start with a lowercase letter and use mixed case thereafter, *e.g.*, *establishmentCause*. If a field identifier begins with an acronym (which would normally be in upper case), the entire acronym is lowercase (*plmn-Identity*, not *pLMN-Identity*). The acronym is set off with a hyphen (*ue-Identity*, not *ueIdentity*), in order to facilitate a consistent search pattern with corresponding type identifiers.
- Identifiers should convey the meaning of the identifier and should avoid adding unnecessary postfixes (e.g. abstractions like 'Info') for the name.
- Identifiers that are likely to be keywords of some language, especially widely used languages, such as C++ or Java, should be avoided to the extent possible.
- Identifiers, other than PDU identifiers, longer than 25 characters should be avoided where possible. It is recommended to use abbreviations, which should be done in a consistent manner i.e. use 'Meas' instead of 'Measurement' for all occurrences. Examples of typical abbreviations are given in table A.3.1.2.1-1 below.
- *For future extension:* When an extension is introduced a suffix is added to the identifier of the concerned ASN.1 field and/or type. A suffix of the form "-rX" is used, with X indicating the release, for ASN.1 fields or types introduced in a later release (i.e. a release later than the original/first release of the protocol) as well as for ASN.1 fields or types for which a revision is introduced in a later release replacing a previous version, *e.g.*, *Foo-r9* for the Rel-9 version of the ASN.1 type *Foo*. A suffix of the form "-rXb" is used for the first revision of a field that it appears in the same release (X) as the original version of the field, "-rXc" for a second intra-release revision and so on. A suffix of the form "-vXYZ" is used for ASN.1 fields or types that only are an extension of a corresponding earlier field or type (see sub-clause A.4), *e.g.*, *AnElement-v10b0* for the extension of the ASN.1 type *AnElement* introduced in version 10.11.0 of the specification. A number 0..9, 10, 11, *etc.* is used to represent the first part of the version number, indicating the release of the protocol. Lower case letters *a, b, c, etc.* are used to represent the second (and third) part of the version number if they are greater than 9. In the procedural specification, in field descriptions as well as in headings suffices are not used, unless there is a clear need to distinguish the extension from the original field.
- More generally, in case there is a need to distinguish different variants of an ASN.1 field or IE, a suffix should be added at the end of the identifiers *e.g.* *MeasObjectUTRA*, *ConfigCommon*. When there is no particular need to distinguish the fields (*e.g.* because the field is included in different IEs), a common field identifier name may be used. This may be attractive *e.g.* in case the procedural specification is the same for the different variants.
- It should be avoided to use field identifiers with the same name within the elements of a CHOICE, including using a CHOICE inside a SEQUENCE (to avoid certain compiler errors).



Table A.3.1.2-1: Examples of typical abbreviations used in ASN.1 identifiers

| Abbreviation | Abbreviated word       |
|--------------|------------------------|
| Config       | Configuration          |
| DL           | Downlink               |
| Ext          | Extension              |
| Freq         | Frequency              |
| Id           | Identity               |
| Ind          | Indication             |
| Meas         | Measurement            |
| MIB          | MasterInformationBlock |
| Neigh        | Neighbour(ing)         |
| Param(s)     | Parameter(s)           |
| Phys         | Physical               |
| PCI          | Physical Cell Id       |
| Proc         | Process                |
| Reconfig     | Reconfiguration        |
| Reest        | Re-establishment       |
| Req          | Request                |
| Rx           | Reception              |
| Sched        | Scheduling             |
| SIB          | SystemInformationBlock |
| Sync         | Synchronisation        |
| Thr          | Threshold              |
| Tx           | Transmission           |
| UL           | Uplink                 |

NOTE: The table A.3.1.2.1-1 is not exhaustive. Additional abbreviations may be used in ASN.1 identifiers when needed.

### A.3.1.3 Text references using ASN.1 identifiers

A text reference into the RRC PDU contents description from other parts of the specification is made using the ASN.1 field identifier of the referenced type. The ASN.1 field and type identifiers used in text references should be in the *italic font style*. The "do not check spelling and grammar" attribute in Word should be set. Quotation marks (i.e., "") should not be used around the ASN.1 field or type identifier.

A reference to an RRC PDU should be made using the corresponding ASN.1 field identifier followed by the word "message", e.g., a reference to the *RRCRelease* message.

A reference to a specific part of an RRC PDU, or to a specific part of any other ASN.1 type, should be made using the corresponding ASN.1 field identifier followed by the word "field", e.g., a reference to the *prioritisedBitRate* field in the example below.

```
-- /example/ ASN1START
```

```
LogicalChannelConfig ::=
    ul-SpecificParameters
        priority
        SEQUENCE {
            SEQUENCE {
                Priority,
```

```

        prioritisedBitRate          PrioritisedBitRate,
        bucketSizeDuration         BucketSizeDuration,
        logicalChannelGroup        INTEGER (0..3)
    }
    OPTIONAL
}
-- ASN1STOP

```

NOTE: All the ASN.1 start tags in the ASN.1 sections, used as examples in this annex to the specification, are deliberately distorted, in order not to include them when the ASN.1 description of the RRC PDU contents is extracted from the specification.

A reference to a specific type of information element should be made using the corresponding ASN.1 type identifier preceded by the acronym "IE", e.g., a reference to the IE *LogicalChannelConfig* in the example above.

References to a specific type of information element should only be used when those are generic, i.e., without regard to the particular context wherein the specific type of information element is used. If the reference is related to a particular context, e.g., an RRC PDU type (message) wherein the information element is used, the corresponding field identifier in that context should be used in the text reference.

A reference to a specific value of an ASN.1 field should be made using the corresponding ASN.1 value without using quotation marks around the ASN.1 value, e.g., 'if the *status* field is set to value *true*'.

## A.3.2 High-level message structure

Within each logical channel type, the associated RRC PDU (message) types are alternatives within a CHOICE, as shown in the example below.

```

-- /example/ ASN1START

DL-DCCH-Message ::= SEQUENCE {
    message          DL-DCCH-MessageType
}

DL-DCCH-MessageType ::= CHOICE {
    c1              CHOICE {
        dlInformationTransfer          DLInformationTransfer,
        handoverFromEUTRAPreparationRequest  HandoverFromEUTRAPreparationRequest,
        mobilityFromEUTRACommand          MobilityFromEUTRACommand,
        rrcConnectionReconfiguration      RRCCConnectionReconfiguration,
        rrcConnectionRelease              RRCCConnectionRelease,
        securityModeCommand                SecurityModeCommand,
        ueCapabilityEnquiry                UECapabilityEnquiry,
        spare1 NULL
    },
    messageClassExtension SEQUENCE {}
}

-- ASN1STOP

```

A nested two-level CHOICE structure is used, where the alternative PDU types are alternatives within the inner level *c1* CHOICE.

Spare alternatives (i.e., *spare1* in this case) may be included within the *c1* CHOICE to facilitate future extension. The number of such spare alternatives should not extend the total number of alternatives beyond an integer-power-of-two number of alternatives (i.e., eight in this case).

Further extension of the number of alternative PDU types is facilitated using the *messageClassExtension* alternative in the outer level CHOICE.

### A.3.3 Message definition

Each PDU (message) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START

RRCConnectionReconfiguration ::= SEQUENCE {
    rrc-TransactionIdentifier      RRC-TransactionIdentifier,
    criticalExtensions             CHOICE {
        c1                        CHOICE {
            rrcConnectionReconfiguration-r8      RRCConnectionReconfiguration-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture      SEQUENCE {}
    }
}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {
    -- Enter the IEs here.
    ...
}

-- ASN1STOP
```

Hooks for *critical* and *non-critical* extension should normally be included in the PDU type specification. How these hooks are used is further described in sub-clause A.4.

Critical extensions are characterised by a redefinition of the PDU contents and need to be governed by a mechanism for protocol version agreement between the encoder and the decoder of the PDU, such that the encoder is prevented from sending a critically extended version of the PDU type, which is not comprehended by the decoder.

Critical extension of a PDU type is facilitated by a two-level CHOICE structure, where the alternative PDU contents are alternatives within the inner level *c1* CHOICE. Spare alternatives (i.e., *spare3* down to *spare1* in this case) may be included within the *c1* CHOICE. The number of spare alternatives to be included in the original PDU specification should be decided case by case, based on the expected rate of critical extension in the future releases of the protocol.

Further critical extension, when the spare alternatives from the original specifications are used up, is facilitated using the *criticalExtensionsFuture* in the outer level CHOICE.

In PDU types where critical extension is not expected in the future releases of the protocol, the inner level *c1* CHOICE and the spare alternatives may be excluded, as shown in the example below.

```
-- /example/ ASN1START
```

```

RRCConnectionReconfigurationComplete ::= SEQUENCE {
    rrc-TransactionIdentifier      RRC-TransactionIdentifier,
    criticalExtensions             CHOICE {
        rrcConnectionReconfigurationComplete-r8
        RRCConnectionReconfigurationComplete-r8-IEs,
        criticalExtensionsFuture   SEQUENCE {}
    }
}

RRCConnectionReconfigurationComplete-r8-IEs ::= SEQUENCE {
    -- Enter the fields here.
    ...
}

-- ASN1STOP

```

Non-critical extensions are characterised by the addition of new information to the original specification of the PDU type. If not comprehended, a non-critical extension may be skipped by the decoder, whilst the decoder is still able to complete the decoding of the comprehended parts of the PDU contents.

Non-critical extensions at locations other than the end of the message or other than at the end of a field contained in a BIT or OCTET STRING are facilitated by use of the ASN.1 extension marker "...". The original specification of a PDU type should normally include the extension marker at the end of the sequence of information elements contained.

Non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING may be facilitated by use of an empty sequence that is marked OPTIONAL e.g. as shown in the following example:

```

-- /example/ ASN1START

RRCMessage-r8-IEs ::=
    field1          InformationElement1,
    field2          InformationElement2,

    nonCriticalExtension SEQUENCE {} OPTIONAL
}

-- ASN1STOP

```

The ASN.1 section specifying the contents of a PDU type may be followed by a *field description* table where a further description of, e.g., the semantic properties of the fields may be included. The general format of this table is shown in the example below. The field description table is absent in case there are no fields for which further description needs to be provided e.g. because the PDU does not include any fields, or because an IE is defined for each field while there is nothing specific regarding the use of this IE that needs to be specified.

| %PDU-TypeIdentifier% field descriptions |                    |
|---|--------------------|
| %field identifier%                      | Field description. |
| %field identifier%                      | Field description. |

The field description table has one column. The header row shall contain the ASN.1 type identifier of the PDU type.

The following rows are used to provide field descriptions. Each row shall include a first paragraph with a *field identifier* (in ***bold and italic*** font style) referring to the part of the PDU to which it applies. The following paragraphs at the same row may include (in regular font style), e.g., semantic description, references to other specifications and/or specification of value units, which are relevant for the particular part of the PDU.

The parts of the PDU contents that do not require a field description shall be omitted from the field description table.

## A.3.4 Information elements

Each IE (information element) type is specified in an ASN.1 section similar to the one shown in the example below.

```
-- /example/ ASN1START
PRACH-ConfigSIB ::=
    rootSequenceIndex
    prach-ConfigInfo
}
SEQUENCE {
    INTEGER (0..1023),
    PRACH-ConfigInfo
}

PRACH-Config ::=
    rootSequenceIndex
    prach-ConfigInfo
}
SEQUENCE {
    INTEGER (0..1023),
    PRACH-ConfigInfo OPTIONAL -- Need N
}

PRACH-ConfigInfo ::=
    prach-ConfigIndex
    highSpeedFlag
    zeroCorrelationZoneConfig
}
SEQUENCE {
    ENUMERATED {ffs},
    ENUMERATED {ffs},
    ENUMERATED {ffs}
}
-- ASN1STOP
```

IEs should be introduced whenever there are multiple fields for which the same set of values apply. IEs may also be defined for other reasons e.g. to break down a ASN.1 definition in to smaller pieces.

A group of closely related IE type definitions, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in this example, are preferably placed together in a common ASN.1 section. The IE type identifiers should in this case have a common base, defined as the *generic type identifier*. It may be complemented by a suffix to distinguish the different variants. The "*PRACH-Config*" is the generic type identifier in this example, and the "*SIB*" suffix is added to distinguish the variant. The sub-clause heading and generic references to a group of closely related IEs defined in this way should use the generic type identifier.

The same principle should apply if a new version, or an extension version, of an existing IE is created for *critical* or *non-critical* extension of the protocol (see sub-clause A.4). The new version, or the extension version, of the IE is included in the same ASN.1 section defining the original. A suffix is added to the type identifier, using the naming conventions defined in sub-clause A.3.1.2, indicating the release or version of the where the new version, or extension version, was introduced.

Local IE type definitions, like the IE *PRACH-ConfigInfo* in the example above, may be included in the ASN.1 section and be referenced in the other IE types defined in the same ASN.1 section. The use of locally defined IE types should be encouraged, as a tool to break up large and complex IE type definitions. It can improve the readability of the

code. There may also be a benefit for the software implementation of the protocol end-points, as these IE types are typically provided by the ASN.1 compiler as independent data elements, to be used in the software implementation.

An IE type defined in a local context, like the IE *PRACH-ConfigInfo*, should not be referenced directly from other ASN.1 sections in the RRC specification. An IE type which is referenced in more than one ASN.1 section should be defined in a separate sub-clause, with a separate heading and a separate ASN.1 section (possibly as one in a set of closely related IE types, like the IEs *PRACH-ConfigSIB* and *PRACH-Config* in the example above). Such IE types are also referred to as 'global IEs'.

**NOTE:** Referring to an IE type, that is defined as a local IE type in the context of another ASN.1 section, does not generate an ASN.1 compilation error. Nevertheless, using a locally defined IE type in that way makes the IE type definition difficult to find, as it would not be visible at an outline level of the specification. It should be avoided.

The ASN.1 section specifying the contents of one or more IE types, like in the example above, may be followed by a *field description* table, where a further description of, e.g., the semantic properties of the fields of the information elements may be included. This table may be absent, similar as indicated in sub-clause A.3.3 for the specification of the PDU type. The general format of the *field description* table is the same as shown in sub-clause A.3.3 for the specification of the PDU type.

## A.3.5 Fields with optional presence

A field with optional presence may be declared with the keyword **DEFAULT**. It identifies a default value to be assumed, if the sender does not include a value for that field in the encoding:

```
-- /example/ ASN1START
PreambleInfo ::=
    numberOfRA-Preambles          SEQUENCE {
        INTEGER (1..64)           DEFAULT 1,
        ...
    }
-- ASN1STOP
```

Alternatively, a field with optional presence may be declared with the keyword **OPTIONAL**. It identifies a field for which a value can be omitted. The omission carries semantics, which is different from any normal value of the field:

```
-- /example/ ASN1START
PRACH-Config ::=
    rootSequenceIndex             INTEGER (0..1023),
    prach-ConfigInfo              PRACH-ConfigInfo          OPTIONAL    -- Need N
}
-- ASN1STOP
```

The semantics of an optionally present field, in the case it is omitted, should be indicated at the end of the paragraph including the keyword **OPTIONAL**, using a short comment text with a need code. The need code includes the keyword "Need", followed by one of the predefined semantics tags (S, M, N or R) defined in sub-clause 6.1. If the semantics tag S is used, the semantics of the absent field are further specified either in the field description table following the ASN.1 section, or in procedure text.

The addition of OPTIONAL keywords for capability groups is based on the following guideline. If there is more than one field in the lower level IE, then OPTIONAL keyword is added at the group level. If there is only one field in the lower level IE, OPTIONAL keyword is not added at the group level.

### A.3.6 Fields with conditional presence

A field with conditional presence is declared with the keyword OPTIONAL. In addition, a short comment text shall be included at the end of the paragraph including the keyword OPTIONAL. The comment text includes the keyword "Cond", followed by a condition tag associated with the field ("UL" in this example):

```
-- /example/ ASN1START
LogicalChannelConfig ::=
    ul-SpecificParameters
        priority
        ...
    } OPTIONAL
}
-- Cond UL
-- ASN1STOP
```

When conditionally present fields are included in an ASN.1 section, the field description table after the ASN.1 section shall be followed by a *conditional presence* table. The conditional presence table specifies the conditions for including the fields with conditional presence in the particular ASN.1 section.

| Conditional presence | Explanation  |
|----------------------|--|
| UL                   | Specification of the conditions for including the field associated with the condition tag = "UL". Semantics in case of optional presence under certain conditions may also be specified. |

The conditional presence table has two columns. The first column (heading: "Conditional presence") contains the condition tag (in *italic* font style), which links the fields with a condition tag in the ASN.1 section to an entry in the table. The second column (heading: "Explanation") contains a text specification of the conditions and requirements for the presence of the field. The second column may also include semantics, in case of an optional presence of the field, under certain conditions i.e. using the same predefined tags as defined for optional fields in A.3.5.

Conditional presence should primarily be used when presence of a field depends on the presence and/or value of other fields within the same message. If the presence of a field depends on whether another feature/function has been configured, while this function can be configured independently e.g. by another message and/or at another point in time, the relation is best reflected by means of a statement in the field description table.

If the ASN.1 section does not include any fields with conditional presence, the conditional presence table shall not be included.

Whenever a field is only applicable in specific cases e.g. TDD, use of conditional presence should be considered.

### A.3.7 Guidelines on use of lists with elements of SEQUENCE type

Where an information element has the form of a list (the SEQUENCE OF construct in ASN.1) with the type of the list elements being a SEQUENCE data type, an information element shall be defined for the list elements even if it would not otherwise be needed.

For example, a list of PLMN identities with reservation flags is defined as in the following example:

```
-- /example/ ASN1START
PLMN-IdentityInfoList ::=          SEQUENCE (SIZE (1..6)) OF PLMN-IdentityInfo
PLMN-IdentityInfo ::=            SEQUENCE {
    plmn-Identity                PLMN-Identity,
    cellReservedForOperatorUse   ENUMERATED {reserved, notReserved}
}
-- ASN1STOP
```

rather than as in the following (bad) example, which may cause generated code to contain types with unpredictable names:

```
-- /bad example/ ASN1START
PLMN-IdentityList ::=            SEQUENCE (SIZE (1..6)) OFSEQUENCE {
    plmn-Identity                PLMN-Identity,
    cellReservedForOperatorUse   ENUMERATED {reserved, notReserved}
}
-- ASN1STOP
```

### A.3.8 Guidelines on use of parameterised SetupRelease type

The usage of the parameterised *SetupRelease* type is like a function call in programming languages where the element type parameter is passed as a parameter. The parameterised type only implies a textual change in abstract syntax where all references to the parameterised type are replaced by the compiler with the release/setup choice. Two examples of the usage are shown below:

```
-- /example/ ASN1START
RRCMessage-r15-IEs ::= SEQUENCE {
    field-r15                SetupRelease { IE-r15 }                OPTIONAL,    -- Need M
    ...
}

RRCMessage-r15-IEs ::= SEQUENCE {
    field-r15                SetupRelease { Element-r15 }
}
                                                                    OPTIONAL,    -- Need M

Element-r15 ::= SEQUENCE {
    field1-r15                IE1-r15,
    field2-r15                IE2-r15
}
                                                                    OPTIONAL,    -- Need N
                                                                    OPTIONAL,    -- Need M
-- /example/ ASN1STOP
```



The *SetupRelease* is always be used with only named IEs, i.e. the example below is not allowed:

```
-- /example/ ASN1START
RRCMessage-r15-IEs ::= SEQUENCE {
    field-r15      SetupRelease { SEQUENCE { -- Unnamed SEQUENCES are not allowed!
        field1-r15      IE1-r15,
        field2-r15      IE2-r15
    }
}
-- /example/ ASN1STOP
```

If a field defined using the parameterized *SetupRelease* type requires procedural text, the field is referred to using the values defined for the type itself, namely, "setup" and "release". For example, procedural text for *field-r15* above could be as follows:

- 1> if *field-r15* is set to "setup":
  - 2> do something;
- 1> else (*field-r15* is set to "release"):
  - 2> release *field-r15* (if appropriate).

### A.3.9 Guidelines on use of *ToAddModList* and *ToReleaseList*

In order to benefit from delta signalling when modifying lists with many and/or large elements, so-called add/mod- and release- lists should be used. Instead of a single list containing all elements of the list, the ASN.1 provides two lists. One list is used to convey the actual elements that are to be added to the list or modified in the list. The second list conveys only the identities (IDs) of the list elements that are to be released from the list. In other words, the ASN.1 defines only means to signal modifications to a list maintained in the receiver (typically the UE). An example is provided below:

```
-- /example/ ASN1START
AnExampleIE ::= SEQUENCE {
    elementsToAddModList SEQUENCE (SIZE (1..maxNrofElements)) OF Element OPTIONAL, -- Need N
    elementsToReleaseList SEQUENCE (SIZE (1..maxNrofElements)) OF ElementId OPTIONAL, -- Need N
    ...
}

Element ::= SEQUENCE {
    elementId ElementId,
    aField INTEGER (0..16777215),
    anotherField OCTET STRING,
    ...
}
```

```
ElementId ::=          INTEGER (0..maxNrofElements-1)
maxNrofElements      INTEGER ::= 50
maxNrofElements-1    INTEGER ::= 49
-- /example/ ASN1STOP
```

As can be seen, the elements of the list must contain an identity (INTEGER) that identifies the elements unambiguously upon addition, modification and removal. It is recommended to define an IE for that identifier (here *ElementId*) so that it can be used both for a field inside the element as well as in the *elementsToReleaseList*.

Both lists should be made OPTIONAL and flagged as "Need N". The need code reflects that the UE does not maintain the received lists as such but rather updates its configuration using the information therein. In other words, it is not possible to provide via delta signalling an update to a previously signalled *elementsToAddModList* or *elementsToReleaseList* (which Need M would imply). The update is always in relation to the UE's internal configuration.

If no procedural text is provided for a set of *ToAddModList* and *ToReleaseList*, the following generic procedure applies:

The UE shall:

- 1> for each *ElementId* in the *elementsToReleaseList*:
  - 2> if the current UE configuration includes an *Element* with the given *ElementId*:
    - 3> release the *Element* from the current UE configuration;
- 1> for each *Element* in the *elementsToAddModList*:
  - 2> if the current UE configuration includes an *Element* with the given *ElementId*:
    - 3> modify the configured *Element* in accordance with the received *Element*;
  - 2> else:
    - 3> add received *Element* to the UE configuration.

---

## A.4 Extension of the PDU specifications

### A.4.1 General principles to ensure compatibility

It is essential that extension of the protocol does not affect interoperability i.e. it is essential that implementations based on different versions of the RRC protocol are able to interoperate. In particular, this requirement applies for the following kind of protocol extensions:

- Introduction of new PDU types (i.e. these should not cause unexpected behaviour or damage).

- Introduction of additional fields in an extensible PDUs (i.e. it should be possible to ignore uncomprehended extensions without affecting the handling of the other parts of the message).
- Introduction of additional values of an extensible field of PDUs. If used, the behaviour upon reception of an uncomprehended value should be defined.

It should be noted that the PDU extension mechanism may depend on the logical channel used to transfer the message e.g. for some PDUs an implementation may be aware of the protocol version of the peer in which case selective ignoring of extensions may not be required.

The non-critical extension mechanism is the primary mechanism for introducing protocol extensions i.e. the critical extension mechanism is used merely when there is a need to introduce a 'clean' message version. Such a need appears when the last message version includes a large number of non-critical extensions, which results in issues like readability, overhead associated with the extension markers. The critical extension mechanism may also be considered when it is complicated to accommodate the extensions by means of non-critical extension mechanisms.

## A.4.2 Critical extension of messages and fields

The mechanisms to critically extend a message are defined in A.3.3. There are both "outer branch" and "inner branch" mechanisms available. The "outer branch" consists of a CHOICE having the name *criticalExtensions*, with two values, *c1* and *criticalExtensionsFuture*. The *criticalExtensionsFuture* branch consists of an empty SEQUENCE, while the *c1* branch contains the "inner branch" mechanism.

The "inner branch" structure is a CHOICE with values of the form "*MessageName-rX-IEs*" (e.g., "*RRCConnectionReconfiguration-r8-IEs*") or "*spareX*", with the spare values having type NULL. The "-rX-IEs" structures contain the *complete* structure of the message IEs for the appropriate release; i.e., the critical extension branch for the Rel-10 version of a message includes all Rel-8 and Rel-9 fields (that are not obviated in the later version), rather than containing only the additional Rel-10 fields.

The following guidelines may be used when deciding which mechanism to introduce for a particular message, i.e. only an 'outer branch', or an 'outer branch' in combination with an 'inner branch' including a certain number of spares:

- For certain messages, e.g. initial uplink messages, messages transmitted on a broadcast channel, critical extension may not be applicable.
- An outer branch may be sufficient for messages not including any fields.
- The number of spares within inner branch should reflect the likelihood that the message will be critically extended in future releases (since each release with a critical extension for the message consumes one of the spare values). The estimation of the critical extension likelihood may be based on the number, size and changeability of the fields included in the message.
- In messages where an inner branch extension mechanism is available, all spare values of the inner branch should be used before any critical extensions are added using the outer branch.

The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release

```
-- /example/ ASN1START          -- Original release
RRCMessage ::=
  rrc-TransactionIdentifier
  criticalExtensions
    c1
      rrcMessage-r8
                                SEQUENCE {
                                  RRC-TransactionIdentifier,
                                CHOICE {
                                  CHOICE{
                                    RRCMessage-r8-IEs,
```

```

        spare3 NULL, spare2 NULL, spare1 NULL
    },
    criticalExtensionsFuture      SEQUENCE {}
}
}
-- ASN1STOP

```

```

-- /example/ ASN1START          -- Later release
RRCMessage ::=                 SEQUENCE {
    rrc-TransactionIdentifier    RRC-TransactionIdentifier,
    criticalExtensions           CHOICE {
        c1                      CHOICE{
            rrcMessage-r8        RRCMessage-r8-IEs,
            rrcMessage-r10       RRCMessage-r10-IEs,
            rrcMessage-r11       RRCMessage-r11-IEs,
            rrcMessage-r14       RRCMessage-r14-IEs
        },
        later                    CHOICE {
            c2                   CHOICE{
                rrcMessage-r16   RRCMessage-r16-IEs,
                spare7 NULL, spare6 NULL, spare5 NULL, spare4 NULL,
                spare3 NULL, spare2 NULL, spare1 NULL
            },
            criticalExtensionsFuture SEQUENCE {}
        }
    }
}
-- ASN1STOP

```

It is important to note that critical extensions may also be used at the level of individual fields i.e. a field may be replaced by a critically extended version. When sending the extended version, the original version may also be included (e.g. original field is mandatory, E-UTRAN is unaware if UE supports the extended version). In such cases, a UE supporting both versions may be required to ignore the original field. The following example illustrates the use of the critical extension mechanism by showing the ASN.1 of the original and of a later release.

```

-- /example/ ASN1START          -- Original release
RRCMessage ::=                 SEQUENCE {
    rrc-TransactionIdentifier    RRC-TransactionIdentifier,
    criticalExtensions           CHOICE {
        c1                      CHOICE{
            rrcMessage-r8        RRCMessage-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}
RRCMessage-rN-IEs ::= SEQUENCE {

```

```

field1-rN          ENUMERATED {
                    value1, value2, value3, value4} OPTIONAL,  -- Need N
field2-rN          InformationElement2-rN          OPTIONAL,  -- Need N
nonCriticalExtension
}
RRCConnectionReconfiguration-vMxy-IEs ::= SEQUENCE {
    field2-rM          InformationElement2-rM          OPTIONAL, -- Cond NoField2rN
    nonCriticalExtension SEQUENCE {}                  OPTIONAL
}
-- ASN1STOP

```

| Conditional presence | Explanation  |
|----------------------|--|
| NoField2rN           | The field is optionally present, need N, if field2-rN is absent. Otherwise the field is absent |

Finally, it is noted that a critical extension may be introduced in the same release as the one in which the original field was introduced e.g. to correct an essential ASN.1 error. In such cases a UE capability may be introduced, to assist the network in deciding whether or not to use the critically extension.

## A.4.3 Non-critical extension of messages

### A.4.3.1 General principles

The mechanisms to extend a message in a non-critical manner are defined in A.3.3. W.r.t. the use of extension markers, the following additional guidelines apply:

- When further non-critical extensions are added to a message that has been critically extended, the inclusion of these non-critical extensions in earlier critical branches of the message should be avoided when possible.
- The extension marker ("...") is the primary non-critical extension mechanism that is used but empty sequences may be used if length determinant is not required. Examples of cases where a length determinant is not required:
  - at the end of a message;
  - at the end of a structure contained in a BIT STRING or OCTET STRING.
- When an extension marker is available, non-critical extensions are preferably placed at the location (e.g. the IE) where the concerned parameter belongs from a logical/functional perspective (referred to as the '*default extension location*').
- It is desirable to aggregate extensions of the same release or version of the specification into a group, which should be placed at the lowest possible level.
- In specific cases it may be preferable to place extensions elsewhere (referred to as the '*actual extension location*') e.g. when it is possible to aggregate several extensions in a group. In such a case, the group should be placed at the lowest suitable level in the message. <TBD: ref to separate example>

- In case placement at the default extension location affects earlier critical branches of the message, locating the extension at a following higher level in the message should be considered.
- In case an extension is not placed at the default extension location, an IE should be defined. The IE's ASN.1 definition should be placed in the same ASN.1 section as the default extension location. In case there are intermediate levels in-between the actual and the default extension location, an IE may be defined for each level. Intermediate levels are primarily introduced for readability and overview. Hence intermediate levels need not always be introduced e.g. they may not be needed when the default and the actual extension location are within the same ASN.1 section. <TBD: ref to separate example>

### A.4.3.2 Further guidelines

Further to the general principles defined in the previous section, the following additional guidelines apply regarding the use of extension markers:

- Extension markers within SEQUENCE:
  - Extension markers are primarily, but not exclusively, introduced at the higher nesting levels.
  - Extension markers are introduced for a SEQUENCE comprising several fields as well as for information elements whose extension would result in complex structures without it (e.g. re-introducing another list).
  - Extension markers are introduced to make it possible to maintain important information structures e.g. parameters relevant for one particular RAT.
  - Extension markers are also used for size critical messages (i.e. messages on BCCH, BR-BCCH, PCCH and CCCH), although introduced somewhat more carefully.
  - The extension fields introduced (or frozen) in a specific version of the specification are grouped together using double brackets.
- Extension markers within ENUMERATED:
  - Spare values may be used until the number of values reaches the next power of 2, while the extension marker caters for extension beyond that limit, given that the use of spare values in a later Release is possible without any error cases.
  - A suffix of the form "vXYZ" is used for the identifier of each new value, e.g. "value-vXYZ".
- Extension markers within CHOICE:
  - Extension markers are introduced when extension is foreseen and when comprehension is not required by the receiver i.e. behaviour is defined for the case where the receiver cannot comprehend the extended value (e.g. ignoring an optional CHOICE field). It should be noted that defining the behaviour of a receiver upon receiving a not comprehended choice value is not required if the sender is aware whether or not the receiver supports the extended value.
  - A suffix of the form "vXYZ" is used for the identifier of each new choice value, e.g. "choice-vXYZ".

Non-critical extensions at the end of a message/ of a field contained in an OCTET or BIT STRING:

- When a nonCriticalExtension is actually used, a "Need" code should not be provided for the field, which always is a group including at least one extension and a field facilitating further possible extensions. For simplicity, it is recommended not to provide a "Need" code when the field is not actually used either.

Further, more general, guidelines:

- In case a need code is not provided for a group, a "Need" code is provided for all individual extension fields within the group i.e. including for fields that are not marked as OPTIONAL. The latter is to clarify the action upon absence of the whole group.

### A.4.3.3 Typical example of evolution of IE with local extensions

The following example illustrates the use of the extension marker for a number of elementary cases (sequence, enumerated, choice). The example also illustrates how the IE may be revised in case the critical extension mechanism is used.

**NOTE** In case there is a need to support further extensions of release n while the ASN.1 of release (n+1) has been frozen, without requiring the release n receiver to support decoding of release (n+1) extensions, more advanced mechanisms are needed e.g. including multiple extension markers.

```
-- /example/ ASN1START
InformationElement1 ::=
  field1
  field2
    field2a
    field2b
    ...
    field2c-v960
  },
  ...
  [[
  field3-r9
  ]],
  [[
  field3-v9a0
  field4-r9
  ]]
}

InformationElement1-r10 ::=
  field1
  field2
    field2a
    field2b
    field2c-v960
    ...
    field2d-v12b0
  },
  field3-r9
  field4-r9
  field5-r10
  field6-r10
  ...
  [[
  field3-v1170
  ]]
```

```

    }}
}
-- ASN1STOP

```

Some remarks regarding the extensions of *InformationElement1* as shown in the above example:

- The *InformationElement1* is initially extended with a number of non-critical extensions. In release 10 however, a critical extension is introduced for the message using this IE. Consequently, a new version of the IE *InformationElement1* (i.e. *InformationElement1-r10*) is defined in which the earlier non-critical extensions are incorporated by means of a revision of the original field.
- The *value4-v880* is replacing a spare value defined in the original protocol version for *field1*. Likewise *value6-v1170* replaces *spare3* that was originally defined in the r10 version of *field1*.
- Within the critically extended release 10 version of *InformationElement1*, the names of the original fields/IEs are not changed, unless there is a real need to distinguish them from other fields/IEs. E.g. the *field1* and *InformationElement4* were defined in the original protocol version (release 8) and hence not tagged. Moreover, the *field3-r9* is introduced in release 9 and not re-tagged; although, the *InformationElement3* is also critically extended and therefore tagged *InformationElement3-r10* in the release 10 version of *InformationElement1*.

#### A.4.3.4 Typical examples of non critical extension at the end of a message

The following example illustrates the use of non-critical extensions at the end of the message or at the end of a field that is contained in a BIT or OCTET STRING i.e. when an empty sequence is used.

```

-- /example/ ASN1START
RRCTestMessage-r8-IEs ::= SEQUENCE {
    field1          InformationElement1,
    field2          InformationElement2,
    field3          InformationElement3          OPTIONAL,  -- Need N
    nonCriticalExtension RRCMessage-v860-IEs
}
RRCTestMessage-v860-IEs ::= SEQUENCE {
    field4-v860    InformationElement4          OPTIONAL,  -- Need S
    field5-v860    BOOLEAN                     OPTIONAL,  -- Cond C54
    nonCriticalExtension RRCMessage-v940-IEs
}
RRCTestMessage-v940-IEs ::= SEQUENCE {
    field6-v940    InformationElement6-r9      OPTIONAL,  -- Need R
    nonCriticalExtensions SEQUENCE {}
}
-- ASN1STOP

```

Some remarks regarding the extensions shown in the above example:



- The *InformationElement4* is introduced in the original version of the protocol (release 8) and hence no suffix is used.

### A.4.3.5 Examples of non-critical extensions not placed at the default extension location

The following example illustrates the use of non-critical extensions in case an extension is not placed at the default extension location.

#### – *ParentIE-WithEM*

The IE *ParentIE-WithEM* is an example of a high level IE including the extension marker (EM). The root encoding of this IE includes two lower level IEs *ChildIE1-WithoutEM* and *ChildIE2-WithoutEM* which not include the extension marker. Consequently, non-critical extensions of the Child-IEs have to be included at the level of the Parent-IE.

The example illustrates how the two extension IEs *ChildIE1-WithoutEM-vNx0* and *ChildIE2-WithoutEM-vNx0* (both in release N) are used to connect non-critical extensions with a default extension location in the lower level IEs to the actual extension location in this IE.

#### ***ParentIE-WithEM* information element**

```
-- /example/ ASN1START
ParentIE-WithEM ::= SEQUENCE {
  -- Root encoding, including:
  childIE1-WithoutEM      ChildIE1-WithoutEM      OPTIONAL,      -- Need N
  childIE2-WithoutEM      ChildIE2-WithoutEM      OPTIONAL,      -- Need N
  ...,
  [
    childIE1-WithoutEM-vNx0      ChildIE1-WithoutEM-vNx0      OPTIONAL,      -- Need N
    childIE2-WithoutEM-vNx0      ChildIE2-WithoutEM-vNx0      OPTIONAL,      -- Need N
  ]
}
-- ASN1STOP
```

Some remarks regarding the extensions shown in the above example:

- The fields *childIEx-WithoutEM-vNx0* may not really need to be optional (depends on what is defined at the next lower level).
- In general, especially when there are several nesting levels, fields should be marked as optional only when there is a clear reason.

#### – *ChildIE1-WithoutEM*

The IE *ChildIE1-WithoutEM* is an example of a lower level IE, used to control certain radio configurations including a configurable feature which can be setup or released using the local IE *ChIE1-ConfigurableFeature*. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature. The example is based on the following assumptions:

- When initially configuring as well as when modifying the new field, the original fields of the configurable feature have to be provided also i.e. as if the extended ones were present within the setup branch of this feature.

- When the configurable feature is released, the new field should be released also.
- When omitting the original fields of the configurable feature the UE continues using the existing values (which is used to optimise the signalling for features that typically continue unchanged upon handover).
- When omitting the new field of the configurable feature the UE releases the existing values and discontinues the associated functionality (which may be used to support release of unsupported functionality upon handover to an eNB supporting an earlier protocol version).

The above assumptions, which affect the use of conditions and need codes, may not always apply. Hence, the example should not be re-used blindly.

### ***ChildIE1-WithoutEM* information element**

```
-- /example/ ASN1START
ChildIE1-WithoutEM ::=          SEQUENCE {
  -- Root encoding, including:
  chIE1-ConfigurableFeature     ChIE1-ConfigurableFeature     OPTIONAL     -- Need N
}

ChildIE1-WithoutEM-vNx0 ::=    SEQUENCE {
  chIE1-ConfigurableFeature-vNx0 ChIE1-ConfigurableFeature-vNx0  OPTIONAL     -- Cond ConfigF
}

ChIE1-ConfigurableFeature ::=  CHOICE {
  release                        NULL,
  setup                          SEQUENCE {
    -- Root encoding
  }
}

ChIE1-ConfigurableFeature-vNx0 ::= SEQUENCE {
  chIE1-NewField-rN              INTEGER (0..31)
}
-- ASN1STOP
```

| Conditional presence | Explanation  |
|----------------------|--|
| <i>ConfigF</i>       | The field is optional present, need R, in case of chIE1-ConfigurableFeature is included and set to "setup"; otherwise the field is absent and the UE shall delete any existing value for this field. |

### – ***ChildIE2-WithoutEM***

The IE *ChildIE2-WithoutEM* is an example of a lower level IE, typically used to control certain radio configurations. The example illustrates how the new field *chIE1-NewField* is added in release N to the configuration of the configurable feature.

**ChildIE2-WithoutEM information element**

```

-- /example/ ASN1START
ChildIE2-WithoutEM ::=
    CHOICE {
        release
            NULL,
        setup
            SEQUENCE {
                -- Root encoding
            }
    }
ChildIE2-WithoutEM-vNx0 ::=
    SEQUENCE {
        chIE2-NewField-rN
            INTEGER (0..31)
    } OPTIONAL -- Cond ConfigF
-- ASN1STOP

```

| Conditional presence | Explanation  |
|----------------------|--|
| <i>ConfigF</i>       | The field is optional present, need R, in case of chIE2-ConfigurableFeature is included and set to "setup"; otherwise the field is absent and the UE shall delete any existing value for this field. |

---

## A.5 Guidelines regarding inclusion of transaction identifiers in RRC messages

The following rules provide guidance on which messages should include a Transaction identifier

- 1: DL messages on CCCH that move UE to RRC-Idle should not include the RRC transaction identifier.
- 2: All network initiated DL messages by default should include the RRC transaction identifier.
- 3: All UL messages that are direct response to a DL message with an RRC Transaction identifier should include the RRC Transaction identifier.
- 4: All UL messages that require a direct DL response message should include an RRC transaction identifier.
- 5: All UL messages that are not in response to a DL message nor require a corresponding response from the network should not include the RRC Transaction identifier.

---

## A.6 Guidelines regarding use of need codes

The following rule provides guidance for determining need codes for optional downlink fields:

- if the field needs to be stored by the UE (i.e. maintained) when absent:
  - use Need M (=Maintain);

- else, if the field needs to be released by the UE when absent:
  - use Need R (=Release);
- else, if UE shall take no action when the field is absent (i.e. UE does not even need to maintain any existing value of the field):
  - use Need N (=None);
- else (UE behaviour upon absence does not fit any of the above conditions):
  - use Need S (=Specified);
  - specify the UE behaviour upon absence of the field in the procedural text or in the field description table.

## A.7 Guidelines regarding use of conditions

Conditions are primarily used to specify network restrictions, for which the following types can be distinguished:

- Message Contents related constraints e.g. that a field B is mandatory present if the same message includes field A and when it is set value X.
- Configuration Constraints e.g. that a field D can only be signalled if field C is configured and set to value Y. (i.e. regardless of whether field C is present in the same message or previously configured).

The use of these conditions is illustrated by an example.

```
-- /example/ ASN1START
RRCMessage-IEs ::= SEQUENCE {
    fieldA          FieldA          OPTIONAL,  -- Need M
    fieldB          FieldB          OPTIONAL,  -- Cond FieldAsetToX
    fieldC          FieldC          OPTIONAL,  -- Need M
    fieldD          FieldD          OPTIONAL,  -- Cond FieldCsetToY
    nonCriticalExtension SEQUENCE {}  OPTIONAL
}
-- /example/ ASN1STOP
```

| Conditional presence | Explanation  |
|----------------------|--|
| <i>FieldAsetToX</i>  | The field is mandatory present if fieldA is included and set to valueX. Otherwise the field is optionally present, need R.                               |
| <i>FieldCsetToY</i>  | The field is optionally present, need M, if fieldC is configured and set to valueY. Otherwise the field is absent and the UE does not maintain the value |

---

## A.8 Miscellaneous

The following miscellaneous convention should be used:

- UE capabilities: TS 38.306 [26] specifies that the network should in general respect the UE's capabilities. Hence there is no need to include statement clarifying that the network, when setting the value of a certain configuration field, shall respect the related UE capabilities unless there is a particular need e.g. particularly complicated cases.

---

## Annex B (informative): RRC Information

### B.1 Protection of RRC messages

The following list provides information which messages can be sent (unprotected) prior to AS security activation and which messages can be sent unprotected after AS security activation. Those messages indicated "-" in "P" column should never be sent unprotected by gNB or UE. Further requirements are defined in the procedural text.

P...Messages that can be sent (unprotected) prior to AS security activation

A – I...Messages that can be sent without integrity protection after AS security activation

A – C...Messages that can be sent unciphered after AS security activation

NA... Message can never be sent after AS security activation

| Message                              | P | A-I | A-C | Comment   |
|--------------------------------------|---|-----|-----|---|
| <i>CounterCheck</i>                  | - | -   | -   |   |
| <i>CounterCheckResponse</i>          | - | -   | -   |   |
| <i>DLInformationTransfer</i>         | + | -   | -   |   |
| <i>FailureInformation</i>            | - | -   | -   |   |
| <i>LocationMeasurementIndication</i> | - | -   | -   |   |
| <i>MIB</i>                           | + | +   | +   |   |
| <i>MeasurementReport</i>             | - | -   | -   | Measurement configuration may be sent prior to AS security activation. But: In order to protect privacy of UEs, <i>MeasurementReport</i> is only sent from the UE after successful AS security activation.  |
| <i>MobilityFromNRCommand</i>         | - | -   | -   |   |
| <i>Paging</i>                        | + | +   | +   |   |
| <i>RRCReconfiguration</i>            | + | -   | -   | The message shall not be sent unprotected before AS security activation if it is used to perform handover or to establish SRB2 and DRBs.  |
| <i>RRCReconfigurationComplete</i>    | + | -   | -   | Unprotected, if sent as response to <i>RRCReconfiguration</i> which was sent before AS security activation.   |
| <i>RRCReestablishment</i>            | - | -   | +   | Integrity protection applied, but no ciphering.   |
| <i>RRCReestablishmentComplete</i>    | - | -   | -   |   |
| <i>RRCReestablishmentRequest</i>     | - | -   | +   | This message is not protected by PDCP operation. However, a <i>shortMAC-I</i> is included.  |
| <i>RRCReject</i>                     | + | +   | +   | Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE state, after the AS security is activated.   |
| <i>RRCRelease</i>                    | + | -   | -   | Justification for P: If the RRC connection only for signalling not requiring DRBs or ciphered messages, or the signalling connection has to be released prematurely, this message is sent as unprotected. <i>RRCRelease</i> message sent before AS security activation cannot include <i>deprioritisationReq</i> , <i>suspendConfig</i> , <i>redirectedCarrierInfo</i> , <i>cellReselectionPriorities</i> information fields. |
| <i>RRCRequest</i>                    | + | NA  | NA  |   |
| <i>RRCResume</i>                     | - | -   | -   |   |
| <i>RRCResumeComplete</i>             | - | -   | -   |   |
| <i>RRCResumeRequest</i>              | - | -   | +   | This message is not protected by PDCP operation. However, a <i>resumeMAC-I</i> is included.   |
| <i>RRCResumeRequest1</i>             | - | -   | +   | This message is not protected by PDCP operation. However, a <i>resumeMAC-I</i> is included.   |
| <i>RRCSetup</i>                      | + | +   | +   | Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE state, after the AS security is activated.   |
| <i>RRCSetupComplete</i>              | + | NA  | NA  |   |
| <i>RRCSystemInfoRequest</i>          | + | +   | +   | Justification for A-I and A-C: the message can be sent in SRB0 in RRC_INACTIVE state, after the AS security is activated.   |
| <i>SIB1</i>                          | + | +   | +   |   |
| <i>SCGFailureInformation</i>         | - | -   | -   |   |
| <i>SCGFailureInformationEUTRA</i>    | - | -   | -   |   |
| <i>SecurityModeCommand</i>           | + | NA  | NA  | Integrity protection applied, but no ciphering (integrity verification done after the message received by RRC).   |
| <i>SecurityModeComplete</i>          | - | -   | +   | The message is sent after AS security activation. Integrity protection applied, but no ciphering. Ciphering is applied after completing the procedure.  |
| <i>SecurityModeFailure</i>           | + | NA  | NA  | Neither integrity protection nor ciphering applied.   |
| <i>SystemInformation</i>             | + | +   | +   |   |
| <i>UEAssistanceInformation</i>       | - | -   | -   |   |
| <i>UECapabilityEnquiry</i>           | + | -   | -   |   |
| <i>UECapabilityInformation</i>       | + | -   | -   |   |

| Message                          | P | A-I | A-C | Comment |
|----------------------------------|---|-----|-----|---------|
| <i>ULInformationTransfer</i>     | + | -   | -   |         |
| <i>ULInformationTransferMRDC</i> | - | -   | -   |         |

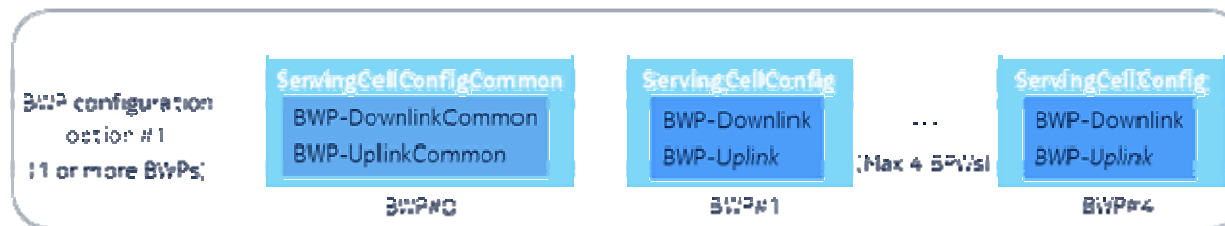
## B.2 Description of BWP configuration options

There are two possible ways to configure BWP#0 (i.e. the initial BWP) for a UE:

- 1) Configure *BWP-DownlinkCommon* and *BWP-UplinkCommon* in *ServingCellConfigCommon*, but do not configure dedicated configurations in *BWP-DownlinkDedicated* or *BWP-UplinkDedicated* in *ServingCellConfig*.
- 2) Configure both *BWP-DownlinkCommon* and *BWP-UplinkCommon* in *ServingCellConfigCommon* and configure dedicated configurations in at least one of *BWP-DownlinkDedicated* or *BWP-UplinkDedicated* in *ServingCellConfig*.

The same way of configuration is used for UL BWP#0 and DL BWP#0 if both are configured.

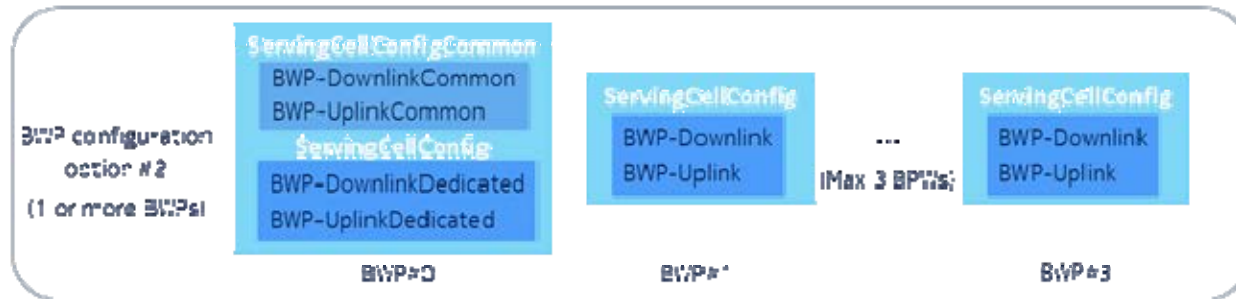
With the first option (illustrated by figure B2-1 below), the BWP#0 is not considered to be an RRC-configured BWP, i.e. UE only supporting one BWP can still be configured with BWP#1 in addition to BWP#0 when using this configuration. The BWP#0 can still be used even if it does not have the dedicated configuration, albeit in a more limited manner since only the SIB1-defined configurations are available. For example, only DCI format 1\_0 can be used with BWP#0 without dedicated configuration, so changing to another BWP requires RRCReconfiguration since DCI format 1\_0 doesn't support DCI-based switching.



**Figure B2-1: BWP#0 configuration without dedicated configuration**

With the second option (illustrated by figure B2-2 below), the BWP#0 is considered to be an RRC-configured BWP, i.e. UE only supporting one BWP cannot be configured with BWP#1 in addition to BWP#0 when using this configuration. However, UE supporting more than one BWP can still switch to and from BWP#0 e.g. via DCI normally, and there are no explicit limitations to using the BWP#0 (compared to the first option).





**Figure B2-2: BWP#0 configuration with dedicated configuration**

For BWP#0, the *BWP-DownlinkCommon* and *BWP-UplinkCommon* in *ServingCellConfigCommon* should match the parameters configured by MIB and SIB1 (if provided) in the corresponding serving cell.

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## Annex C (informative): Change history

| Change history |             |            |      |     |          |   |             |
|----------------|-------------|------------|------|-----|----------|---|-------------|
| Date           | Meeting     | TDoc       | CR   | Rev | Category | Subject/Comment   | New version |
| 04/2017        | RAN2 #97bis | R2-1703395 |      |     |          |   | 0.0.1       |
| 04/2017        | RAN2 #97bis | R2-1703922 |      |     |          |   | 0.0.2       |
| 05/2017        | RAN2 #98    | R2-1705815 |      |     |          |   | 0.0.3       |
| 06/2017        | RAN2 #NR2   | R2-1707187 |      |     |          |   | 0.0.4       |
| 08/2017        | RAN2 #99    | R2-1708468 |      |     |          |   | 0.0.5       |
| 09/2017        | RAN2 #99bis | R2-1710557 |      |     |          |   | 0.1.0       |
| 11/2017        | RAN2 #100   | R2-1713629 |      |     |          |   | 0.2.0       |
| 11/2017        | RAN2 #100   | R2-1714126 |      |     |          |   | 0.3.0       |
| 12/2017        | RAN2 #100   | R2-1714259 |      |     |          |   | 0.4.0       |
| 12/2017        | RP#78       | RP-172570  |      |     |          | Submitted for Approval in RAN#78  | 1.0.0       |
| 12/2017        | RP#78       |            |      |     |          | Upgraded to Rel-15 (MCC)  | 15.0.0      |
| 03/2018        | RP#79       | RP-180479  | 0008 | 1   | F        | Corrections for EN-DC (Note: the clause numbering between 15.0.0 and 15.1.0 has changed in some cases). | 15.1.0      |
| 06/2018        | RP-80       | RP-181326  | 0042 | 7   | F        | Miscellaneous EN-DC corrections   | 15.2.0      |
|                | RP-80       |            |      |     |          | Correction: Duplicate Foreword section removed & ASN.1 sections touched up                              | 15.2.1      |
| 09/2018        | RP-81       | RP-181942  | 0100 | 4   | F        | Introduction of SA  | 15.3.0      |
| 12/2018        | RP-82       | RP-182656  | 0179 | 3   | F        | Handling of Resume Failure  | 15.4.0      |
|                | RP-82       | RP-182651  | 0187 | 1   | F        | Clarification on the presence of ra-ResponseWindow  | 15.4.0      |
|                | RP-82       | RP-182656  | 0188 | 3   | F        | Addition of RAN specific Access Category  | 15.4.0      |
|                | RP-82       | RP-182653  | 0199 | 2   | F        | CR for TS38.331 on MIB  | 15.4.0      |
|                | RP-82       | RP-182653  | 0200 | 1   | F        | CR for TS38.331 on PDCCH-ConfigSIB  | 15.4.0      |
|                | RP-82       | RP-182661  | 0202 | 2   | F        | Handling Cell Reselection during SI Request   | 15.4.0      |
|                | RP-82       | RP-182649  | 0213 | 2   | F        | Corrections on security field descriptions  | 15.4.0      |
|                | RP-82       | RP-182649  | 0216 | 2   | F        | Remain issue for T302   | 15.4.0      |
|                | RP-82       | RP-182649  | 0219 | 1   | F        | [C204] Handling of timer T380   | 15.4.0      |
|                | RP-82       | RP-182655  | 0229 | 2   | F        | Clarification on configured grant timer in 38.331   | 15.4.0      |
|                | RP-82       | RP-182663  | 0232 | 2   | F        | CR for ServingCellConfigCommon in 38.331  | 15.4.0      |
|                | RP-82       | RP-182659  | 0234 | 3   | F        | Introduction of cell level rate matching parameters in ServingCellConfig                                | 15.4.0      |
|                | RP-82       | RP-182650  | 0235 | 2   | F        | CR for introducing PSCell frequency in CG-Config  | 15.4.0      |
|                | RP-82       | RP-182650  | 0236 | 2   | F        | CR for security handling for eLTE in 38.331   | 15.4.0      |
|                | RP-82       | RP-182650  | 0237 | 1   | F        | Handling on simultaneously triggered NAS&AS events (I770)   | 15.4.0      |
|                | RP-82       | RP-182650  | 0238 | 2   | F        | Handling on security keys for resume procedure (I774)   | 15.4.0      |
|                | RP-82       | RP-182664  | 0239 | 5   | F        | RIL I556, I557, I558 on RB handling when resuming   | 15.4.0      |
|                | RP-82       | RP-182650  | 0242 | 2   | F        | Security for RRC connection release   | 15.4.0      |
|                | RP-82       | RP-182650  | 0243 | 4   | F        | Corrections on reestablishment and security procedures  | 15.4.0      |

|  |       |           |      |   |   |  |        |
|--|-------|-----------|------|---|---|--|--------|
|  | RP-82 | RP-182650 | 0244 | 1 | F | RIL I118 on release case to upper layers for CN paging for a UE in RRC_INACTIVE            | 15.4.0 |
|  | RP-82 | RP-182650 | 0246 | 2 | F | CR on SI request procedure in TS38.331   | 15.4.0 |
|  | RP-82 | RP-182650 | 0248 | 2 | F | CR to 38331 on ul-DataSplitThreshold for SRB   | 15.4.0 |
|  | RP-82 | RP-182652 | 0249 | 2 | F | Clarification of guami-Type  | 15.4.0 |
|  | RP-82 | RP-182652 | 0252 | 1 | F | CR to 38.331 on Protection of RRC messages Table   | 15.4.0 |
|  | RP-82 | RP-182663 | 0254 | 2 | F | Access barring check after handover  | 15.4.0 |
|  | RP-82 | RP-182663 | 0259 | 3 | F | Stop of T390 and related UE actions  | 15.4.0 |
|  | RP-82 | RP-182657 | 0260 | 4 | F | Corrections for handover between NR and E-UTRA   | 15.4.0 |
|  | RP-82 | RP-182738 | 0267 | 3 | F | CR on ssb-ToMeasure in MeasurementTimingConfiguration                                      | 15.4.0 |
|  | RP-82 | RP-182659 | 0269 | 3 | F | Clarification of the applicability of 38.331 to EN-DC                                      | 15.4.0 |
|  | RP-82 | RP-182654 | 0270 | 3 | F | Clarification on the smtc signalled for intra-NR handover, PSCell change or SCell addition | 15.4.0 |
|  | RP-82 | RP-182654 | 0273 | 3 | F | CR on fallback to the setup procedure  | 15.4.0 |
|  | RP-82 | RP-182654 | 0275 | 1 | F | Correction on cell sorting for periodical measurement reporting                            | 15.4.0 |
|  | RP-82 | RP-182660 | 0277 | 2 | F | Measurement related actions upon re-establishment  | 15.4.0 |
|  | RP-82 | RP-182654 | 0278 | 1 | F | CR on threshold description for cell quality derivation                                    | 15.4.0 |
|  | RP-82 | RP-182654 | 0282 | 1 | F | CR to avoid unnecessary L3 filtered beam measurements                                      | 15.4.0 |
|  | RP-82 | RP-182660 | 0283 | 2 | F | CR on CGI reporting  | 15.4.0 |
|  | RP-82 | RP-182660 | 0291 | 3 | F | Additional UE capabilities for NR standalone   | 15.4.0 |
|  | RP-82 | RP-182667 | 0294 | 4 | F | NR RRC Processing Time   | 15.4.0 |
|  | RP-82 | RP-182812 | 0295 | 5 | F | Update of L1/RF capabilities   | 15.4.0 |
|  | RP-82 | RP-182651 | 0296 | 2 | F | UE configuration on re-establishment procedure   | 15.4.0 |
|  | RP-82 | RP-182651 | 0298 | 2 | F | SIB size limitation [M201]   | 15.4.0 |
|  | RP-82 | RP-182651 | 0299 | 2 | F | Correction on SRS-TPC-CommandConfig  | 15.4.0 |
|  | RP-82 | RP-182651 | 0302 | 2 | F | Clarification on counter check procedure   | 15.4.0 |
|  | RP-82 | RP-182666 | 0307 | 4 | F | CR on the Clarification for the Support of the Delay Budget Report in NR                   | 15.4.0 |
|  | RP-82 | RP-182666 | 0320 | 3 | F | ssb-PositionsInBurst correction  | 15.4.0 |
|  | RP-82 | RP-182666 | 0325 | 3 | F | Barring behaviour when SIB1 reception fails  | 15.4.0 |
|  | RP-82 | RP-182666 | 0329 | 5 | F | System Information Storing and Validity Clarifications and Corrections                     | 15.4.0 |
|  | RP-82 | RP-182666 | 0330 | 3 | F | SIBs required before initiating connection   | 15.4.0 |
|  | RP-82 | RP-182652 | 0333 | 1 | F | On contents of measObjectEUTRA   | 15.4.0 |
|  | RP-82 | RP-182654 | 0335 | 2 | F | A3 and A5 corrections – neighbouring cell definition                                       | 15.4.0 |
|  | RP-82 | RP-182650 | 0339 | 2 | F | SI reception in RRC Connected mode (RIL#I1611)   | 15.4.0 |
|  | RP-82 | RP-182650 | 0340 | 2 | F | Miscellaneous corrections on SI procedures   | 15.4.0 |
|  | RP-82 | RP-182652 | 0342 | 1 | F | On RRM measurements related procedural text corrections                                    | 15.4.0 |
|  | RP-82 | RP-182651 | 0344 | 1 | F | Clarification for absense of nr-NS-PmaxList IE   | 15.4.0 |
|  | RP-82 | RP-182652 | 0345 | 2 | F | Clarification on paging in connected mode  | 15.4.0 |
|  | RP-82 | RP-182651 | 0350 | 2 | F | ASN.1 correction to fr-InfoListSCG in CG-Config  | 15.4.0 |
|  | RP-82 | RP-182661 | 0355 | 2 | F | Update of L2 capability parameters   | 15.4.0 |
|  | RP-82 | RP-182651 | 0364 | 1 | F | Procedures for full config at RRCResume  | 15.4.0 |
|  | RP-82 | RP-182651 | 0365 | 2 | F | Clarification of PDCP-Config field descriptions  | 15.4.0 |
|  | RP-82 | RP-182653 | 0368 | 2 | F | UE Context handling during handover to NR  | 15.4.0 |
|  | RP-82 | RP-182652 | 0371 | 2 | F | [E255] CR to 38.331 on corrections related to CGI reporting timer T321                     | 15.4.0 |
|  | RP-82 | RP-182655 | 0375 | 3 | F | R2-1817981 CR to 38.331 on pendingRnaUpdate setting  | 15.4.0 |
|  | RP-82 | RP-182653 | 0376 | 2 | F | Introducing procedure for reporting RLC failures   | 15.4.0 |
|  | RP-82 | RP-182654 | 0379 | 2 | F | Correction of frequency band indication in MeasObjectNR                                    | 15.4.0 |
|  | RP-82 | RP-182654 | 0382 | 2 | F | RRC connection release triggered by upper layers   | 15.4.0 |
|  | RP-82 | RP-182660 | 0384 | 3 | F | Correction to configuration of measurement object  | 15.4.0 |

|  |       |           |      |   |   |   |        |
|--|-------|-----------|------|---|---|---|--------|
|  | RP-82 | RP-182665 | 0388 | 3 | F | Correction to 38331 in SRS-Config   | 15.4.0 |
|  | RP-82 | RP-182657 | 0391 | 2 | F | Correction for PowerControl-related issues  | 15.4.0 |
|  | RP-82 | RP-182668 | 0395 | 4 | F | Inter-band EN-DC Configured Output Power requirements   | 15.4.0 |
|  | RP-82 | RP-182655 | 0396 | 2 | F | E573 Configuration of SRB1 during Resume  | 15.4.0 |
|  | RP-82 | RP-182655 | 0402 | 1 | F | Triggers for abortion of RRC establishment  | 15.4.0 |
|  | RP-82 | RP-182656 | 0406 | 2 | F | Correction on CN type indication for Redirection from NR to E-UTRA                              | 15.4.0 |
|  | RP-82 | RP-182664 | 0409 | 4 | F | Miscellaneous minor corrections   | 15.4.0 |
|  | RP-82 | RP-182654 | 0410 | 1 | F | Invalidation of L1 parameter nrofCQIsPerReport  | 15.4.0 |
|  | RP-82 | RP-182654 | 0411 | 1 | F | Clarifications on RNA update and CN registration (N023)   | 15.4.0 |
|  | RP-82 | RP-182666 | 0412 | 3 | F | Missing optionality bit in CG-ConfigInfo  | 15.4.0 |
|  | RP-82 | RP-182662 | 0414 | 2 | F | Clarification for the implementation of UE feature list item 6-1 (BWP op1)                      | 15.4.0 |
|  | RP-82 | RP-182654 | 0417 | 1 | F | Clarification on ssb-PositionsInBurst   | 15.4.0 |
|  | RP-82 | RP-182667 | 0418 | 3 | F | Correction to commonControlResourceSet  | 15.4.0 |
|  | RP-82 | RP-182667 | 0420 | 2 | F | Correction to TDD configuration in SIB1   | 15.4.0 |
|  | RP-82 | RP-182668 | 0421 | 5 | F | Clarification on handling of default parameters   | 15.4.0 |
|  | RP-82 | RP-182663 | 0429 | 2 | F | SRB3 integrity protection failure handling  | 15.4.0 |
|  | RP-82 | RP-182653 | 0431 | 2 | F | Corrections to the field descriptions of System Information                                     | 15.4.0 |
|  | RP-82 | RP-182653 | 0434 | 1 | F | Correction to SI provision in connected mode  | 15.4.0 |
|  | RP-82 | RP-182661 | 0436 | 3 | F | PDCCH Monitoring Occasions in SI Window   | 15.4.0 |
|  | RP-82 | RP-182655 | 0438 | 3 | F | CR on SI Message Acquisition  | 15.4.0 |
|  | RP-82 | RP-182652 | 0439 | 1 | F | Update of nas-SecurityParamFromNR according to LS from SA3                                      | 15.4.0 |
|  | RP-82 | RP-182652 | 0445 | 2 | F | Correction to Default MAC Cell Group configuration  | 15.4.0 |
|  | RP-82 | RP-182652 | 0447 | 1 | F | Correction to missing field descriptions of PLMN Identity                                       | 15.4.0 |
|  | RP-82 | RP-182657 | 0448 | 2 | F | Introducing PDCP suspend procedure  | 15.4.0 |
|  | RP-82 | RP-182657 | 0449 | 2 | F | Correction to PDCP statusReportRequired   | 15.4.0 |
|  | RP-82 | RP-182664 | 0454 | 3 | F | CR to 38.331 on the ambiguity of targetCellIdentity in Resume/Reestablishment MAC-I calculation | 15.4.0 |
|  | RP-82 | RP-182655 | 0457 | 1 | F | Corrections on P-Max description  | 15.4.0 |
|  | RP-82 | RP-182651 | 0460 | 2 | F | Clarification on Configuration of multiplePHR for EN-DC and NR-CA                               | 15.4.0 |
|  | RP-82 | RP-182656 | 0469 | 2 | F | Correction on conditional presence of PCellOnly   | 15.4.0 |
|  | RP-82 | RP-182657 | 0474 | 4 | F | Introduction of power boosting indicator for pi2BPSK waveform                                   | 15.4.0 |
|  | RP-82 | RP-182655 | 0475 | 1 | F | Correction on the allowedBC-ListMRDC  | 15.4.0 |
|  | RP-82 | RP-182649 | 0476 | 2 | F | Removal of restriction on RB removal and addition   | 15.4.0 |
|  | RP-82 | RP-182649 | 0482 | 2 | F | Correction to full configuration  | 15.4.0 |
|  | RP-82 | RP-182661 | 0492 | 3 | F | CR on MeasurementTimingConfiguration  | 15.4.0 |
|  | RP-82 | RP-182654 | 0502 | 1 | F | Bandwidth configuration for initial BWP   | 15.4.0 |
|  | RP-82 | RP-182664 | 0503 | 4 | F | CORESET#0 configuration when SIB1 is not broadcast  | 15.4.0 |
|  | RP-82 | RP-182663 | 0506 | 1 | F | Correction on the behaviors with cell reselection while T302 is running                         | 15.4.0 |
|  | RP-82 | RP-182661 | 0509 | 2 | F | Correction on SDAP reconfiguration handling   | 15.4.0 |
|  | RP-82 | RP-182663 | 0510 | 1 | F | Clarification for the UE behaviour in camped normally and camped on any cell states             | 15.4.0 |
|  | RP-82 | RP-182663 | 0514 | 2 | F | Correction to description of parameter Ns nAndPagingFrameOffset                                 | 15.4.0 |
|  | RP-82 | RP-182649 | 0515 | - | F | Correction to description of parameter Ns   | 15.4.0 |
|  | RP-82 | RP-182661 | 0516 | 1 | F | CR on UE behaviour after SI Acquisition Failure   | 15.4.0 |
|  | RP-82 | RP-182662 | 0518 | 1 | F | CR on PUCCH-ConfigCommon  | 15.4.0 |
|  | RP-82 | RP-182662 | 0520 | 1 | F | Clarifications on receiving RRCReject without wait timer  | 15.4.0 |
|  | RP-82 | RP-182665 | 0522 | 1 | F | CR on powerControlOffset  | 15.4.0 |
|  | RP-82 | RP-182664 | 0524 | 2 | F | Correction to configuration of firstPDCCH-MonitoringOccasionOfPO                                | 15.4.0 |
|  | RP-82 | RP-182660 | 0539 | 1 | F | R on PCCH-Config  | 15.4.0 |

|  |       |           |      |   |   |  |        |
|--|-------|-----------|------|---|---|--|--------|
|  | RP-82 | RP-182649 | 0541 | - | F | Clarification to no barring configuration for Implicit UAC                                 | 15.4.0 |
|  | RP-82 | RP-182649 | 0542 | - | F | Correction to Access Category and barring config determination for implicit access barring | 15.4.0 |
|  | RP-82 | RP-182664 | 0543 | 2 | F | Per serving cell MIMO layer configuration  | 15.4.0 |
|  | RP-82 | RP-182661 | 0545 | 1 | F | Correction to reconfiguration with sync  | 15.4.0 |
|  | RP-82 | RP-182659 | 0552 | 1 | F | Correction for SSB power   | 15.4.0 |
|  | RP-82 | RP-182659 | 0554 | 1 | F | Corrections on SearchSpace configuration   | 15.4.0 |
|  | RP-82 | RP-182665 | 0558 | 1 | F | Correction for TCI state in ControlResourceSet   | 15.4.0 |
|  | RP-82 | RP-182663 | 0560 | 1 | F | CR for the optional configuration of subbandSize   | 15.4.0 |
|  | RP-82 | RP-182650 | 0562 | - | F | Correction on ShortMAC-I description in 38.331   | 15.4.0 |
|  | RP-82 | RP-182661 | 0567 | 1 | F | CR to the field descriptions of System Information   | 15.4.0 |
|  | RP-82 | RP-182650 | 0569 | - | F | Clarification on SRB3 release  | 15.4.0 |
|  | RP-82 | RP-182650 | 0570 | - | F | Avoiding security risk for RLC UM bearers during termination point change                  | 15.4.0 |
|  | RP-82 | RP-182660 | 0571 | 1 | F | MO configuration with SSB SCS for a given SSB frequency                                    | 15.4.0 |
|  | RP-82 | RP-182663 | 0572 | 1 | F | Barring alleviation for emergency service  | 15.4.0 |
|  | RP-82 | RP-182664 | 0575 | 1 | F | Corrections for security configurations during setup of SRB1                               | 15.4.0 |
|  | RP-82 | RP-182660 | 0577 | 1 | F | Clarification of UE behaviour when frequencyBandList is absent in SIB4                     | 15.4.0 |
|  | RP-82 | RP-182661 | 0578 | 2 | F | Handling of missing fields in SIB1   | 15.4.0 |
|  | RP-82 | RP-182659 | 0580 | 1 | F | Correction to ControlResourceSetZero   | 15.4.0 |
|  | RP-82 | RP-182667 | 0582 | 2 | F | Full configuration for inter-RAT handover  | 15.4.0 |
|  | RP-82 | RP-182664 | 0587 | 1 | F | Corrections on number of RadioLinkMonitoringRS condifuration                               | 15.4.0 |
|  | RP-82 | RP-182659 | 0591 | 1 | F | Clarification on phr-Type2OtherCell  | 15.4.0 |
|  | RP-82 | RP-182667 | 0594 | 2 | F | Addition of PCI in MeasTiming  | 15.4.0 |
|  | RP-82 | RP-182667 | 0600 | 5 | F | Clarifications to SIBs requiring request procedure   | 15.4.0 |
|  | RP-82 | RP-182659 | 0601 | 1 | F | Correction for support of initial downlink BWP   | 15.4.0 |
|  | RP-82 | RP-182657 | 0602 | 1 | F | Miscellaneous corrections related to idle mode SIBs  | 15.4.0 |
|  | RP-82 | RP-182657 | 0603 | 1 | F | Correction for missing fields in SIB2 and SIB4   | 15.4.0 |
|  | RP-82 | RP-182657 | 0604 | 2 | F | Correction to Q-QualMin value range  | 15.4.0 |
|  | RP-82 | RP-182663 | 0616 | 1 | F | Clarification of cell reselection during resume procedure                                  | 15.4.0 |
|  | RP-82 | RP-182663 | 0617 | 1 | F | Determination of Access Identities for RRC-triggered Access Attempts                       | 15.4.0 |
|  | RP-82 | RP-182663 | 0618 | 1 | F | CR to 38.331 on stopping of timer T390 upon reception of RRCRelease                        | 15.4.0 |
|  | RP-82 | RP-182840 | 0620 | 3 | F | CR on MN/SN coordination for report CGI procedure  | 15.4.0 |
|  | RP-82 | RP-182666 | 0624 | 2 | F | CR to 38.331 on aligning I-RNTI terminology in paging and SuspendConfig (Alt.2)            | 15.4.0 |
|  | RP-82 | RP-182665 | 0627 | 2 | F | CR to 38.331 on IRAT Cell reselection in RRC_INACTIVE                                      | 15.4.0 |
|  | RP-82 | RP-182662 | 0638 | 1 | F | CR for pendingRnaUpdate set  | 15.4.0 |
|  | RP-82 | RP-182665 | 0640 | 2 | F | Corrections on BWP ID  | 15.4.0 |
|  | RP-82 | RP-182664 | 0643 | 1 | F | Inter-frequency handover capability  | 15.4.0 |
|  | RP-82 | RP-182659 | 0646 | 1 | F | Search space configuration for DCI format 2_0 monitoring                                   | 15.4.0 |
|  | RP-82 | RP-182739 | 0647 | 3 | F | Correction on power headroom configuration exchange  | 15.4.0 |
|  | RP-82 | RP-182665 | 0649 | 2 | F | UE capability on PA architecture   | 15.4.0 |
|  | RP-82 | RP-182662 | 0654 | 1 | F | CR on pdsch-TimeDomainAllocationList and pusch-TimeDomainAllocationList                    | 15.4.0 |
|  | RP-82 | RP-182664 | 0655 | 1 | F | Correction on the SSB based RACH configuration   | 15.4.0 |
|  | RP-82 | RP-182659 | 0656 | 1 | F | CR on starting bit of Format 2-3   | 15.4.0 |
|  | RP-82 | RP-182663 | 0660 | 1 | C | CR on wait timer in RRC release  | 15.4.0 |
|  | RP-82 | RP-182662 | 0664 | 1 | F | SCell release at RRC Reestablishment   | 15.4.0 |
|  | RP-82 | RP-182663 | 0665 | 1 | F | Clean up of SRB1 terminology   | 15.4.0 |
|  | RP-82 | RP-182662 | 0670 | 1 | F | Correction on the size of PUCCH resource ID  | 15.4.0 |
|  | RP-82 | RP-182667 | 0673 | 3 | F | CR to 38.331 on Integrity Check failure at RRC Reestablishment                             | 15.4.0 |

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|         | RP-82 | RP-182661 | 0680 | 1 | F | Correction on SI message acquisition timing   | 15.4.0 |
|         | RP-82 | RP-182653 | 0682 | - | F | Add t-ReselectionNR-SF in SIB2  | 15.4.0 |
|         | RP-82 | RP-182654 | 0683 | - | F | freqBandIndicatorNR correction in MultiFrequencyBandListNR-SIB                                | 15.4.0 |
|         | RP-82 | RP-182658 | 0684 | 2 | F | Corrections to CellSelectionInfo in SIB1 and SIB4   | 15.4.0 |
|         | RP-82 | RP-182654 | 0686 | - | F | Correction on the field description of DRX timers   | 15.4.0 |
|         | RP-82 | RP-182661 | 0687 | 1 | F | Correction on DC subcarrier usage in SetupComplete message                                    | 15.4.0 |
|         | RP-82 | RP-182665 | 0688 | 3 | F | Various carrier frequency definiton corrections   | 15.4.0 |
|         | RP-82 | RP-182661 | 0689 | 1 | F | CR on signaling contiguous and non-contiguous EN-DC capability                                | 15.4.0 |
|         | RP-82 | RP-182654 | 0692 | - | F | Update of the usage of QCL type-C   | 15.4.0 |
|         | RP-82 | RP-182659 | 0694 | 1 | F | Cleanup of references to L1 specifications  | 15.4.0 |
|         | RP-82 | RP-182660 | 0695 | 1 | F | Correction of MeasResultEUTRA   | 15.4.0 |
|         | RP-82 | RP-182660 | 0696 | 1 | F | Missing need code for refFreqCSI-RS   | 15.4.0 |
|         | RP-82 | RP-182661 | 0697 | 2 | F | Missing procedure text in RRC Reconfiguration   | 15.4.0 |
|         | RP-82 | RP-182781 | 0700 | 3 | F | Correction to UE capability procedures in 38.331  | 15.4.0 |
|         | RP-82 | RP-182667 | 0701 | 1 | F | Correction to aperiodicTriggeringOffset   | 15.4.0 |
|         | RP-82 | RP-182664 | 0709 | 1 | F | CR to 38.331 on including serving cell measurements   | 15.4.0 |
|         | RP-82 | RP-182660 | 0711 | 1 | F | CR to 38.331 on associatedSSB   | 15.4.0 |
|         | RP-82 | RP-182662 | 0714 | 1 | F | CR on 38.331 for RRCResumeRequest and RRCResumeRequest1 and protection of RRCResumeRequest1   | 15.4.0 |
|         | RP-82 | RP-182667 | 0715 | 2 | F | Correction for reporting of NR serving cell measurements when rsType is missing               | 15.4.0 |
|         | RP-82 | RP-182656 | 0719 | 1 | F | Clarification of the values for RangeToBestCell   | 15.4.0 |
|         | RP-82 | RP-182668 | 0721 | 2 | F | CR on handling of timer T380  | 15.4.0 |
|         | RP-82 | RP-182662 | 0723 | 2 | F | CR on supporting signalling only connection   | 15.4.0 |
|         | RP-82 | RP-182838 | 0725 | 3 | F | Signalling introduction of SRS switching capability   | 15.4.0 |
|         | RP-82 | RP-182667 | 0729 | 3 | B | CR on signalling introduction of UE overheating support in NR SA scenario                     | 15.4.0 |
|         | RP-82 | RP-182856 | 0730 | 4 | F | CR on SRS antenna switching   | 15.4.0 |
|         | RP-82 | RP-182660 | 0731 | 1 | F | Correction to offsetToPointA  | 15.4.0 |
|         | RP-82 | RP-182655 | 0732 | - | F | Correction to cell selection parameters   | 15.4.0 |
|         | RP-82 | RP-182665 | 0746 | 2 | F | CR to 38.331 on stopping T302 and UE related actions  | 15.4.0 |
|         | RP-82 | RP-182666 | 0750 | 2 | F | Correction on indication for user plane resource release                                      | 15.4.0 |
|         | RP-82 | RP-182662 | 0767 | 1 | F | Correction on the terminology scg-ChangeFailure   | 15.4.0 |
|         | RP-82 | RP-182661 | 0768 | 1 | F | Correction on default configuration   | 15.4.0 |
|         | RP-82 | RP-182660 | 0772 | 1 | F | Clarification of measurement object for beam reporting for NR cells                           | 15.4.0 |
|         | RP-82 | RP-182667 | 0773 | 3 | F | CR to 38.331 on UE AS Context definition – Include suspendConfig                              | 15.4.0 |
|         | RP-82 | RP-182661 | 0778 | 1 | F | CR to 38.331 on HO support in Setup Procedure   | 15.4.0 |
|         | RP-82 | RP-182656 | 0781 | - | F | CR on description of k0   | 15.4.0 |
|         | RP-82 | RP-182666 | 0783 | 2 | F | CR to 38.331 on removing FFS of locationInfo  | 15.4.0 |
|         | RP-82 | RP-182661 | 0787 | - | F | Clarification on MIB Acquisition  | 15.4.0 |
|         | RP-82 | RP-182662 | 0788 | - | F | CR to 38331 on release after completion of inter-RAT HO                                       | 15.4.0 |
|         | RP-82 | RP-182662 | 0789 | - | F | CR to 38.331 on rbg-Size in PDSCH-Config, PUSCH-Config and ConfiguredGrantConfig              | 15.4.0 |
|         | RP-82 | RP-182657 | 0790 | - | F | Advanced processing time configuration for PDSCH and PUSCH                                    | 15.4.0 |
|         | RP-82 | RP-182896 | 0791 | 2 | F | UE specific channel bandwidth signaling   | 15.4.0 |
| 03/2019 | RP-83 | RP-190541 | 0416 | 4 | F | Clarification on hopping parameters for PUSCH   | 15.5.0 |
|         | RP-83 | RP-190541 | 0593 | 2 | F | Removal of creation of MCG MAC entity   | 15.5.0 |
|         | RP-83 | RP-190633 | 0792 | 1 | F | Capability for aperiodic CSI-RS triggering with different numerology between PDCCH and CSI-RS | 15.5.0 |
|         | RP-83 | RP-190541 | 0796 | 2 | F | Correction on Mapping between SSBs and PDCCH Monitoring Occasions in SI Window                | 15.5.0 |

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|  | RP-83 | RP-190541 | 0797 | 2 | F | Correction to SI Request Procedure  | 15.5.0 |
|  | RP-83 | RP-190546 | 0798 | 2 | F | CR to 38.331 on clarification of reportCGI  | 15.5.0 |
|  | RP-83 | RP-190545 | 0799 | 2 | F | Describing mandatory/optional information in inter-node RRC messages                                | 15.5.0 |
|  | RP-83 | RP-190541 | 0800 | 1 | F | Search space configuration for cross carrier scheduling   | 15.5.0 |
|  | RP-83 | RP-190542 | 0803 | 1 | F | Clarification on FeatureSetCombinationId zero value   | 15.5.0 |
|  | RP-83 | RP-190546 | 0805 | 2 | F | Clarification on UE Capability Request Filtering  | 15.5.0 |
|  | RP-83 | RP-190545 | 0807 | 3 | F | Miscellaneous non-controversial corrections   | 15.5.0 |
|  | RP-83 | RP-190541 | 0808 | 2 | F | CR to 38.331 on MAC configuration   | 15.5.0 |
|  | RP-83 | RP-190543 | 0810 | 2 | F | Correction to SCG failiure  | 15.5.0 |
|  | RP-83 | RP-190540 | 0811 | 1 | F | Clarifying handling of parent and child IE need nodes   | 15.5.0 |
|  | RP-83 | RP-190544 | 0812 | 2 | F | Clarification to channel bandwidth signalling   | 15.5.0 |
|  | RP-83 | RP-190541 | 0813 | 1 | F | Clarifications to BWP configuration options   | 15.5.0 |
|  | RP-83 | RP-190543 | 0822 | 2 | F | Correction to EUTRA-MBSFN-SubframeConfig  | 15.5.0 |
|  | RP-83 | RP-190545 | 0823 | 2 | F | Clarification on dedicated serving cell configuration in Re-establishment                           | 15.5.0 |
|  | RP-83 | RP-190541 | 0828 | 2 | F | Clarification on the BWP id configuration   | 15.5.0 |
|  | RP-83 | RP-190541 | 0836 | 1 | F | Upon entering a new PLMN which is in the list of EPLMNs in RRC INACTIVE state                       | 15.5.0 |
|  | RP-83 | RP-190546 | 0843 | 1 | F | EUTRA UE capability filtering in NR UE capability enquiry   | 15.5.0 |
|  | RP-83 | RP-190543 | 0847 | 2 | F | Correction to SIB1 transmission during handover   | 15.5.0 |
|  | RP-83 | RP-190545 | 0850 | 2 | F | Clarification to monitoring occasion of PWS notification  | 15.5.0 |
|  | RP-83 | RP-190541 | 0853 | 1 | F | HandoverPreparationInformation for CU/DU  | 15.5.0 |
|  | RP-83 | RP-190542 | 0855 | 1 | F | CR to introduce simultaneousRxDataSSB-DiffNumerology for NR SA                                      | 15.5.0 |
|  | RP-83 | RP-190550 | 0858 | - | F | Condition on integrity protection for DRB   | 15.5.0 |
|  | RP-83 | RP-190544 | 0860 | 2 | F | Handling on UE Inactive AS context upon resume  | 15.5.0 |
|  | RP-83 | RP-190542 | 0861 | 1 | F | Miscellaneous Corrections for INACTIVE  | 15.5.0 |
|  | RP-83 | RP-190542 | 0864 | 1 | F | Correction on RRC processing delay  | 15.5.0 |
|  | RP-83 | RP-190540 | 0865 | - | F | Dummify the ue-BeamLockFunction IE  | 15.5.0 |
|  | RP-83 | RP-190545 | 0866 | 2 | F | Further update of Need codes  | 15.5.0 |
|  | RP-83 | RP-190541 | 0867 | 1 | F | Corrections to reestablishment procedure  | 15.5.0 |
|  | RP-83 | RP-190545 | 0868 | 2 | F | CR on use of positioning measurement gaps for subframe and slot timing detection towards E-UTRA     | 15.5.0 |
|  | RP-83 | RP-190542 | 0876 | 2 | F | Barring alleviation when T302 or T390 is stopped  | 15.5.0 |
|  | RP-83 | RP-190544 | 0877 | 2 | F | Correction on smtc configuration in NR SCell addition procedure                                     | 15.5.0 |
|  | RP-83 | RP-190543 | 0884 | 2 | F | Correction on the configuration for transform preceding of PUSCH                                    | 15.5.0 |
|  | RP-83 | RP-190543 | 0896 | 2 | F | Correction to Need Codes in system information  | 15.5.0 |
|  | RP-83 | RP-190541 | 0897 | 1 | F | Corrections on drb-ContinueROHC   | 15.5.0 |
|  | RP-83 | RP-190541 | 0898 | 1 | F | Correction on outOfOrderDelivery  | 15.5.0 |
|  | RP-83 | RP-190542 | 0902 | 1 | F | Corrections on radio link failure related actions   | 15.5.0 |
|  | RP-83 | RP-190541 | 0904 | 1 | F | Clarification for SIB validity  | 15.5.0 |
|  | RP-83 | RP-190540 | 0905 | - | F | Corrections to MFBI   | 15.5.0 |
|  | RP-83 | RP-190542 | 0912 | 1 | F | CR on clarification on the description of NIA0  | 15.5.0 |
|  | RP-83 | RP-190542 | 0913 | 1 | F | CR on the number of bits of downlink NAS COUNT value  | 15.5.0 |
|  | RP-83 | RP-190541 | 0920 | 1 | F | CR to 38.331 for not supporting different quantities for thresholds in Event A5 and B2              | 15.5.0 |
|  | RP-83 | RP-190544 | 0922 | 2 | F | CR on SSB type indication   | 15.5.0 |
|  | RP-83 | RP-190545 | 0923 | 2 | F | Correction for measurements of serving cells without SSB or without CSI-RS                          | 15.5.0 |
|  | RP-83 | RP-190540 | 0930 | - | F | CR on introduction of UE assistance information in inter-node message                               | 15.5.0 |
|  | RP-83 | RP-190540 | 0931 | - | F | CR on description of SRS carrier switching  | 15.5.0 |
|  | RP-83 | RP-190542 | 0932 | 1 | F | Clarification on the relation between CA configuration and supported featureset combination_Option1 | 15.5.0 |



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|         | RP-83 | RP-190545 | 0935 | 2 | F | Unification of EN-DC terminology  | 15.5.0 |
|         | RP-83 | RP-190550 | 0938 | - | F | PDCP re-establishment during SRB modification for EUTRA/5GC                               | 15.5.0 |
|         | RP-83 | RP-190541 | 0939 | 1 | F | The support of drb-ContinueROHC   | 15.5.0 |
|         | RP-83 | RP-190541 | 0948 | 1 | F | Correction on PTRS port index   | 15.5.0 |
|         | RP-83 | RP-190541 | 0956 | 1 | F | CR on the supplementaryUplink and uplinkConfig  | 15.5.0 |
|         | RP-83 | RP-190545 | 0963 | 2 | F | Correction on MIB acquisition upon Reconfiguration with Sync                              | 15.5.0 |
|         | RP-83 | RP-190543 | 0967 | 2 | F | Qoffset for inter-RAT cell reselection  | 15.5.0 |
|         | RP-83 | RP-190541 | 0975 | 1 | F | Correction on SI scheduling   | 15.5.0 |
|         | RP-83 | RP-190543 | 0976 | 2 | F | Correction of uac-AccessCategory1-SelectionAssistanceInfo field description               | 15.5.0 |
|         | RP-83 | RP-190546 | 0978 | 3 | F | Correction on going to RRC_IDLE upon inter-RAT cell reselection in RRC_INACTIVE           | 15.5.0 |
|         | RP-83 | RP-190543 | 0981 | 2 | F | Clarification on nrofSS-BlocksToAverage and absThreshSS-BlocksConsolidation               | 15.5.0 |
|         | RP-83 | RP-190543 | 0984 | 3 | F | Correction on compilation of featureSets for NR container                                 | 15.5.0 |
|         | RP-83 | RP-190540 | 0985 | - | F | Enable and disable of security at DRB setup   | 15.5.0 |
|         | RP-83 | RP-190545 | 0986 | 2 | F | Clarification on TCI state ID   | 15.5.0 |
|         | RP-83 | RP-190544 | 0987 | - | F | Clarification for random access on SUL  | 15.5.0 |
|         | RP-83 | RP-190545 | 0988 | 1 | F | Correction on supportedBandwidthCombinationSetEUTRA-v1530 usage                           | 15.5.0 |
|         | RP-83 | RP-190544 | 0989 | - | F | CR on Processing delay requirements for RRC Resume procedures in TS 38.331                | 15.5.0 |
| 04/2019 | RP-83 |           |      |   |   | MCC: Formatting error correction (missing carriage return) in the end of clause 5.3.5.11. | 15.5.1 |
| 06/2019 | RP-84 | RP-191379 | 0906 | 5 | F | Reconfig with sync terminology  | 15.6.0 |
|         | RP-84 | RP-191378 | 0916 | 5 | B | Introduction of late drop NGEN-DC, NE-DC and NR-DC  | 15.6.0 |
|         | RP-84 | RP-191374 | 0996 | 2 | F | Correction to the need code of some fields in SIB2  | 15.6.0 |
|         | RP-84 | RP-191377 | 1003 | 3 | F | Clarification for handling of suspendConfig   | 15.6.0 |
|         | RP-84 | RP-191377 | 1005 | 3 | F | Reporting of serving cell and best neighbour cell and sorting of beam                     | 15.6.0 |
|         | RP-84 | RP-191377 | 1011 | 1 | F | On T321 timer related informative text correction   | 15.6.0 |
|         | RP-84 | RP-191377 | 1013 | 1 | C | CR to direct current report for UL and SUL  | 15.6.0 |
|         | RP-84 | RP-191380 | 1014 | 1 | F | Correction on storing UE AS Inactive Context  | 15.6.0 |
|         | RP-84 | RP-191373 | 1015 | - | F | Correction on ReconfigurationWithSync   | 15.6.0 |
|         | RP-84 | RP-191380 | 1016 | 2 | F | Correction on Handover from NR to EUTRAN  | 15.6.0 |
|         | RP-84 | RP-191373 | 1018 | - | F | Introduction of additional UE capability on HARQ-ACK multiplexing on PUSCH                | 15.6.0 |
|         | RP-84 | RP-191378 | 1019 | 1 | F | Correction on bar indication of emergency service (access category 2)                     | 15.6.0 |
|         | RP-84 | RP-191373 | 1020 | - | F | Correction on UE configuration for RRC Resume procedure                                   | 15.6.0 |
|         | RP-84 | RP-191373 | 1021 | - | F | RRC release with suspend configuration and inter-RAT redirection                          | 15.6.0 |
|         | RP-84 | RP-191373 | 1022 | - | F | RRC Reconfiguration via SRB3 in EN-DC   | 15.6.0 |
|         | RP-84 | RP-191373 | 1023 | - | F | Corrections on RLC bearer setup   | 15.6.0 |
|         | RP-84 | RP-191373 | 1024 | - | F | Clarification to Permitted MaxCID for ROHC and Uplink-Only ROHC                           | 15.6.0 |
|         | RP-84 | RP-191373 | 1025 | - | F | Coordination of ROHC capability for MR-DC   | 15.6.0 |
|         | RP-84 | RP-191373 | 1026 | - | F | Correction on the rlmInSyncOutOfSyncThreshold   | 15.6.0 |
|         | RP-84 | RP-191373 | 1027 | - | F | Correction on description of tci-PresentInDCI   | 15.6.0 |
|         | RP-84 | RP-191374 | 1031 | - | F | RRC processing delay for UE capability transfer   | 15.6.0 |
|         | RP-84 | RP-191377 | 1032 | 1 | F | Handling of SMTC configuration  | 15.6.0 |
|         | RP-84 | RP-191378 | 1033 | 1 | F | Clarification on filters used to generate FeatureSets (38.331)                            | 15.6.0 |
|         | RP-84 | RP-191374 | 1034 | - | F | Correction of behavior for eutra-nr-only  | 15.6.0 |
|         | RP-84 | RP-191377 | 1038 | 1 | F | Clarification on CSI-RS resource configuration in MO                                      | 15.6.0 |
|         | RP-84 | RP-191378 | 1039 | 2 | F | Update on usage of Need codes   | 15.6.0 |
|         | RP-84 | RP-191377 | 1040 | 1 | F | Ignore additional fields in RRC Release message before security activation                | 15.6.0 |

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|  | RP-84 | RP-191374 | 1041 | - | F | Correction on use of Null algorithm for DRBs during emergency calls in LSM   | 15.6.0 |
|  | RP-84 | RP-191380 | 1042 | 2 | F | NR changes for FullConfig for Inter-RAT intra-system HO  | 15.6.0 |
|  | RP-84 | RP-191376 | 1043 | 2 | F | Monitoring of short messages with multi-beams  | 15.6.0 |
|  | RP-84 | RP-191377 | 1045 | 1 | F | Clarification of commonControlResourceSet frequency reference point  | 15.6.0 |
|  | RP-84 | RP-191379 | 1046 | 2 | F | CR on capability of maxUplinkDutyCycle for FR2   | 15.6.0 |
|  | RP-84 | RP-191374 | 1049 | - | F | CR to subcarrierSpacing in RateMatchPattern and SCS-SpecificCarrier  | 15.6.0 |
|  | RP-84 | RP-191377 | 1053 | 1 | F | CR on transferring common configuration during handover and SN change  | 15.6.0 |
|  | RP-84 | RP-191381 | 1054 | 2 | F | Correction to barring alleviation  | 15.6.0 |
|  | RP-84 | RP-191381 | 1055 | 3 | F | UE behaviour on the cell without TAC   | 15.6.0 |
|  | RP-84 | RP-191379 | 1058 | 2 | F | Correction to RRC resume   | 15.6.0 |
|  | RP-84 | RP-191376 | 1061 | 1 | F | Corrections to inter-node messages   | 15.6.0 |
|  | RP-84 | RP-191378 | 1063 | 1 | F | Clarification on mandatory information in inter node RRC messages  | 15.6.0 |
|  | RP-84 | RP-191374 | 1066 | - | F | Correction to PWS reception  | 15.6.0 |
|  | RP-84 | RP-191377 | 1068 | 1 | F | Serving cell measurement handling with different rsType configuration scenarios  | 15.6.0 |
|  | RP-84 | RP-191374 | 1069 | - | F | On CGI reporting contents  | 15.6.0 |
|  | RP-84 | RP-191374 | 1071 | - | F | CR for 38.331 on security related corrections to UE and Network initiated RRC procedures to increase user's security and privacy | 15.6.0 |
|  | RP-84 | RP-191379 | 1072 | 3 | F | Correction on the issue with NCP and ECP for RateMatchPattern  | 15.6.0 |
|  | RP-84 | RP-191377 | 1075 | 1 | F | Security protection of RRC messages  | 15.6.0 |
|  | RP-84 | RP-191381 | 1076 | 1 | F | Introduction of a new NR band for LTE/NR spectrum sharing in Band 41/n41   | 15.6.0 |
|  | RP-84 | RP-191375 | 1077 | - | F | Stop of T302 and T390 at reception of RRCRelease with waitTime   | 15.6.0 |
|  | RP-84 | RP-191375 | 1078 | - | F | Restriction of piggybacking of NAS PDUs  | 15.6.0 |
|  | RP-84 | RP-191379 | 1079 | 3 | F | Correction on intra-band fallback behavior with FeatureSetsPerCC   | 15.6.0 |
|  | RP-84 | RP-191375 | 1081 | - | F | Removal of spurious requirement on consistency of feature set combination IDs  | 15.6.0 |
|  | RP-84 | RP-191381 | 1082 | 3 | F | Miscellaneous non-controversial corrections Set II   | 15.6.0 |
|  | RP-84 | RP-191377 | 1083 | 1 | F | Correction to configuration of security in RadioBearerConfig   | 15.6.0 |
|  | RP-84 | RP-191379 | 1086 | 2 | F | CR to 38.331 on MeasurementTimingConfiguration   | 15.6.0 |
|  | RP-84 | RP-191375 | 1088 | - | F | Correction to the description of subcarrierspacing usage in ServingCellConfigCommon  | 15.6.0 |
|  | RP-84 | RP-191375 | 1089 | - | F | 38.331 Clarification on multiple TA capabilities   | 15.6.0 |
|  | RP-84 | RP-191375 | 1091 | - | F | Set beamCorrespondenceCA dummy   | 15.6.0 |
|  | RP-84 | RP-191377 | 1092 | 1 | F | Correction on Measurement Report Triggering for Periodical Report  | 15.6.0 |
|  | RP-84 | RP-191375 | 1094 | - | F | Correction on PDCP duplication configuration   | 15.6.0 |
|  | RP-84 | RP-191375 | 1095 | - | F | Correction on BWP configuration  | 15.6.0 |
|  | RP-84 | RP-191377 | 1097 | 1 | F | Correction on configuration of pucch-ResourceCommon  | 15.6.0 |
|  | RP-84 | RP-191376 | 1098 | 1 | F | Clarification of PUCCH reconfiguration on NR UL and SUL  | 15.6.0 |
|  | RP-84 | RP-191375 | 1100 | 1 | F | Correction on initial BWP configuration in DownlinkConfigCommon and UplinkConfigCommon   | 15.6.0 |
|  | RP-84 | RP-191377 | 1101 | 1 | F | Correction on PUCCH cell   | 15.6.0 |
|  | RP-84 | RP-191377 | 1103 | 1 | F | Correction on the pdcp-Config  | 15.6.0 |
|  | RP-84 | RP-191379 | 1104 | 2 | F | Correction on pathlossReferenceLinking   | 15.6.0 |
|  | RP-84 | RP-191381 | 1106 | 2 | F | Clarification of dedicated priority handling from RRC_INACTIVE to RRC_IDLE   | 15.6.0 |
|  | RP-84 | RP-191375 | 1110 | - | F | Clarification on sending condition for mcg-RB-Config   | 15.6.0 |
|  | RP-84 | RP-191375 | 1111 | - | F | Clarification of timing reference for CSI-RS resources   | 15.6.0 |
|  | RP-84 | RP-191376 | 1113 | - | F | Setting of resumeCause for NAS triggered event   | 15.6.0 |
|  | RP-84 | RP-191376 | 1114 | - | F | UE capability signalling for FD-MIMO processing capabilities for EN-DC   | 15.6.0 |

|  |       |           |      |   |   |  |        |
|--|-------|-----------|------|---|---|--|--------|
|  | RP-84 | RP-191376 | 1115 | - | F | Modified UE capability on different numerologies within the same PUCCH group                               | 15.6.0 |
|  | RP-84 | RP-191478 | 1116 | 2 | F | Clarification to commonSearchSpaceList in PDCCH-ConfigCommon   | 15.6.0 |
|  | RP-84 | RP-191589 | 1117 | 1 | F | Removal of "Capability for aperiodic CSI-RS triggering with different numerology between PDCCH and CSI-RS" | 15.6.0 |

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## History

| <b>Document history</b> |              |             |
|-------------------------|--------------|-------------|
| V15.2.1                 | June 2018    | Publication |
| V15.3.0                 | October 2018 | Publication |
| V15.4.0                 | April 2019   | Publication |
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