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*Technical Specification*

## **Universal Mobile Telecommunications System (UMTS); Medium Access Control (MAC) protocol specification (3GPP TS 25.321 version 8.4.0 Release 8)**

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## Foreword

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---

# 1 Scope

The present document specifies the MAC protocol.

The specification describes:

- MAC architecture;
- MAC entities;
- channel structure;
- services provided to upper layers;
- MAC functions;
- services expected from the physical layer;
- elements for layer-to-layer communication including primitives between MAC and RLC;
- elements for peer-to-peer communication;
- protocol data units, formats and parameters;
- elementary procedures.

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# 2 References

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- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 25.301: "Radio Interface Protocol Architecture".
- [3] 3GPP TS 25.302: "Services provided by the Physical Layer".
- [4] 3GPP TS 25.303: "Interlayer Procedures in Connected Mode".
- [5] 3GPP TS 25.304: "UE Procedures in Idle Mode and Procedures for Cell Reselection in Connected Mode".
- [6] 3GPP TS 25.322: "RLC Protocol Specification".
- [7] 3GPP TS 25.331: "Radio Resource Control (RRC); protocol specification".
- [8] 3GPP TR 25.921: "Guidelines and Principles for Protocol Description and Error Handling".
- [9] 3GPP TR 25.990: "Vocabulary for the UTRAN".
- [10] 3GPP TS 33.102: "Security architecture".
- [11] 3GPP TS 25.425: "UTRAN Iur Interface User Plane Protocols for Common Transport Channel Data Streams".

- [12] 3GPP TS 25.133: "Requirements for support of radio resource management (FDD)".
- [13] 3GPP TS 25.214: "Physical layer procedures (FDD)".
- [14] 3GPP TS 25.123: "Requirements for support of radio resource management (TDD)".
- [15] 3GPP TS 33.105: "Cryptographic Algorithm Requirements".
- [16] 3GPP TS 25.212: "Multiplexing and Channel Coding (FDD)".
- [17] 3GPP TS 25.215: "Physical layer - Measurements (FDD)".
- [18] 3GPP TS 25.224: "Physical layer procedures (TDD)".
- [19] 3GPP TS 25.222: "Multiplexing and Channel Coding (TDD)".
- [20] 3GPP TS 25.225: "Physical layer – Measurements (TDD)".
- [21] 3GPP TS 25.221 "Physical Channels and Mapping of Transport Channels onto Physical Channels (TDD)"
- [22] 3GPP TS 25.213: "Spreading and modulation (FDD)".
- [23] 3GPP TS 25.306: "UE Radio Access Capabilities".
- [24] 3GPP TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)"

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given below and in [9] and [1] apply.

#### 3.1.1 HS-DSCH Specific Definitions

#### 3.1.2 E-DCH Specific Definitions

##### 3.1.2.1 General

**E-DCH:** The Enhanced Dedicated Channel (E-DCH) is an uplink transport channel.

**HARQ profile:** One HARQ profile consists of a power offset attribute and maximum number of transmissions. For 1.28 Mcps TDD, it also includes a retransmission timer attribute.

**Power offset attribute (FDD):** This represents the power offset between E-DPDCH(s) and reference E-DPDCH power level for a given E-TFC. This power offset attribute is set to achieve the required QoS in this MAC-d flow when carried alone in a MAC-e or MAC-i PDU and subsequently in the corresponding CCTrCh of E-DCH type. Details on the mapping on Beta factors can be found in [13]. The reference E-DPDCH power offset is signalled to the UE for one (or several) reference E-TFC(s) (see details in subclause 11.1).

**Power offset attribute (TDD):** The power offset attribute is set to achieve the required QoS in this MAC-d flow when carried alone in a MAC-e or MAC-i PDU and subsequently in the corresponding CCTrCh of E-DCH type. Details on the power offset can be found in [18].

**Primary Absolute Grant:** Absolute Grant received with the primary E-RNTI. Note that the primary E-RNTI is the only E-RNTI for TDD.

**Serving E-DCH cell:** Cell from which the UE receives Absolute Grants from the Node-B scheduler. A UE has one Serving E-DCH cell.

**Serving\_Grant (FDD):** The state variable `Serving_Grant` indicates the maximum E-DPDCH to DPCCH power ratio that the UE is allowed to use for scheduled data in the following transmission. The value in the appropriate state variable will be provided to the E-TFC selection function to help in selecting the best format for the upcoming transmission. Possible values are: "Zero\_Grant" and numerical values. The DPCCH power assumed for the `Serving_Grant` in a compressed frame is the actual DPCCH power in the compressed frame minus  $10\log_{10}(N_{\text{pilot,N}}/N_{\text{pilot,C}})$  as defined in [13].

**Serving\_Grant (TDD):** The state variable `Serving_Grant` indicates the power ratio of maximum E-PUCH power level per TDD resource unit relative to a reference E-PUCH power level  $P_{e\text{-ref}}$  that the UE is allowed to use for scheduled data on the physical resources associated with the E-AGCH grant.  $P_{e\text{-ref}}$  is defined as the calculated E-PUCH transmit power ( $P_{E\text{-PUCH}}$ ) in [18] with  $\beta_e=0$ . The value in the appropriate state variable will be provided to the E-TFC selection function to help in selecting the best format for the upcoming transmission. Possible values are: "Zero\_Grant" and numerical values.

### 3.1.2.2 FDD

**Active Process:** HARQ process for which Scheduling Grant are applicable, i.e. scheduled data can be sent.

**AG\_Timer:** This timer is set to one HARQ RTT (40ms in the case of 10ms TTI, 16ms in the case of 2ms TTI).

**Common E-DCH resource:** Common E-DCH resources are under direct control of the Node B and are shared by UEs in CELL\_FACH state and IDLE mode.

**E-DCH active set:** The set of cells which carry the E-DCH for one UE. For FDD, in CELL\_FACH state and Idle mode, the E-DCH active set consists of the Serving E-DCH cell only.

**Inactive Process:** HARQ process for which Scheduling Grants are not applicable, i.e. scheduled data cannot be sent.

**INACTIVE:** Absolute Grant value that can be sent by the serving cell's scheduler on the E-AGCH to deactivate a process or to switch the UE to its secondary E-RNTI. In CELL\_FACH state, this absolute grant value is used to release a common E-DCH resource.

**Maximum\_Serving\_Grant:** The variable `Maximum_Serving_Grant` indicates the maximum E-DPDCH to DPCCH power ratio that the UE is allowed to use for scheduled data while the timer `Non_Serving_RG_Timer` has not expired.

**Maximum number of re-transmissions, Maximum number of transmissions:** Maximum number of re-transmissions = maximum number of transmissions - 1. Both these notations are used.

**Minimum\_Grant:** The value `Minimum_Grant` corresponds to the minimum E-DPDCH to DPCCH power ratio that the UE considers. This value is in index 0 of the configured scheduling grant table described in subclause 9.2.5.2.1.

**Non-serving E-DCH RL or Non-serving RL:** Cell which belongs to the E-DCH active set but does not belong to the Serving E-DCH RLS and from which the UE can receive one Relative Grant. The UE can have zero, one or several Non-serving E-DCH RL(s). For FDD, in CELL\_FACH state and Idle mode, the Serving E-DCH RLS or Serving RLS contains the Serving E-DCH cell only, from which the UE can receive one Relative Grant.

**Non\_Serving\_RG\_Timer:** This timer is set to one HARQ RTT (40ms in the case of 10ms TTI, 16ms in the case of 2ms TTI).

**Primary Absolute Grant:** Absolute Grant received with the primary E-RNTI.

**Primary\_Grant\_Available:** This state variable is a Boolean, indicating whether the UE's serving grant is only affected by Primary Absolute Grants and Relative Grants (i.e. not by Secondary Absolute Grants).

**reference\_ETPR:** The state variable `reference_ETPR` holds the E-DPDCH to DPCCH power ratio used as reference for relative grant commands. This variable is set to the E-DPDCH to DPCCH power ratio used for the E-TFC selected for the previous TTI on this HARQ process, calculated using the amplitude ratios prior to the quantization according to subclause 5.1.2.5B.2.3 or 5.1.2.5B.2.4 of [13], excluding non-scheduled transmissions, excluding any scaling applied according to subclause 5.1.2.6 of [13] and is obtained from the physical layer. In case no scheduled transmission took place on a HARQ process in the previous TTI, `reference_ETPR` shall be set to `Minimum_Grant` for this HARQ process.

**reference\_ETPR2:** The state variable `reference_ETPR2` holds the E-DPDCH to DPCCH power ratio used as reference for non serving relative grant commands. This variable is set to the previously stored **reference\_ETPR** on this HARQ process when the `reference_ETPR` is updated with a new value.

**Secondary Absolute Grant:** Absolute Grant received with the secondary E-RNTI.

**Serving E-DCH RLS or Serving RLS:** Set of cells which contains at least the Serving E-DCH cell and from which the UE can receive and combine one Relative Grant. The UE has only one Serving E-DCH RLS.

**Stored\_Secondary\_Grant:** This state variable is used to store the last received Secondary Absolute Grant Value. Possible values are: "Zero\_Grant" and numerical values.

**UL Common MAC Flow:** an UL Common MAC Flow is a flow of MAC-c PDU mapped to E-DCH configured for UEs in Cell\_FACH state and IDLE mode.

### 3.1.3 DTX-DRX and HS-SCCH less Specific definitions (FDD only)

**MAC DTX cycle:** Defines the pattern of time instances where the start the uplink E-DCH transmission after inactivity is allowed.

**MAC Inactivity Threshold:** E-DCH inactivity time after which the UE can start E-DCH transmission only at given times.

**UE DTX DRX Offset:** Uplink DPCCCH burst pattern and HS-SCCH reception pattern offset in subframes.

**HS-SCCH less mode of operation:** HS-SCCH less mode of operation is enabled when the variable HS\_SCCH\_LESS\_STATUS defined in [7] is set to TRUE.

**Inactivity Threshold for UE Grant Monitoring:** Determines the number of E-DCH TTIs after an E-DCH scheduled transmission during which the UE is required to monitor the full E-AGCH transmissions from the serving radio link and the full E-RGCH(s) from all the cells in the E-DCH active set.

**Inactivity Threshold for UE DTX cycle 2:** Defines a number of consecutive E-DCH TTIs without an E-DCH transmission, after which the UE shall immediately move from UE\_DTX\_cycle\_1 to using UE\_DTX\_cycle\_2.

**Default-SG-in-DTX-Cycle-2:** Defines the default E-DCH Serving Grant used in the case when the UE moves from UE DTX cycle 1 to UE DTX cycle 2 after Inactivity Threshold for UE DTX cycle 2 triggers.

## 3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

|         |                                                       |
|---------|-------------------------------------------------------|
| AG      | Absolute Grant                                        |
| ASC     | Access Service Class                                  |
| BCCH    | Broadcast Control Channel                             |
| BCH     | Broadcast Channel                                     |
| C-      | Control-                                              |
| CCCH    | Common Control Channel                                |
| DCCH    | Dedicated Control Channel                             |
| DCH     | Dedicated Channel                                     |
| DL      | Downlink                                              |
| DSCH    | Downlink Shared Channel                               |
| DTCH    | Dedicated Traffic Channel                             |
| E-AGCH  | E-DCH Absolute Grant Channel                          |
| E-DCH   | Enhanced Dedicated Transport Channel                  |
| E-DPCCH | E-DCH Dedicated Physical Control Channel (FDD only)   |
| ENI     | E-UCCH Number Indication (1.28Mcps TDD only)          |
| E-HICH  | E-DCH HARQ Acknowledgement Indicator Channel          |
| E-PUCH  | Enhanced Uplink Physical Channel (TDD only)           |
| E-RGCH  | E-DCH Relative Grant Channel                          |
| E-RGCH  | E-DCH Relative Grant Channel (FDD only)               |
| E-RNTI  | E-DCH Radio Network Temporary Identifier              |
| E-RUCCH | E-DCH Random Access Uplink Control Channel (TDD only) |
| E-TFC   | E-DCH Transport Format Combination                    |
| E-TFCI  | E-DCH Transport Format Combination Indicator          |
| E-UCCH  | E-DCH Uplink Control Channel (TDD only)               |

|         |                                             |
|---------|---------------------------------------------|
| FACH    | Forward Link Access Channel                 |
| FDD     | Frequency Division Duplex                   |
| HARQ    | Hybrid Automatic Repeat Request             |
| HCSN    | HS-SCCH Cyclic Sequence Number              |
| HSDPA   | High Speed Downlink Packet Access           |
| HS-DSCH | High Speed Downlink Shared Channel          |
| L1      | Layer 1 (physical layer)                    |
| L2      | Layer 2 (data link layer)                   |
| L3      | Layer 3 (network layer)                     |
| MAC     | Medium Access Control                       |
| MBMS    | Multimedia Broadcast Multicast Service      |
| MCCH    | MBMS point-to-multipoint Control Channel    |
| MTCH    | MBMS point-to-multipoint Traffic Channel    |
| MSCH    | MBMS point-to-multipoint Scheduling Channel |
| PCCH    | Paging Control Channel                      |
| PCH     | Paging Channel                              |
| PDU     | Protocol Data Unit                          |
| PHY     | Physical layer                              |
| PhyCH   | Physical Channels                           |
| RACH    | Random Access Channel                       |
| RG      | Relative Grant                              |
| RLC     | Radio Link Control                          |
| RLS     | Radio Link Set                              |
| RNC     | Radio Network Controller                    |
| RNS     | Radio Network Subsystem                     |
| RNTI    | Radio Network Temporary Identity            |
| RRC     | Radio Resource Control                      |
| RSN     | Retransmission Sequence Number              |
| SAP     | Service Access Point                        |
| SDU     | Service Data Unit                           |
| SHCCH   | Shared Channel Control Channel              |
| SRNC    | Serving Radio Network Controller            |
| SRNS    | Serving Radio Network Subsystem             |
| TDD     | Time Division Duplex                        |
| TFCI    | Transport Format Combination Indicator      |
| TFI     | Transport Format Indicator                  |
| TSN     | Transmission Sequence Number                |
| U-      | User-                                       |
| UE      | User Equipment                              |
| UL      | Uplink                                      |
| UMTS    | Universal Mobile Telecommunications System  |
| USCH    | Uplink Shared Channel                       |
| UTRA    | UMTS Terrestrial Radio Access               |
| UTRAN   | UMTS Terrestrial Radio Access Network       |

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## 4 General

### 4.1 Objective

The objective is to describe the MAC architecture and the different MAC entities from a functional point of view.

### 4.2 MAC architecture

The description in this subclause is a model and does not specify or restrict implementations.

According to the RRC functions the RRC is generally in control of the internal configuration of the MAC.

Both MAC-hs and MAC-ehs are responsible for handling the data transmitted on the HS-DSCH. Furthermore they are responsible for the management of the physical resources allocated to HS-DSCH. Upper layers configure which of the two entities, MAC-hs or MAC-ehs, is to be applied to handle HS-DSCH functionality.

Both MAC-e/es and MAC-i/is are responsible for handling the data transmitted on the E-DCH. Upper layers configure which of the two entities, MAC-e/es or MAC-i/is, is to be applied to handle E-DCH functionality.

## 4.2.1 MAC Entities

The diagrams that describe the MAC architecture are constructed from MAC entities.

The entities are assigned the following names.

- MAC-b is the MAC entity that handles the following transport channels:
  - broadcast channel (BCH)
- MAC-c/sh/m, is the MAC entity that handles the following transport channels:
  - paging channel (PCH)
  - forward access channel (FACH)
  - random access channel (RACH)
  - downlink shared channel (DSCH). The DSCH exists only in TDD mode.
  - uplink shared channel (USCH). The USCH exists only in TDD mode.
- MAC-d is the MAC entity that handles the following transport channels:
  - dedicated transport channel (DCH)
- MAC-hs/ehs is the MAC entity that handles the following transport channels:
  - high speed downlink shared channel (HS-DSCH)
- MAC-m is the MAC entity that handles the following transport channels:
  - forward access channel (FACH).
- MAC-e/es and MAC-i/is are the MAC entities that handle the following transport channels:
  - enhanced dedicated transport channel (E-DCH).

The exact functions completed by the entities are different in the UE from those completed in the UTRAN.

NOTE: When a UE is allocated resources for exclusive use by the bearers that it supports the MAC-d entities dynamically share the resources between the bearers and are responsible for selecting the TFI/ TFCI that is to be used in each transmission time interval.

## 4.2.2 MAC-b

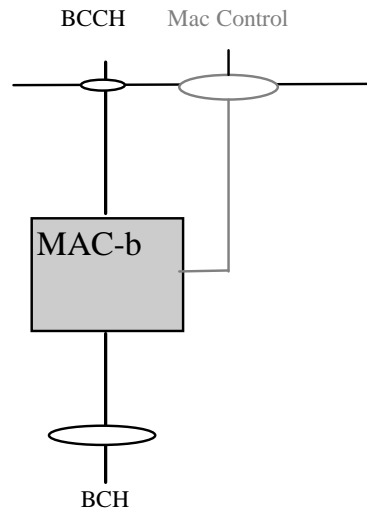
The following diagram illustrates the connectivity of the MAC-b entity in a UE and in each cell of the UTRAN.

MAC-b represents the control entity for the broadcast channel (BCH).

There is one (current cell) or multiple (current and neighbour cells) MAC-b entities in each UE and one MAC-b in the UTRAN for each cell.

The MAC Control SAP is used to transfer Control information to MAC-b.

The MAC-b entity is located in the Node B.



**Figure 4.2.2.1: UE side and UTRAN side architecture**

### 4.2.3 Traffic Related Architecture - UE Side

Figure 4.2.3.1 illustrates the connectivity of MAC entities.

The MAC-c/sh/m controls access to all common transport channels, except the HS-DSCH transport channel and the E-DCH transport channel (FDD and 1.28Mcps TDD only).

The MAC-d controls access to all dedicated transport channels, to MAC-c/sh/m and MAC-hs/ehs.

The MAC-c/sh/m controls access to MAC-is/i. (FDD and 1.28Mcps TDD only for UEs in CELL\_FACH state and Idle mode).

The MAC-hs/ehs handles the HSDPA specific functions and controls access to the HS-DSCH transport channel. Upper layers configure which of the two entities, MAC-hs or MAC-ehs, is to be applied to handle HS-DSCH functionality.

The MAC-e/es or MAC-i/is controls access to the E-DCH transport channel. Upper layers configure which of the two entities, MAC-e/es or MAC-i/is, is to be applied to handle E-DCH functionality.

In case of selective combining of MTCH channels from multiple cells, the MAC-m controls access to the FACH transport channels used to carry MTCH and MSCH.

In the downlink, if logical channels of dedicated type are mapped to common transport channels then MAC-d receives the data from MAC-c/sh/m or MAC-hs/ehs via the illustrated connection between the functional entities.

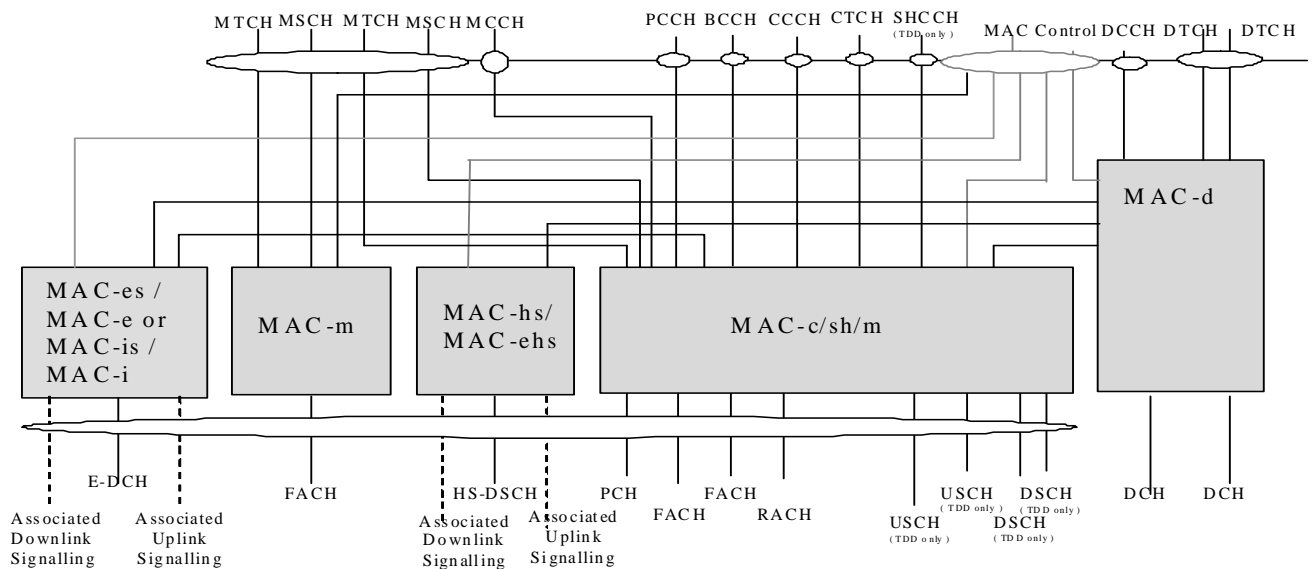
In the uplink, if logical channels of dedicated type are mapped to common transport channels then MAC-d submits the data to MAC-c/sh/m and MAC-is/i via the illustrated connection between the functional entities.

The mapping of logical channels on transport channels depends on the multiplexing that is configured by RRC.

The MAC Control SAP is used to transfer Control information to each MAC entity.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].





**Figure 4.2.3.1: UE side MAC architecture**

#### 4.2.3.1 MAC-c/sh/m entity – UE Side

Figure 4.2.3.1.1 shows the UE side MAC-c/sh/m entity.

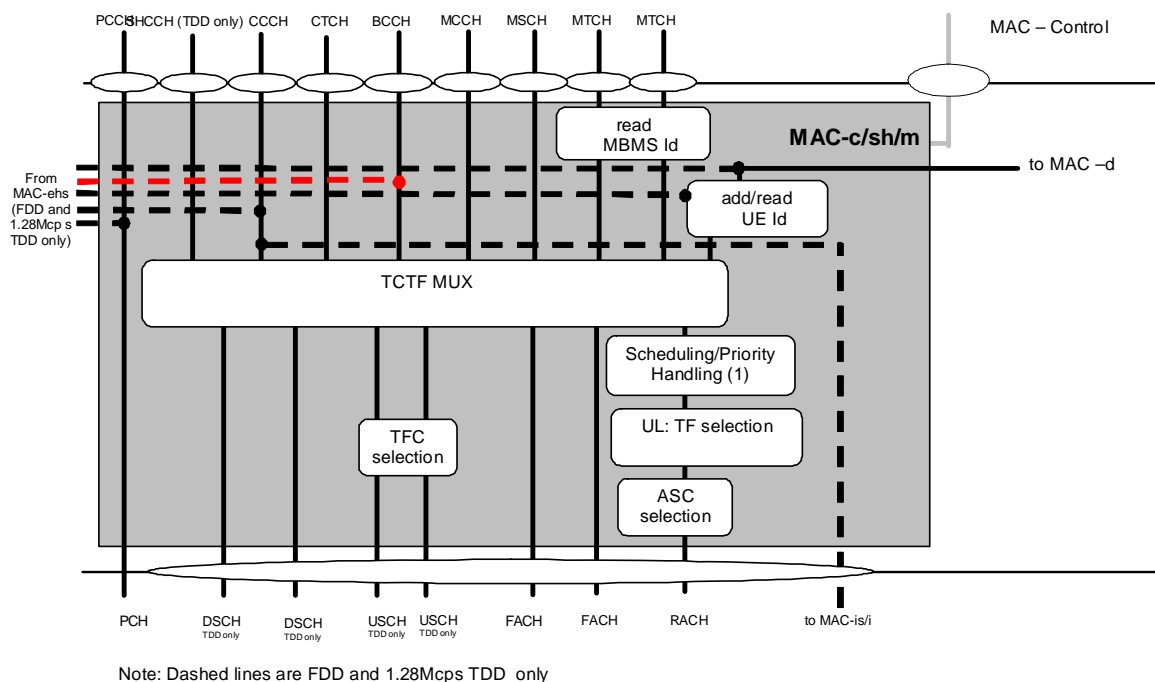
The following functionality is covered:

- TCTF MUX:
  - this function represents the handling (insertion for uplink channels and detection and deletion for downlink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels.  
The TCTF field indicates the common logical channel type, or if a dedicated logical channel is used;
- add/read UE Id:
  - the UE Id is added for RACH transmissions;
  - the UE Id, when present, identifies data to this UE.
- read MBMS Id:
  - the MBMS Id is read in case of MTCH reception;
  - the MBMS Id identifies received data to an MBMS service.
- UL: TF selection:
  - in the uplink, the possibility of transport format selection exists.
- ASC selection:
  - For RACH, MAC indicates the ASC associated with the PDU to the physical layer. This is to ensure that RACH messages associated with a given Access Service Class (ASC) are sent on the appropriate signature(s) and time slot(s). MAC also applies the appropriate back-off parameter(s) associated with the given ASC. When sending an RRC CONNECTION REQUEST message, RRC will determine the ASC; in all other cases MAC selects the ASC;
- scheduling /priority handling

- this functionality is used to transmit the information received from MAC-d on RACH based on logical channel priorities. This function is related to TF selection.
- TFC selection
- transport format and transport format combination selection according to the transport format combination set (or transport format combination subset) configured by RRC is performed,

The RLC provides RLC-PDUs to the MAC, which fit into the available transport blocks on the transport channels.

There is one MAC-c/sh/m entity in each UE.



**Figure 4.2.3.1.1: UE side MAC architecture / MAC-c/sh/m details**

#### 4.2.3.1b MAC-m entity – UE Side

Figure 4.2.3.1b.1 shows the UE side MAC-m entity.

The following functionality is covered:

- TCTF DEMUX:
  - this function represents the handling (detection and deletion for downlink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels. The TCTF field indicates the common logical channel type;
- read MBMS Id
  - the MBMS Id is read in case of MTCH reception;
  - the MBMS Id identifies received data to an MBMS service.

The MAC Control SAP is used to transfer control information to MAC-m.

If MTCH channels are selectively combined, the MAC-m entity exists in the UE. Otherwise, the MAC-m entity does not exist.

In case of selective combining of MTCH channels from multiple cells, there are one MAC-c/sh/m for the current cell and one MAC-m entity for each neighboring cell in the UE.

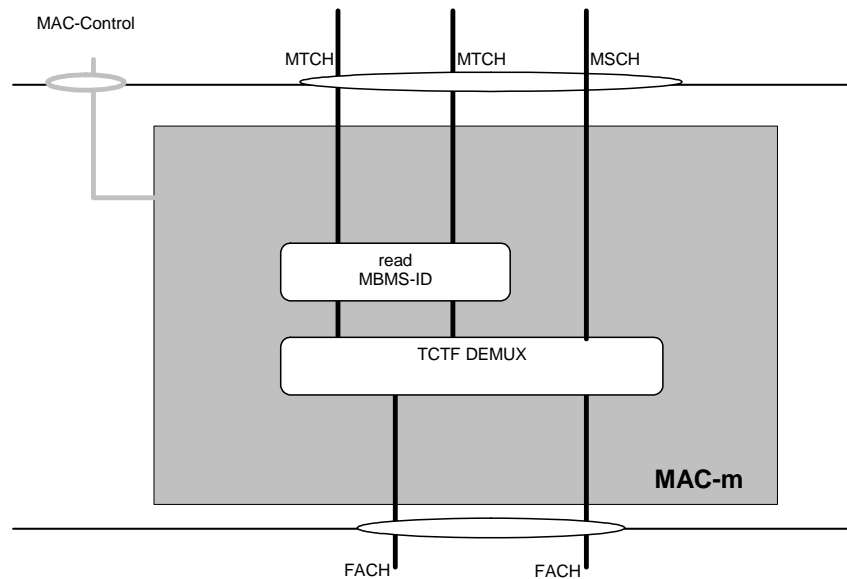


Figure 4.2.3.1b.1: UE side MAC architecture / MAC-m details

#### 4.2.3.2 MAC-d entity – UE Side

Figure 4.2.3.2.1 shows the UE side MAC-d entity.

The following functionality is covered:

- Transport Channel type switching
  - Transport Channel type switching is performed by this entity, based on decision taken by RRC. This is related to a change of radio resources. If requested by RRC, MAC shall switch the mapping of one designated logical channel between common and dedicated transport channels.
- C/T MUX:
  - The C/T MUX is used when multiplexing of several dedicated logical channels onto one transport channel (other than HS-DSCH) or one MAC-d flow (HS-DSCH) is used. An unambiguous identification of the logical channel is included. If MAC-ehs is configured, C/T MUX toward MAC-ehs is not used.
- Ciphering:
  - Ciphering for transparent mode data to be ciphered is performed in MAC-d. Details about ciphering can be found in [10].
- Deciphering:
  - Deciphering for ciphered transparent mode data is performed in MAC-d. Details about ciphering can be found in [10].
- UL TFC selection:
  - Transport format and transport format combination selection according to the transport format combination set (or transport format combination subset) configured by RRC is performed.

The MAC-d entity is responsible for mapping dedicated logical channels for the uplink either onto dedicated transport channels or to transfer data to MAC-c/sh/m to be transmitted via common channels.

One dedicated logical channel can be mapped simultaneously onto DCH and DSCH in TDD mode.

One dedicated logical channel can be simultaneously mapped onto DCH and HS-DSCH.

The MAC-d entity has a connection to the MAC-c/sh/m entity. This connection is used to transfer data to the MAC-c/sh/m to transmit data on transport channels that are handled by MAC-c/sh/m (uplink) or to receive data from transport channels that are handled by MAC-c/sh/m (downlink).

The MAC-d entity has a connection to the MAC-hs or MAC-ehs entity. This connection is used to receive data from the HS-DSCH transport channel which is handled by MAC-hs or MAC-ehs (downlink).

The MAC-d entity has a connection to the MAC-e/es or MAC-i/is entity. This connection is used to transmit data on the E-DCH transport channel which is handled by the MAC-e/es or MAC-i/is (uplink).

There is one MAC-d entity in the UE.

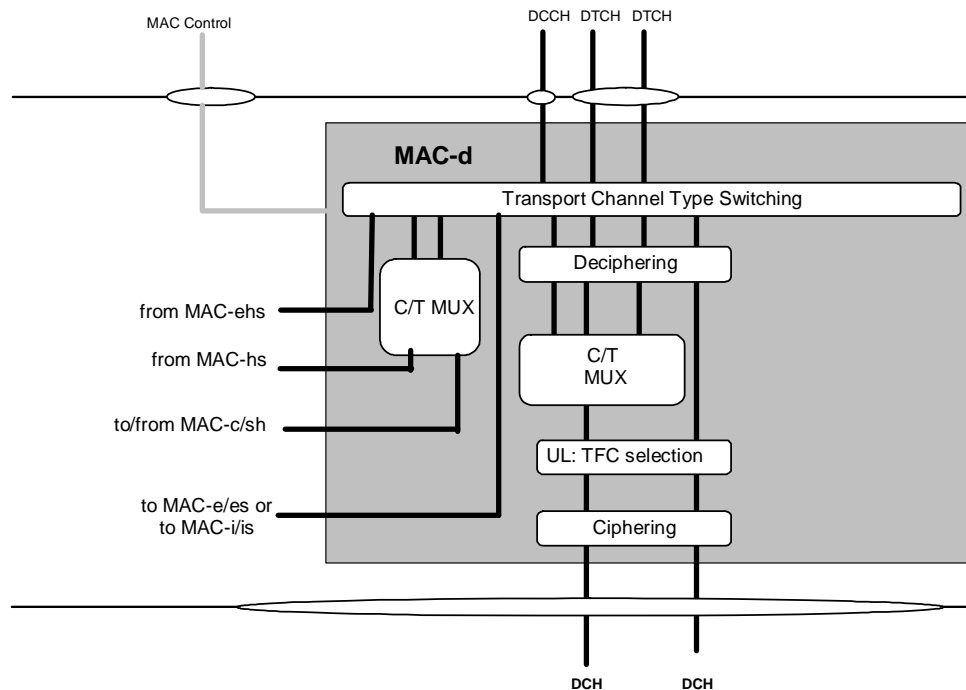


Figure 4.2.3.2.1: UE side MAC architecture / MAC-d details

#### 4.2.3.3 MAC-hs entity – UE Side

In the model below the MAC-hs comprises the following entities. In 1.28 Mcps TDD multi-frequency HS-DSCH cell, the associated downlink control channel and uplink control channel pair controlling the HS-DSCH transmission on the certain carrier shall be allocated on the same carrier. The downlink control channel carries the HS-DSCH operation related info and the uplink control channel carries the feedback info from the UE side.

- HARQ:  
The HARQ entity is responsible for handling the MAC functions relating to the HARQ protocol. The HARQ functional entity handles all the tasks that are required for hybrid ARQ. It is responsible for generating ACKs or NACKs. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP. In 1.28 Mcps TDD multi-frequency HS-DSCH cell, multiple HARQ processes are assigned for HS-DSCH operation on every carrier independently, namely HARQ sub-entity; only one HARQ process is allowed to receive HS-DSCH in one TTI for each carrier. The maximum number of HARQ process per HS-DSCH per TTI on which an HS-DSCH transmission can be received is one.
- Reordering Queue distribution:  
The reordering queue distribution function routes the MAC-hs PDUs to the correct reordering buffer based on the Queue ID.
- Reordering:  
The reordering entity reorders received MAC-hs PDUs according to the received TSN. MAC-hs PDUs with consecutive TSNs are delivered to the disassembly function upon reception. MAC-hs PDUs are not delivered to the disassembly function if MAC-hs PDUs with lower TSN are missing. There is one reordering entity for each Queue ID configured at the UE.
- Disassembly:  
The disassembly entity is responsible for the disassembly of MAC-hs PDUs. When a MAC-hs PDU is

disassembled the MAC-hs header is removed, the MAC-d PDUs are extracted and any present padding bits are removed. Then the MAC-d PDUs are delivered to higher layer.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

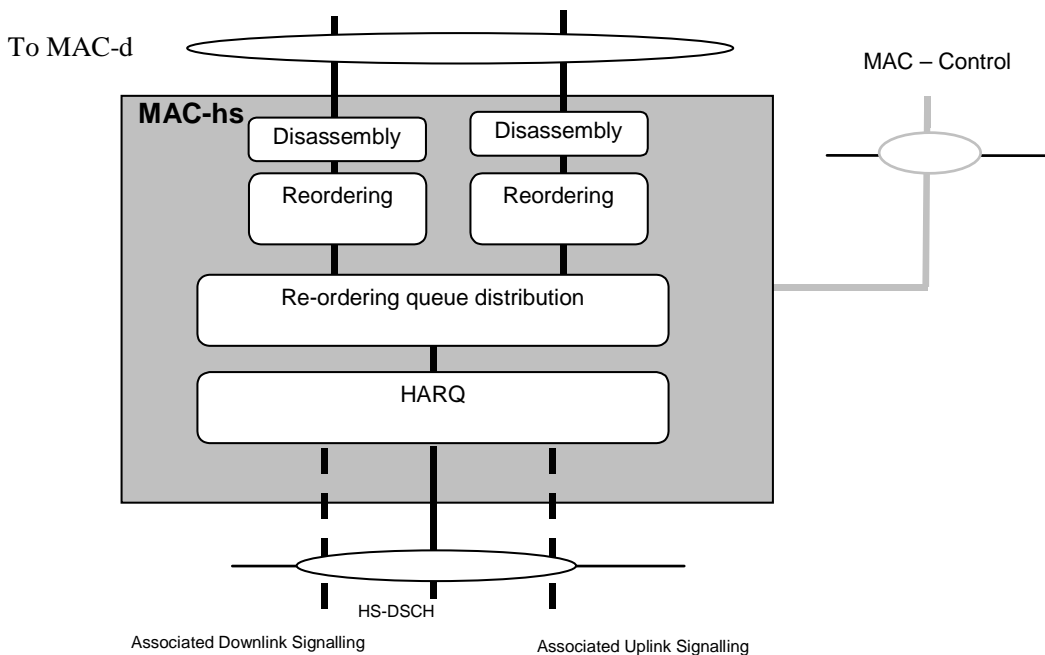


Figure 4.2.3.3.1: UE side MAC architecture / MAC-hs details

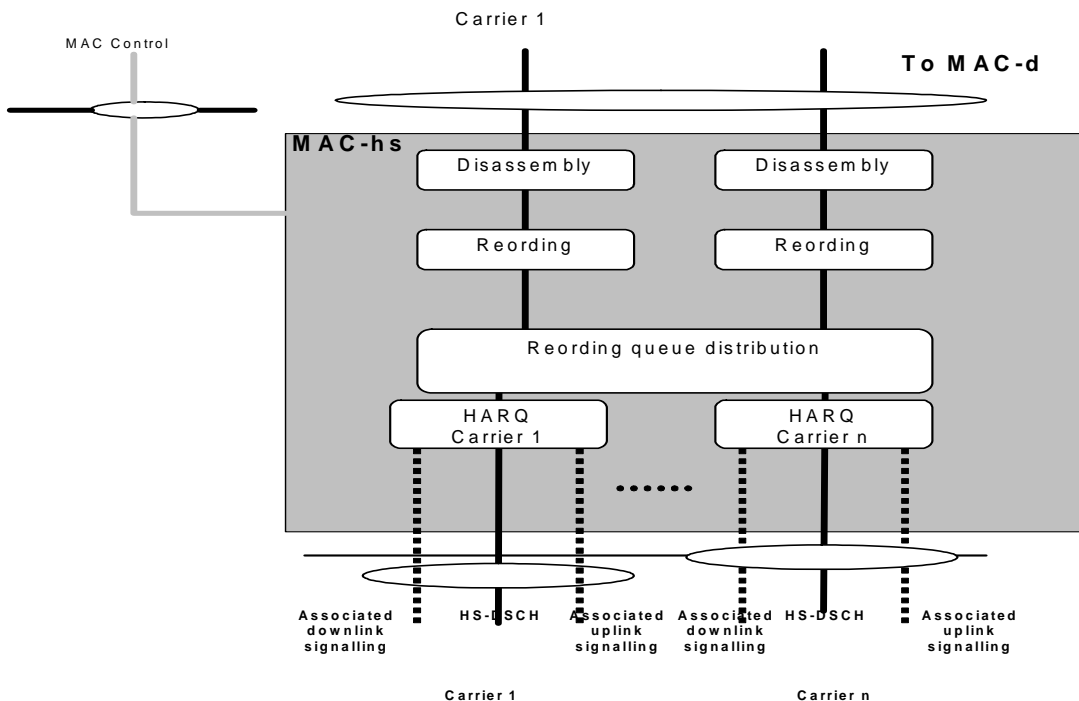


Figure 4.2.3.3.2: UE side MAC architecture/MAC-hs details (1.28Mcps TDD multi-frequency HS-DSCH operation mode only)

#### 4.2.3.4 MAC-e/es entity – UE Side

The split between MAC-e and MAC-es in the UE is not detailed. In the model below the MAC-e/es comprises the following entities:

- HARQ:  
The HARQ entity is responsible for handling the MAC functions relating to the HARQ protocol. It is responsible for storing MAC-e payloads and re-transmitting them. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP.
  - For FDD: The HARQ entity provides the E-TFC, the retransmission sequence number (RSN), and the power offset to be used by L1. Redundancy version (RV) of the HARQ transmission is derived by L1 from RSN, CFN and in case of 2 ms TTI from the sub-frame number.
  - For TDD: The HARQ entity provides the HARQ process identity, the E-TFC, the retransmission sequence number (RSN) and an indication of the power offset to be used by L1. The redundancy version (RV) of the HARQ transmission is derived by L1 from RSN. RRC signalling can also configure the L1 to use RV=0 for every transmission.
- Multiplexing and TSN setting:  
The multiplexing and TSN setting entity is responsible for concatenating multiple MAC-d PDUs into MAC-es PDUs, and to multiplex one or multiple MAC-es PDUs into a single MAC-e PDU, to be transmitted in the next TTI, as instructed by the E-TFC selection function. It is also responsible for managing and setting the TSN per logical channel for each MAC-es PDU.
- E-TFC selection:  
This entity is responsible for E-TFC selection according to the scheduling information, Relative Grants (FDD only) and Absolute Grants, received from UTRAN via L1 and Serving Grant value signalled through RRC, and for arbitration among the different flows mapped on the E-DCH. The detailed configuration of the E-TFC entity is provided by RRC over the MAC-Control SAP. The E-TFC selection function controls the multiplexing function.
- Scheduling Access Control (TDD only):  
The Scheduling Access Control entity is responsible for routing associated uplink signalling via E-UCCH and MAC-e PDU (in the case that E-DCH resources are assigned) or via E-RUCCH (in the case that no E-DCH resources are assigned). It is also responsible for obtaining and formatting the appropriate information to be carried on E-UCCH/E-RUCCH.

NOTE: HARQ process ID and RSN are carried on E-UCCH.

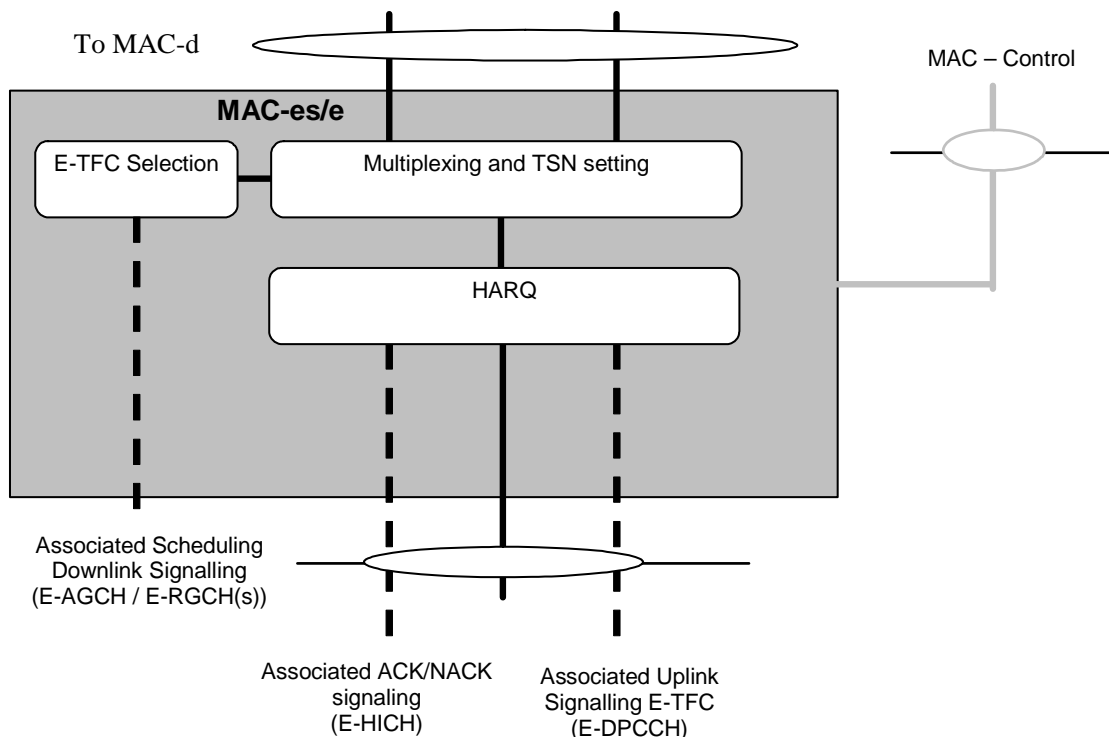


Figure 4.2.3.4.1a: UE side MAC architecture / MAC-e/es details (FDD)

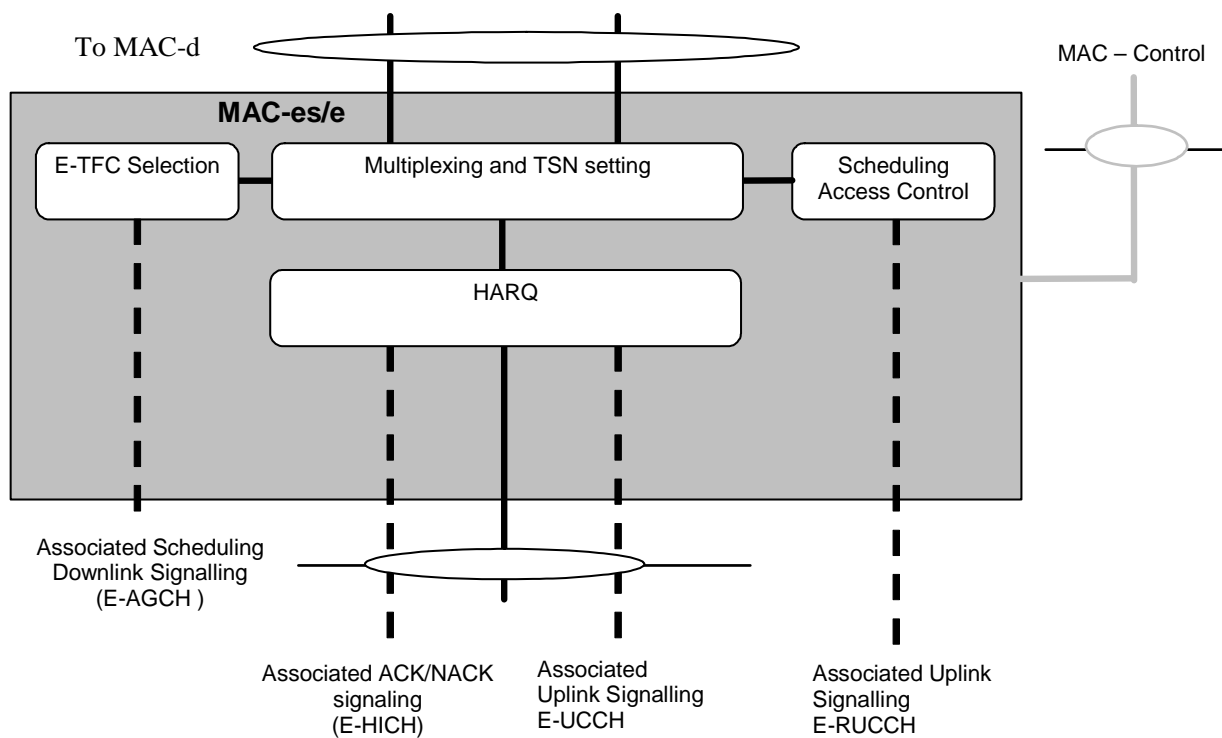


Figure 4.2.3.4.1b: UE side MAC architecture / MAC-e/es details (TDD)

4.2.3.5 MAC-ehs entity – UE Side

In the model below the MAC-ehs comprise the following entities:

- HARQ:  
The HARQ entity is responsible for handling the HARQ protocol. There shall be one HARQ process per HS-

DSCH per TTI for single stream transmission and two HARQ processes per HS-DSCH per TTI for dual stream transmission. There shall be one HARQ entity per HS-DSCH. The HARQ functional entity handles all the tasks that are required for hybrid ARQ. It is for example responsible for generating ACKs or NACKs. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP.

- Disassembly  
The disassembly entity disassembles the MAC-ehs PDUs by removing the MAC-ehs header and possible padding.
- Reordering queue distribution  
The reordering queue distribution function routes the received reordering PDUs to correct reordering queues based on the received logical channel identifier.
- Reordering:  
The reordering entity organises received reordering PDUs according to the received TSN. Data blocks with consecutive TSNs are delivered to reassembly entity upon reception. A timer mechanism determines delivery of non-consecutive data blocks to higher layers. There is one reordering entity for each priority class.
- Reassembly:  
The reassembly entity reassembles segmented MAC-ehs SDUs (corresponding to either MAC-c or MAC-d PDUs) and forwards the MAC PDUs to LCH-ID demultiplexing entity.
- LCH-ID demultiplexing:  
The demultiplexing entity routes the MAC-ehs SDUs to correct logical channel based on the received logical channel identifier.

The following is allowed:

The MAC-ehs SDUs included in a MAC-ehs PDU can have a different size and a different priority and can be mapped to different priority queues.

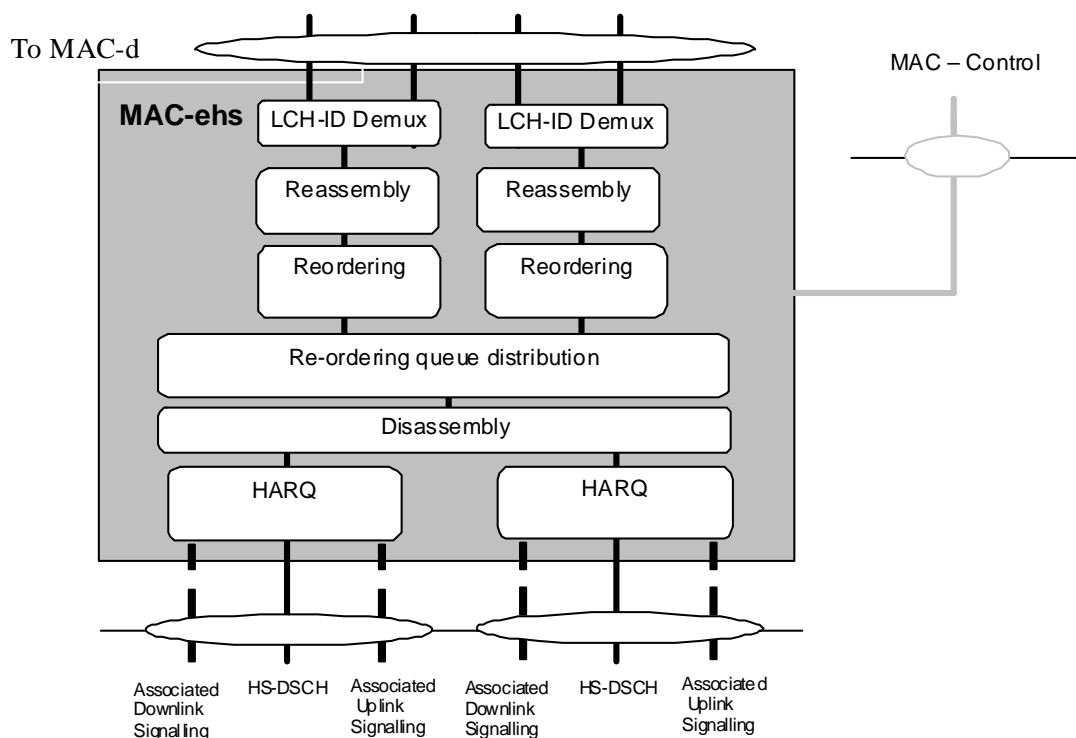


Figure 4.2.3.5-1: UE side MAC architecture/MAC-ehs details.

#### 4.2.3.6 MAC-i/is entity – UE Side

The split between MAC-i and MAC-is in the UE is not detailed. In the model below the MAC-i/is comprises the following entities:



- HARQ:  
The HARQ entity is responsible for handling the MAC functions relating to the HARQ protocol. It is responsible for storing MAC-i payloads and re-transmitting them. The detailed configuration of the hybrid ARQ protocol is provided by RRC over the MAC-Control SAP.
  - For FDD: The HARQ entity provides the E-TFC, the retransmission sequence number (RSN), and the power offset to be used by L1. Redundancy version (RV) of the HARQ transmission is derived by L1 from RSN, CFN and in case of 2 ms TTI from the sub-frame number.
  - For TDD: The HARQ entity provides the HARQ process identity, the E-TFC, the retransmission sequence number (RSN) and an indication of the power offset to be used by L1. The redundancy version (RV) of the HARQ transmission is derived by L1 from RSN. RRC signalling can also configure the L1 to use RV=0 for every transmission.
- Multiplexing and TSN setting:  
The multiplexing and TSN setting entity is responsible for concatenating multiple MAC-d PDUs into MAC-is PDUs, and to multiplex one or multiple MAC-is PDUs into a single MAC-i PDU, to be transmitted in the next TTI, as instructed by the E-TFC selection function. It is also responsible for managing and setting the TSN per logical channel for each MAC-is PDU.  
In FDD and 1.28 Mcps TDD, the multiplexing and TSN setting entity is responsible for multiplexing MAC-c PDUs or segments of MAC-c PDUs into a single MAC-is PDU, and for multiplexing MAC-is PDUs into a single MAC-i PDU, to be transmitted in the next TTI, as instructed by the E-TFC selection function. It is also responsible for managing and setting the TSN for the common control channel for each MAC-is PDU.
- Segmentation:  
The segmentation function is responsible for segmenting MAC-d PDUs and MAC-c PDUs (FDD and 1.28 Mcps TDD only).
- CRC Attachment (FDD and 1.28 Mcps TDD only):  
If MAC segmentation is performed for MAC-c PDUs, a CRC is appended to the MAC-is SDU before this data (MAC-c PDU and CRC checksum) is segmented. The size of the CRC field is 8 bits and the CRC is calculated as specified in section 4.2.1.1 in [16] or [19]. In the CRC field, figure 9.1.5.4d, the LSB is the rightmost bit and the MSB is the leftmost bit.
- Add UE ID (FDD only):  
In CELL\_DCH state, no E-RNTI is included in the MAC-PDU header.  
In CELL\_FACH, the E-RNTI is added in all MAC-i PDUs for DCCH and DTCH transmission at the UE side until the UE receives an E-AGCH with its E-RNTI (through an E-RNTI-specific CRC attachment).  
In CELL\_FACH state and in Idle mode, no E-RNTI is added in MAC-i PDUs for CCCH data transmission.
- E-TFC selection:  
This entity is responsible for E-TFC selection according to the scheduling information, Relative Grants (FDD only) and Absolute Grants, received from UTRAN via L1 and Serving Grant value signalled through RRC, and for arbitration among the different flows mapped on the E-DCH. The detailed configuration of the E-TFC entity is provided by RRC over the MAC-Control SAP. The E-TFC selection function controls the multiplexing function.
- ASC selection (FDD and 1.28 Mcps TDD only):  
At the start of the Enhanced Uplink in CELL\_FACH state and Idle mode, MAC-is/i applies the appropriate back-off parameter(s) associated with the given ASC. When sending an RRC CONNECTION REQUEST message, RRC will determine the ASC; in all other cases MAC-is/i selects the ASC.
- Scheduling Access Control (TDD only):  
The Scheduling Access Control entity is responsible for routing associated uplink signalling via E-UCCH and MAC-e PDU (in the case that E-DCH resources are assigned) or via E-RUCCH (in the case that no E-DCH resources are assigned). It is also responsible for obtaining and formatting the appropriate information to be carried on E-UCCH/E-RUCCH.

NOTE: HARQ process ID and RSN are carried on E-UCCH.

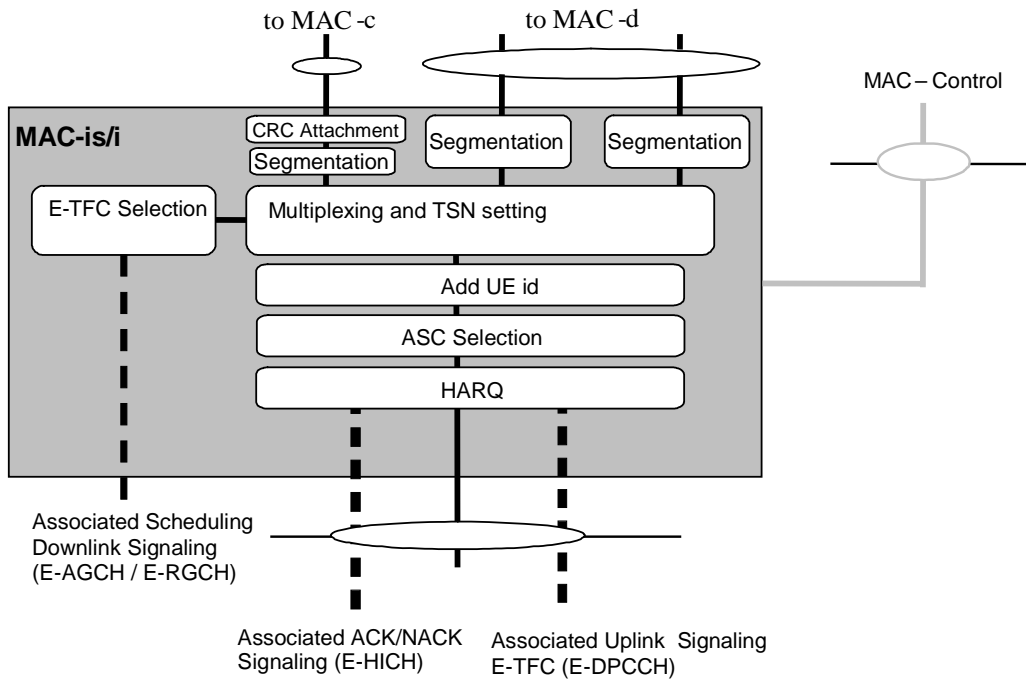


Figure 4.2.3.6-1: UE side MAC architecture / MAC-i/is details (FDD)

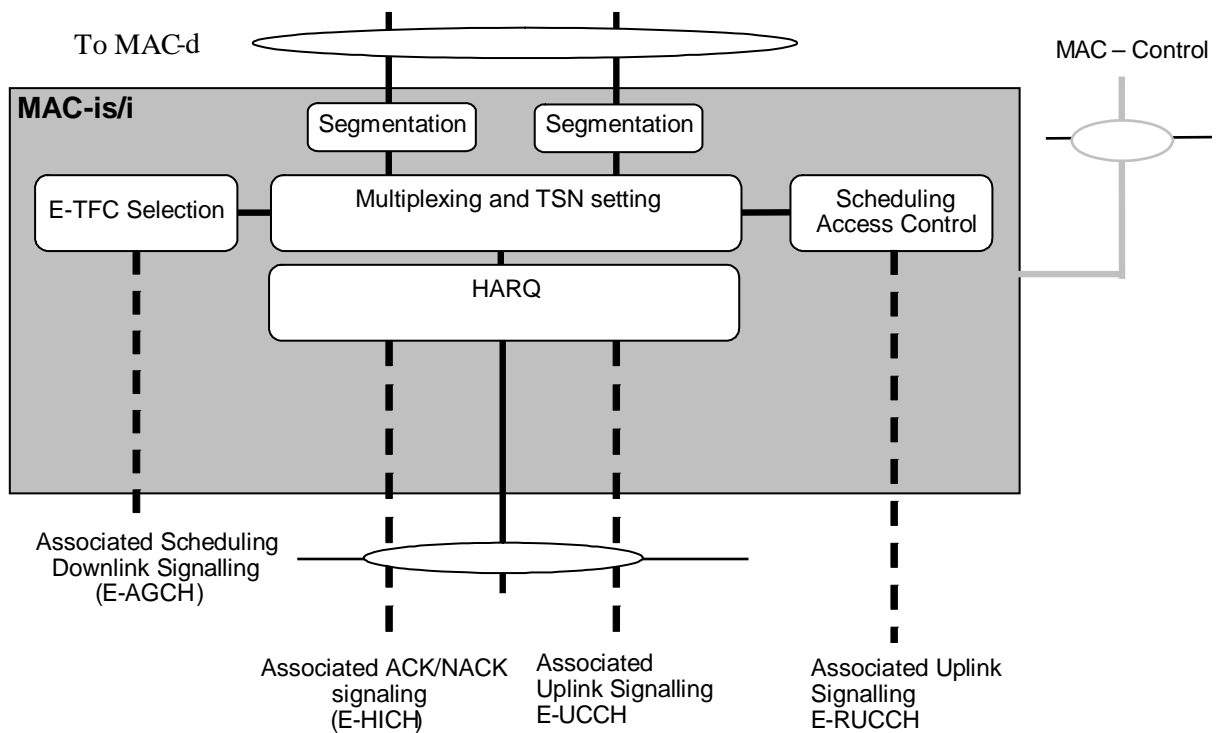


Figure 4.2.3.6-2: UE side MAC architecture / MAC-i/is details (TDD)

### 4.2.4 Traffic Related Architecture - UTRAN Side

Figure 4.2.4.1 illustrates the connectivity between the MAC entities from the UTRAN side.

It is similar to the UE case with the exception that there will be one MAC-d for each UE and each UE (MAC-d) that is associated with a particular cell may be associated with that cell's MAC-c/sh/m.

MAC-c/sh/m is located in the controlling RNC while MAC-d is located in the serving RNC. MAC-hs/ehs is located in the Node B. The MAC-d PDUs to be transmitted are transferred from MAC-c/sh/m to the MAC-hs/ehs via the Iub interface in case of configuration with MAC-c/sh/m, or from the MAC-d via Iur/Iub in case of configuration without MAC-c/sh/m.

For TDD, and for FDD in CELL\_DCH, for each UE that uses E-DCH, one MAC-e or MAC-i entity per Node-B and one MAC-es or MAC-is entity in the SRNC are configured. MAC-e or MAC-i, located in the Node B, controls access to the E-DCH and is connected to MAC-es or MAC-is, located in the SRNC. MAC-es or MAC-is is further connected to MAC-d. There is one transport bearer set up per E-DCH MAC-d flow.

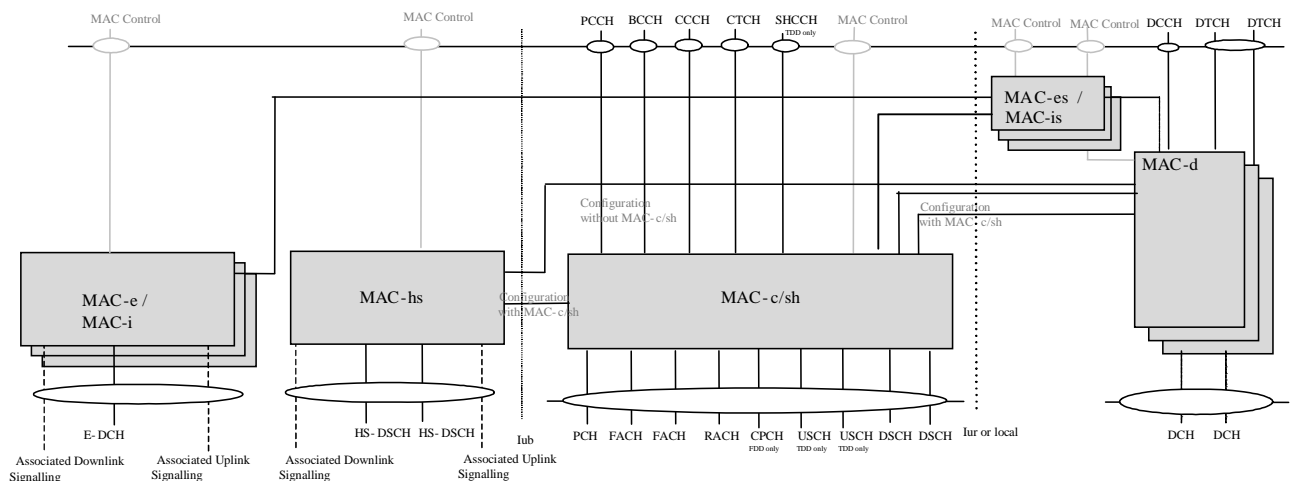
For FDD and 1.28 Mcps TDD, for DTCH and DCCH transmission in CELL\_FACH, for each UE that uses E-DCH, one MAC-i entity per Node-B and one MAC-is entity in the SRNC are configured. MAC-i, located in the Node B, controls access to the E-DCH and is connected to MAC-is, located in the SRNC. MAC-is is further connected to MAC-d.

For FDD, for CCCH transmission, for each UE that uses E-DCH, one MAC-i entity per Node-B and one MAC-is entity in the CRNC are configured. MAC-i, located in the Node B, controls access to the E-DCH and is connected to MAC-is in the CRNC.

For 1.28 Mcps TDD, for CCCH transmission, for each UE that uses E-DCH, one MAC-i entity per common E-RNTI in Node-B and one MAC-is entity in the CRNC are configured. MAC-i, located in the Node B, controls access to the E-DCH and is connected to MAC-is in the CRNC.

The MAC Control SAP is used to transfer Control information to each MAC entity belonging to one UE.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].



**Figure 4.2.4.1: UTRAN side MAC architecture**

#### 4.2.4.1 MAC-c/sh/m entity – UTRAN Side

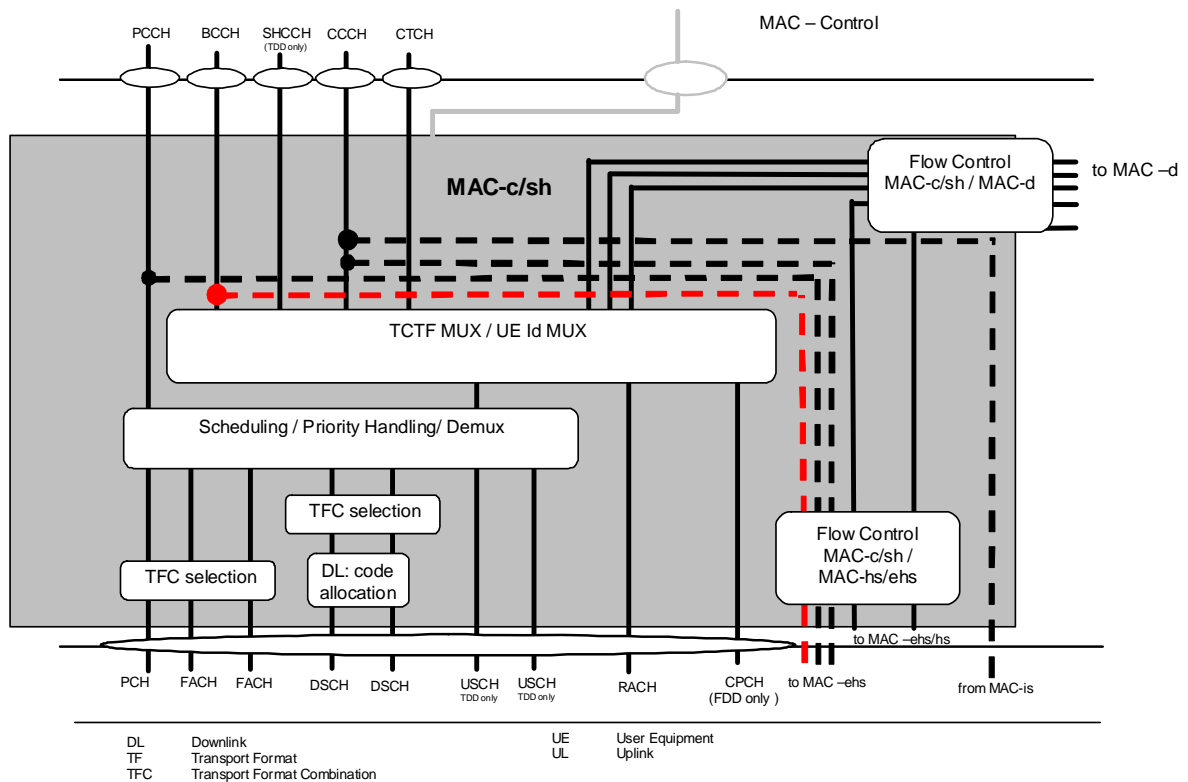
Figure 4.2.4.1.1 shows the UTRAN side MAC-c/sh/m entity. The following functionality is covered:

- Scheduling – Buffering – Priority Handling;

- this function manages FACH and for TDD DSCH resources between the UEs and between data flows according to their priority and delay requirements set by higher layers.
- TCTF MUX
  - this function represents the handling (insertion for downlink channels and detection and deletion for uplink channels) of the TCTF field in the MAC header, and the respective mapping between logical and transport channels.  
The TCTF field indicates the common logical channel type, or if a dedicated logical channel is used;
- UE Id Mux;
  - for dedicated type logical channels, the UE Id field in the MAC header is used to distinguish between UEs;
- MBMS Id Mux;
  - for MTCH channels, the MBMS Id field in the MAC header is used to distinguish between MBMS services;
- TFC selection:
  - in the downlink, transport format combination selection is done for FACH and PCH and for TDD DSCHs;
- Demultiplex;
  - for TDD operation the demultiplex function is used to separate USCH data from different UEs, i.e. to be transferred to different MAC-d entities;
- DL code allocation;
  - for TDD this function is used to indicate the code used on the DSCH;
- Flow control;
  - a flow control function exists toward MAC-d to limit buffering between MAC-d and MAC-c/sh/m entities. a flow control function also exists towards MAC-hs/ehs in case of configuration with MAC-c/sh/m.

The RLC provides RLC-PDUs to the MAC, which fit into the available transport blocks on the transport channels.

There is one MAC-c/sh/m entity in the UTRAN for each cell;



**Figure 4.2.4.1.1: UTRAN side MAC architecture / MAC-c/sh/m details**

#### 4.2.4.2 MAC-d entity – UTRAN Side

Figure 4.2.4.2.1 shows the UTRAN side MAC-d entity.

The following functionality is covered:

- Transport Channel type switching:
  - Transport Channel type switching is performed by this entity, based on decision taken by RRC; this is related to a change of radio resources. If requested by RRC, MAC shall switch the mapping of one designated logical channel between common and dedicated transport channels.
- C/T MUX box;
  - the function includes the C/T field when multiplexing of several dedicated logical channels onto one transport channel (other than HS-DSCH) or one MAC-d flow (HS-DSCH) is used. If MAC-ehs is configured, C/T MUX toward MAC-ehs is not used.
- LCH MUX box;
  - If MAC-ehs is configured, the LCH MUX function associates each block of MAC-d PDUs of a logical channel with the related LCH-ID, regardless whether one or several logical channels are multiplexed onto one MAC-d flow.
- Priority setting;
  - This function is responsible for priority setting on data received from DCCH / DTCH;
- Ciphering;
  - Ciphering for transparent mode data to be ciphered is performed in MAC-d. Details about ciphering can be found in [10].
- Deciphering;

- Deciphering for ciphered transparent mode data is performed in MAC-d. Details about ciphering can be found in [10].
- DL Scheduling/Priority handling;
  - in the downlink, scheduling and priority handling of transport channels is performed within the allowed transport format combinations of the TFCS assigned by the RRC.
- Flow Control;
  - a flow control function exists toward MAC-c/sh/m to limit buffering between MAC-d and MAC-c/sh/m entities. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of FACH or for TDD DSCH congestion. For the Iur interface this is specified in [11]. A flow control function also exists towards MAC-hs/ehs in case of configuration without MAC-c/sh/m, see subclause 4.2.4.2.

A MAC-d entity using common channels other than the high speed downlink shared channel is connected to a MAC-c/sh/m entity that handles the scheduling of the common channels to which the UE is assigned and DL (FACH) priority identification to MAC-c/sh/m;

A MAC-d entity using downlink shared channel is connected to a MAC-c/sh/m entity that handles the shared channels to which the UE is assigned and indicates the level of priority of each PDU to MAC-c/sh/m;

A MAC-d entity using the high speed downlink shared channel may be connected to a MAC-c/sh/m entity that in turn is connected to the MAC-hs/ehs entity in the Node B (configuration with MAC-c/sh/m); alternately, a MAC-d entity using the high speed downlink shared channel may be connected to the MAC-hs/ehs entity in the Node B in case of configuration without MAC-c/sh/m.

A MAC-d entity using the enhanced dedicated transport channel (Uplink only) is connected to a MAC-es or MAC-is entity that handles the re-ordering and combining of data received from different Node Bs. Given that the MAC-es or MAC-is is collocated in the SRNC, it is not necessary to flow control this connection. The MAC-es or MAC-is indicates the logical channel for which the data is intended, to allow the MAC-d to route it appropriately.

A MAC-d entity is responsible for mapping dedicated logical channels onto the available dedicated transport channels or routing the data received on a DCCH or DTCH to MAC-c/sh/m or to MAC-hs/ehs.

One dedicated logical channel can be mapped simultaneously on DCH and DSCH in TDD mode. Different scheduling mechanisms apply for DCH and DSCH. One dedicated logical channel can be mapped simultaneously on DCH and HS-DSCH.

There is one MAC-d entity in the UTRAN for each UE that has one or more dedicated logical channels to or from the UTRAN.

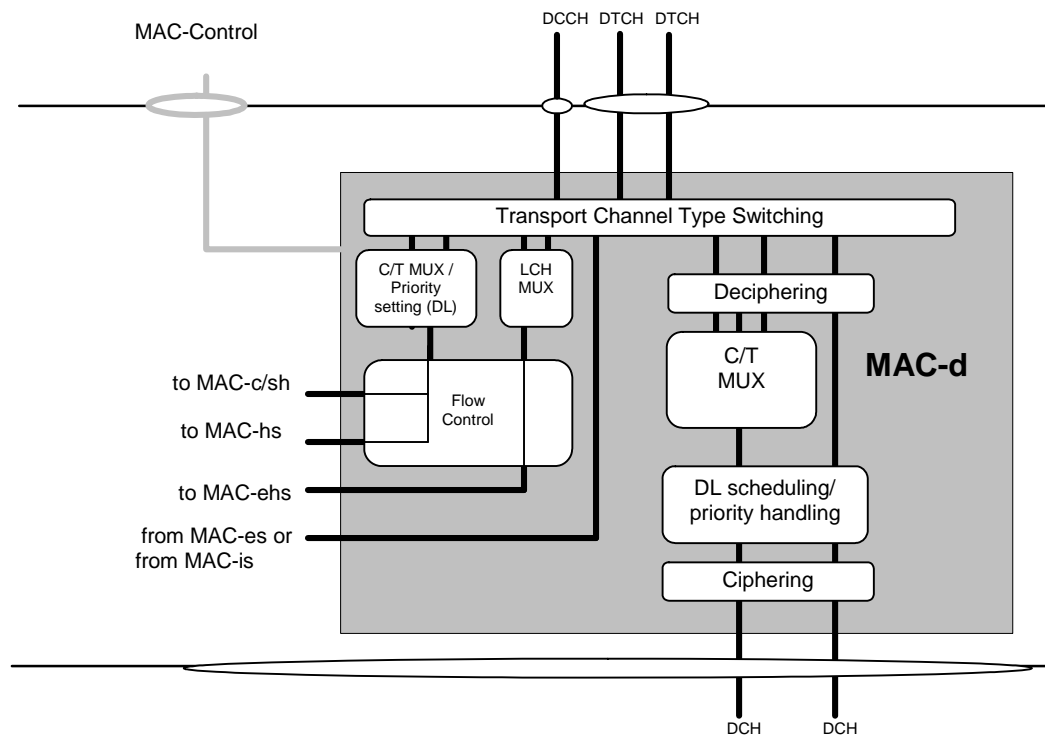


Figure 4.2.4.2.1: UTRAN side MAC architecture / MAC-d details

#### 4.2.4.3 MAC-hs entity – UTRAN Side

There is one MAC-hs entity in the UTRAN for each cell that supports HS-DSCH transmission. The MAC-hs is responsible for handling the data transmitted on the HS-DSCH when configured by upper layers. Furthermore, when configured by upper layers, it is responsible for the management of the physical resources allocated to HSDPA. There should be priority handling per MAC-d PDU in the MAC-hs. The MAC-hs is comprised of four different functional entities:

- **Flow Control:**  
This is the companion flow control function to the flow control function in the MAC-c/sh/m in case of configuration with MAC-c/sh/m and MAC-d in case of configuration without MAC-c/sh/m. Both entities together provide a controlled data flow between the MAC-c/sh/m and the MAC-hs (Configuration with MAC-c/sh/m) or the MAC-d and MAC-hs (Configuration without MAC-c/sh/m) taking the transmission capabilities of the air interface into account in a dynamic manner. This function is intended to limit layer 2 signalling latency and reduce discarded and retransmitted data as a result of HS-DSCH congestion. Flow control is provided independently by MAC-d flow for a given MAC-hs entity.
- **Scheduling/Priority Handling:**  
This function manages HS-DSCH resources between HARQ entities and data flows according to their priority. Based on status reports from associated uplink signalling either new transmission or retransmission is determined. Further it determines the Queue ID and TSN for each new MAC-hs PDU being serviced, and in the case of TDD the HCSN is determined. A new transmission can be initiated instead of a pending retransmission at any time to support the priority handling.

In 1.28 Mcps TDD multi-frequency HS-DSCH cell:

- multiple HARQ processes are assigned for HS-DSCH operation on every carrier for every user, namely HARQ sub-entity; only one HARQ process in HARQ sub-entity is allowed to receive HS-DSCH in one TTI for each carrier.
- choice of 6bit or 9bit TSN is configured by upper layer signalling
- **HARQ:**  
One HARQ entity handles the hybrid ARQ functionality for one user. One HARQ entity is capable of supporting multiple instances (HARQ process) of stop and wait HARQ protocols. There shall be one HARQ process per

HS-DSCH per TTI. In 1.28 Mcps TDD multi-frequency HS-DSCH cell, multiple HARQ processes are assigned independently for HS-DSCH operation on every carrier for every user, namely HARQ sub-entity. Only one HARQ process in HARQ sub-entity is allowed to receive HS-DSCH in one TTI for each carrier.

- TFRC selection:  
Selection of an appropriate transport format and resource for the data to be transmitted on HS-DSCH.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

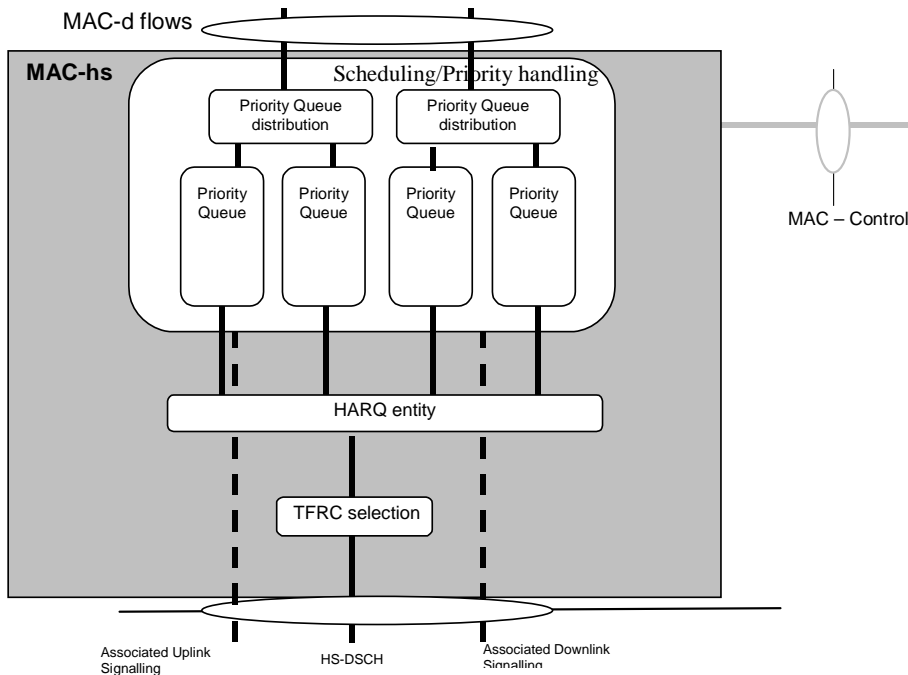


Figure 4.2.4.3.1: UTRAN side MAC architecture / MAC-hs details

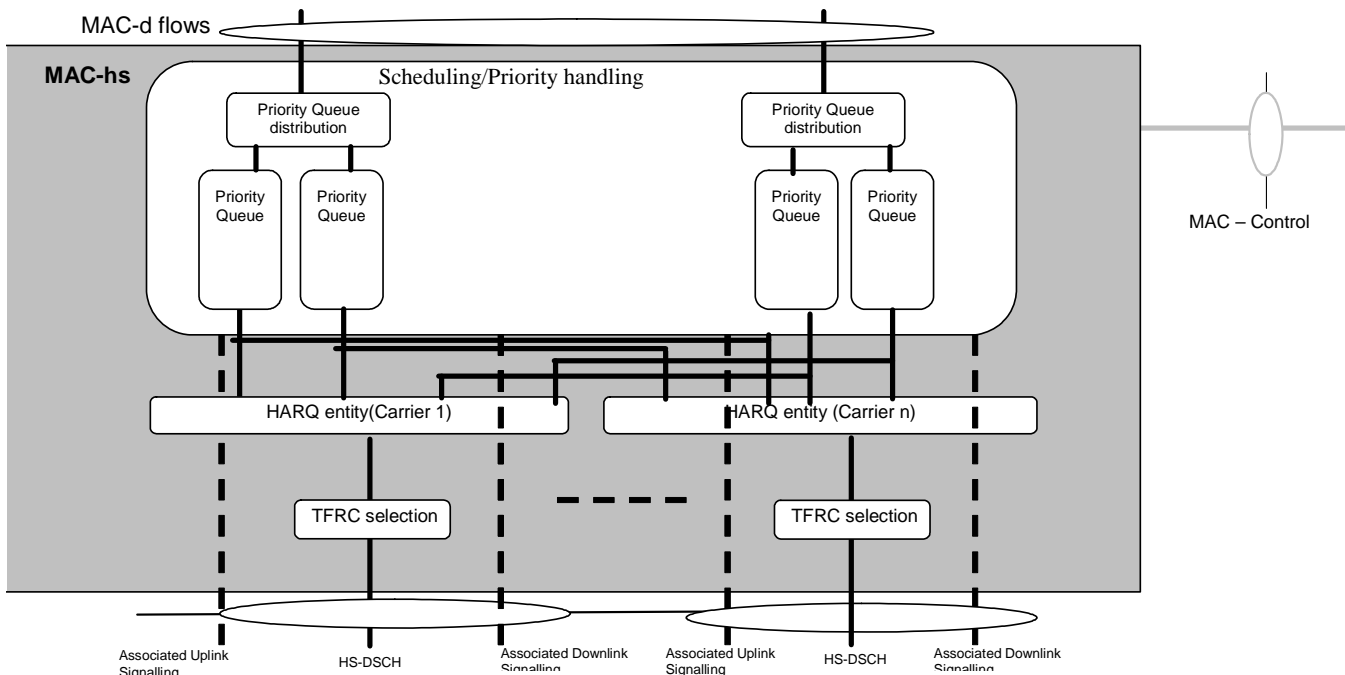


Figure 4.2.4.3.2: UTRAN side MAC architecture/MAC-hs details (1.28Mcps TDD multi-frequency HS-DSCH operation mode only)



#### 4.2.4.4 MAC-es entity – UTRAN Side

For each UE, there is one MAC-es entity in the SRNC. When configured by the upper layers, the MAC-es sublayer handles E-DCH specific functionality, which is not covered in the MAC-e entity in Node B. In the model below, the MAC-es comprises the following entities:

- Reordering Queue Distribution:  
The reordering queue distribution function routes the MAC-es PDUs to the correct reordering buffer based on the SRNC configuration.
- Reordering:  
This function reorders received MAC-es PDUs according to the received TSN and Node-B tagging i.e. (CFN, subframe number). MAC-es PDUs with consecutive TSNs are delivered to the disassembly function upon reception. Mechanisms for reordering MAC-es PDUs received out-of-order are left up to the implementation. There is one Re-ordering Process per logical channel.
- Macro diversity selection (FDD only):  
The function is performed in the MAC-es, in case of soft handover with multiple Node-Bs (The soft combining for all the cells of a Node-B takes place in the Node-B). This means that the reordering function receives MAC-es PDUs from each Node-B in the E-DCH active set. The exact implementation is not specified. However the model below is based on one Reordering Queue Distribution entity receiving all the MAC-d flow from all the Node-Bs, and one MAC-es entity per UE.
- Disassembly:  
The disassembly function is responsible for disassembly of MAC-es PDUs. When a MAC-es PDU is disassembled the MAC-es header is removed, the MAC-d PDU"s are extracted and delivered to MAC-d.

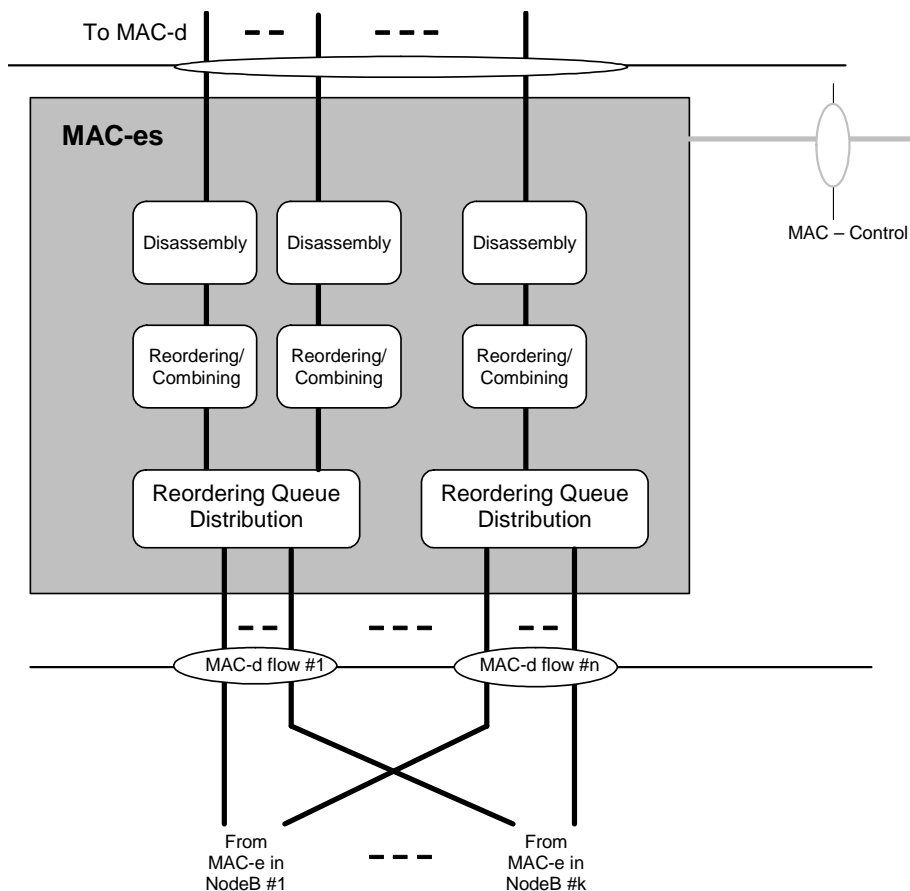


Figure 4.2.4.4-1: UTRAN side MAC architecture / MAC-es details (SHO case, FDD only)

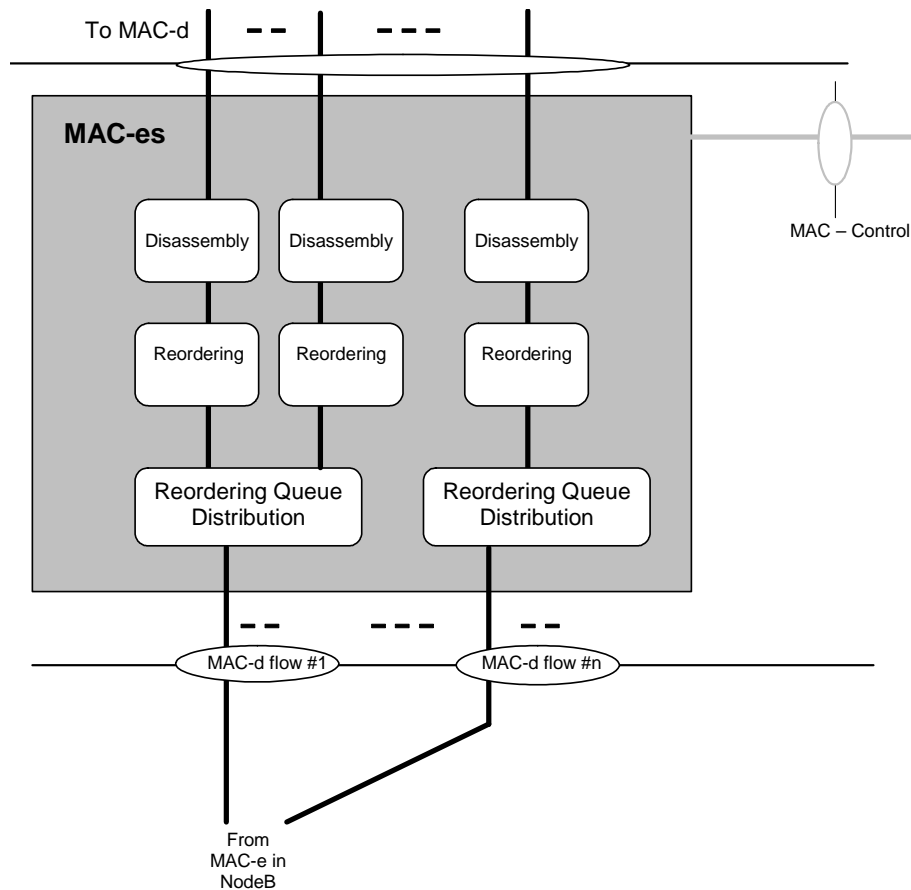


Figure 4.2.4.4-1b: UTRAN side MAC architecture / MAC-es details (TDD)

#### 4.2.4.5 MAC-e entity – UTRAN Side

There is one MAC-e entity in the Node B for each UE and one E-DCH scheduler function in the Node-B. When configured by the upper layers the MAC-e and E-DCH scheduler handle HSUPA specific functions in the Node B. In the model below, the MAC-e and E-DCH scheduler comprises the following entities:

- E-DCH Scheduling:  
This function manages E-DCH cell resources between UEs. Based on scheduling requests, Scheduling Grants are determined and transmitted. The general principles of the E-DCH scheduling are described in subclauses 11.8.2.3 and 11.9.2.3 below. However implementation is not specified (i.e. depends on RRM strategy).
- E-DCH Control:  
The E-DCH control entity is responsible for reception of scheduling requests and transmission of Scheduling Grants. The general principles of the E-DCH scheduling are described in subclauses 11.8.2.3 and 11.9.2.3 below.
- De-multiplexing:  
This function provides de-multiplexing of MAC-e PDUs. MAC-es PDUs are forwarded to the associated MAC-d flow.
- HARQ:  
One HARQ entity is capable of supporting multiple instances (HARQ processes) of stop and wait HARQ protocols. Each process is responsible for generating ACKs or NACKs indicating delivery status of E-DCH transmissions. The HARQ entity handles all tasks that are required for the HARQ protocol.

The associated signalling shown in the figures illustrates the exchange of information between layer 1 and layer 2 provided by primitives.

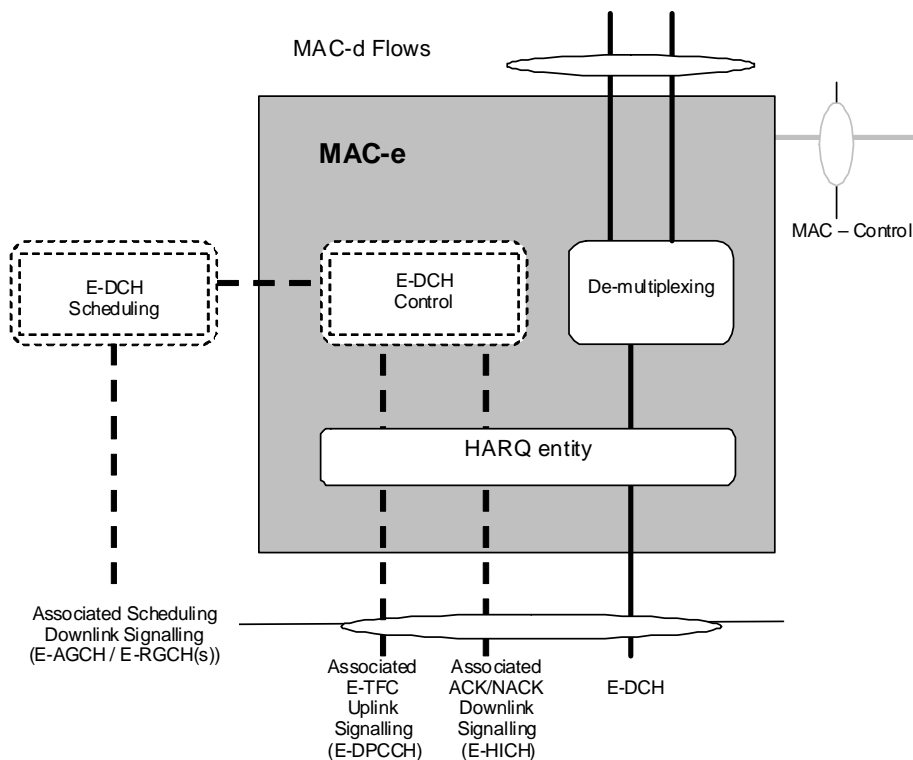


Figure 4.2.4.5-1a: UTRAN side MAC architecture / MAC-e details (FDD)

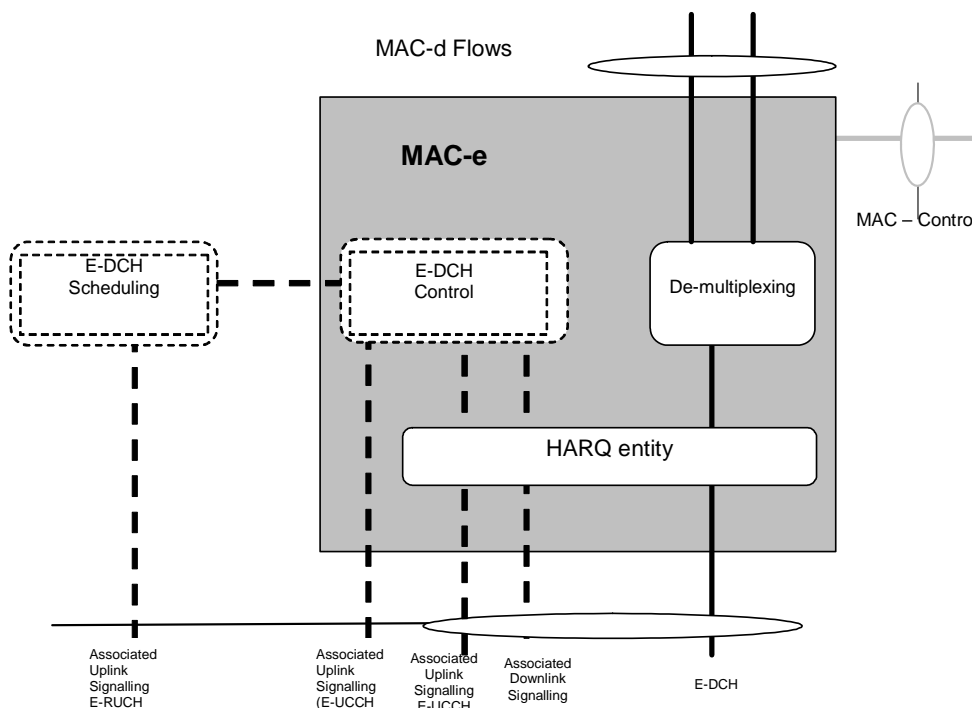


Figure 4.2.4.5-1b: UTRAN side MAC architecture / MAC-e details (TDD)

4.2.4.6 MAC-ehs entity UTRAN Side

There is one MAC-ehs entity in the UTRAN for each cell that supports HS-DSCH transmission. The same MAC-ehs entity may support HS-DSCH transmission in more than one cell served by the same Node-B. The MAC-ehs is responsible for handling the data transmitted on the HS-DSCH when configured. There should be priority handling per MAC-ehs SDU in the MAC-ehs. The MAC-ehs is comprised of six different functional entities:

- Flow Control:  
The flow control for MAC-ehs is identical to the flow control for MAC-hs.
- Scheduling/Priority Handling:  
This function manages HS-DSCH resources between HARQ entities and data flows according to their priority class. In FDD, the scheduler determines for each TTI if single or dual stream transmission should be used. Based on status reports from associated uplink signalling either new transmission or retransmission is determined when operating in CELL\_DCH state. In FDD, when operating in CELL\_FACH, CELL\_PCH and URA\_PCH state HS-DSCH reception, the MAC-ehs can perform retransmission without uplink signalling. In 1.28 Mcps TDD, when operating in CELL\_FACH, CELL\_PCH and URA\_PCH state and HS-DSCH reception without dedicated H-RNTI, the MAC-ehs can perform retransmission without uplink signalling. Further it sets the logical channel identifiers for each new reordering SDU and TSNs for each new reordering PDU being serviced. To maintain proper transmission priority a new transmission can be initiated on a HARQ process at any time. The TSN is unique to each priority class within a HS-DSCH. It is not permitted to schedule new transmissions, including retransmissions originating in the RLC layer, along with retransmissions originating from the HARQ layer within the same TTI over the same HS-DSCH, and HARQ process.
- HARQ:  
One HARQ entity handles the hybrid ARQ functionality for one user and per HS-DSCH transport channel.. One HARQ entity is capable of supporting multiple instances (HARQ process) of stop and wait HARQ protocols. There shall be one HARQ entity per HS-DSCH, one HARQ process per TTI for single stream transmission and two HARQ processes per TTI for dual stream transmission.
- TFRI selection:  
The TFRI selection for MAC-ehs is identical to the TFRI selection of the MAC-hs.
- Priority Queue MUX:  
This function determinates the number of octets to be included in a MAC-ehs PDU from each priority queue based on the scheduling decision and available TFRI for this function.
- Segmentation:  
This function performs necessary segmentation of MAC-ehs SDUs.

The following is allowed:

The MAC-ehs SDUs included in a MAC-ehs PDU can have a different size and a different priority and can be mapped to different logical channels.

The associated signalling shown in the figure illustrates the exchange of information between layer 1 and layer 2 provided by primitives shown in [3].

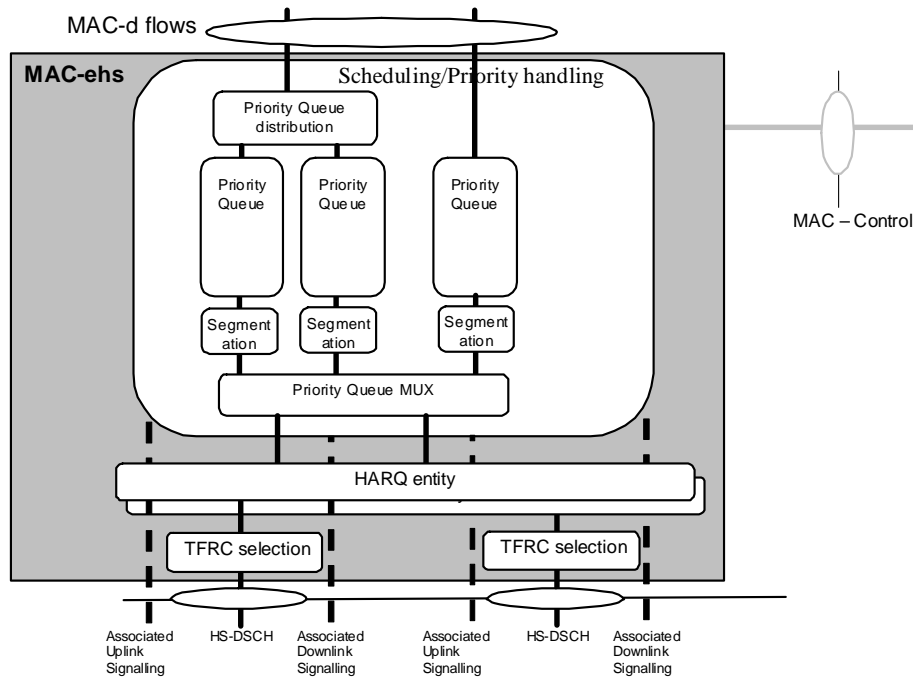


Figure 4.2.4.6-1: UTRAN side MAC architecture / MAC-ehs details

#### 4.2.4.7 MAC-is entity – UTRAN Side

For TDD, and for FDD in CELL\_DCH and CELL\_FACH, for each UE, there is one MAC-is entity in the SRNC. For FDD, for CCCH transmission in CELL\_FACH state and Idle mode, there is one MAC-is entity per common E-DCH resource configured in the controlling RNC. For 1.28 Mcps TDD, for CCCH transmission in CELL\_FACH state and Idle mode, there is one MAC-is entity per UE in the controlling RNC. When configured by the upper layers, the MAC-is sublayer handles E-DCH specific functionality, which is not covered in the MAC-i entity in Node B. In the model below, the MAC-is comprises the following entities:

- Disassembly:  
The disassembly function is responsible for disassembly of MAC-is PDUs. When a MAC-is PDU is disassembled the MAC-is header is removed.
- Reordering Queue Distribution:  
For DCCH and DTCH transmission, the reordering queue distribution function routes the MAC-is PDUs to the correct reordering buffer based on the SRNC configuration.
- Reordering:  
This function reorders received MAC-is PDUs according to the received TSN and Node-B tagging i.e. (CFN, subframe number). MAC-is PDUs with consecutive TSNs are delivered to the disassembly function upon reception. Mechanisms for reordering MAC-is PDUs received out-of-order are left up to the implementation. There is one Re-ordering Process per logical channel.
- Macro diversity selection (FDD only):  
The function is performed in the MAC-is, in case of soft handover with multiple Node-Bs (The soft combining for all the cells of a Node-B takes place in the Node-B). This means that the reordering function receives MAC-is PDUs from each Node-B in the E-DCH active set. The exact implementation is not specified. However the model below is based on one Reordering Queue Distribution entity receiving all the MAC-d flow from all the Node-Bs, and one MAC-is entity per UE.
- Reassembly:  
For DTCH/DCCH transmission, the reassembly function reassembles segmented MAC-d PDUs, and delivers the MAC-d PDUs to the correct MAC-d entity. For CCCH transmission, the reassembly function reassembles segmented MAC-c PDUs, and delivers it to the CRC Error Correction function.
- CRC Error Correction (FDD and 1.28 Mcps TDD only):  
When the MAC-c PDU is received correctly after reassembly is performed for CCCH, then the CRC field is removed and the resulting data is delivered to the MAC-c. However, if a MAC-c PDU has been received with an incorrect CRC, the MAC-c PDU is discarded. The size of the CRC field is 8 bits and the CRC is calculated as specified in section 4.2.1.1 in [16] or [19].

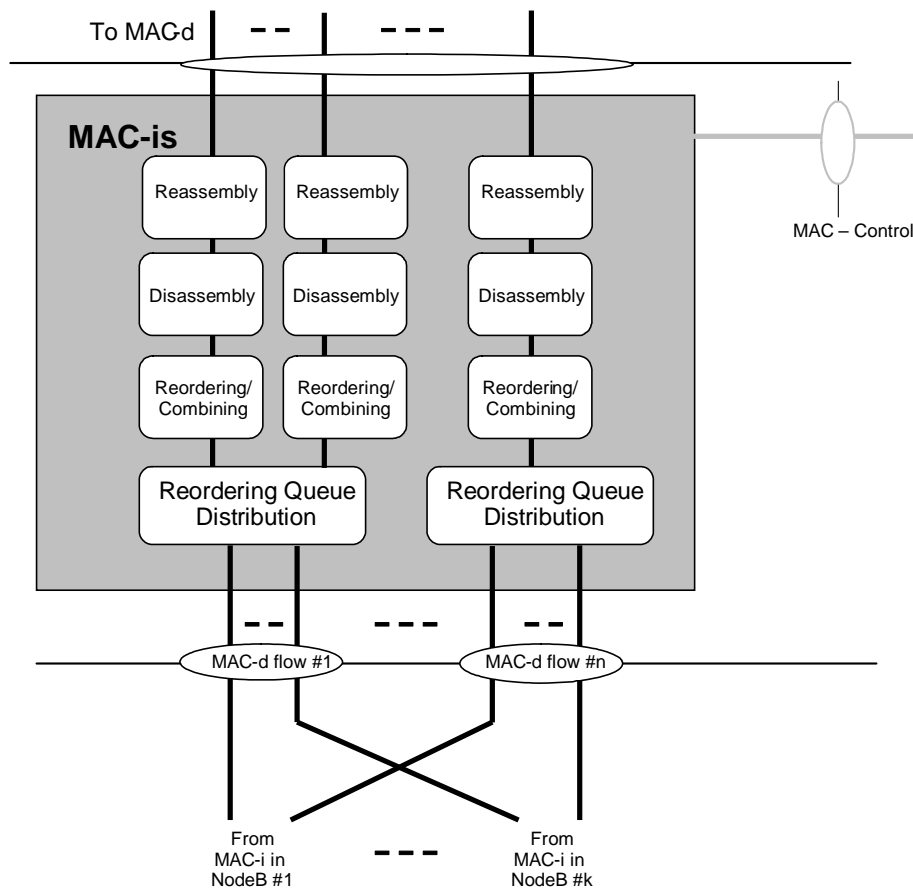


Figure 4.2.4.7-1: UTRAN side MAC architecture / MAC-is details for DCCH/DTCH transmission (SHO case, FDD only)

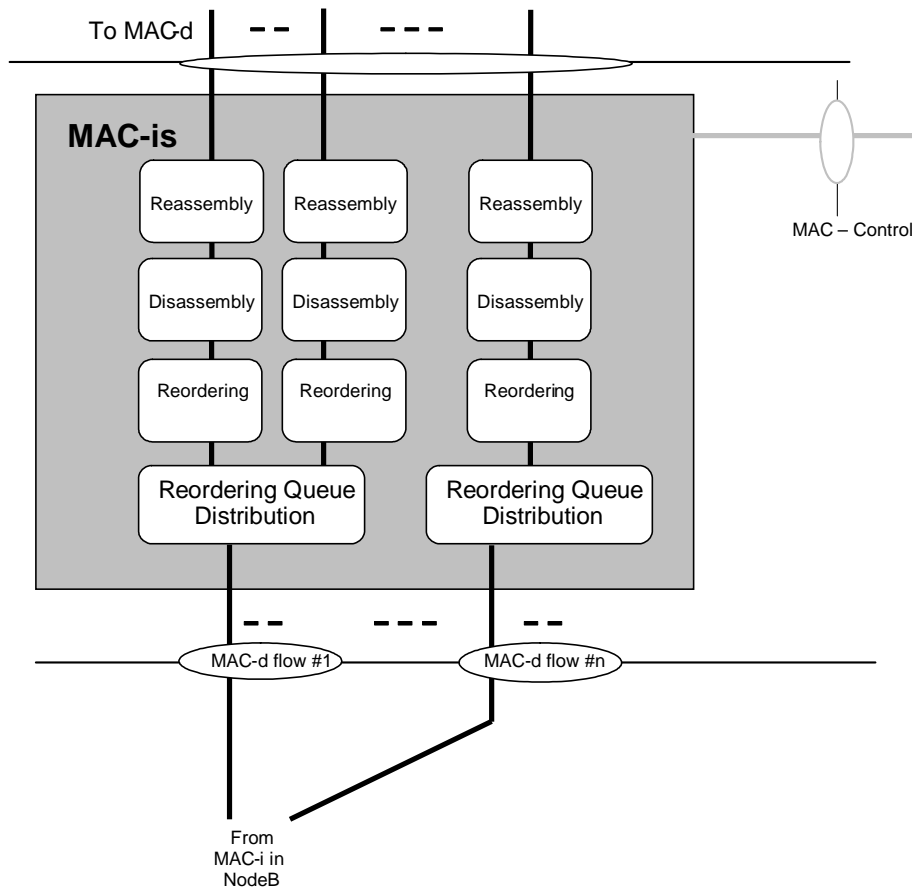
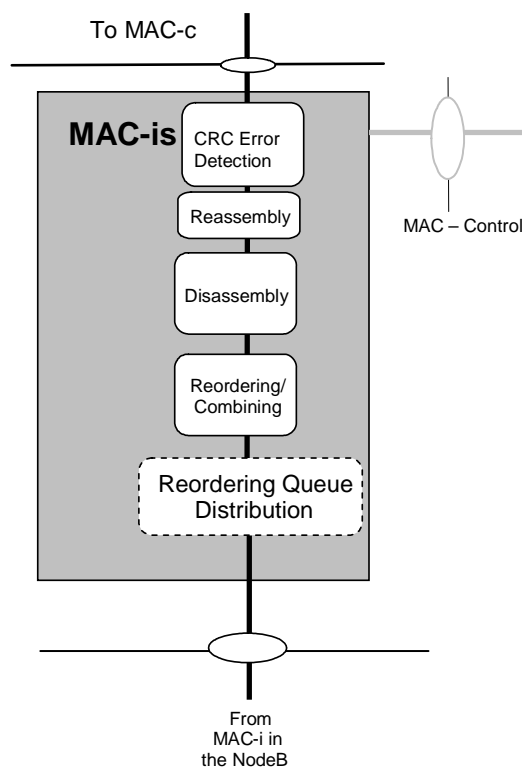


Figure 4.2.4.7-2: UTRAN side MAC architecture / MAC-is details (TDD)



**Figure 4.2.4.7-3: UTRAN side MAC architecture / MAC-is details (for CCCH transmission, FDD and 1.28 Mcps TDD only)**

#### 4.2.4.8 MAC-i entity – UTRAN Side

For TDD, and for FDD in CELL\_DCH, there is one MAC-i entity in the Node B for each UE. For FDD, there is one MAC-i entity in the Node B for each common E-DCH resource. For 1.28 Mcps TDD in CELL-FACH state, there is one MAC-i entity in the Node B for each UE with dedicated E-RNTI, and one MAC-i entity in the Node B for each common E-RNTI. And there is one E-DCH scheduler function in the Node-B. When configured by the upper layers, the MAC-i and E-DCH scheduler handle HSUPA specific functions in the Node B. In the model below, the MAC-i and E-DCH scheduler comprises the following entities:

- E-DCH Scheduling:  
This function manages E-DCH cell resources between UEs. Based on scheduling requests, Scheduling Grants are determined and transmitted. The general principles of the E-DCH scheduling are described in subclauses 11.8.2.3 and 11.9.2.3 below. However implementation is not specified (i.e. depends on RRM strategy).
- E-DCH Control:  
The E-DCH control entity is responsible for reception of scheduling requests and transmission of Scheduling Grants. In FDD, for UEs in CELL\_FACH state and Idle mode, the E-DCH control entity is additionally responsible for collision resolution and common E-DCH resource release by transmitting Scheduling Grants. The general principles of the E-DCH scheduling are described in subclauses 11.8.2.3 and 11.9.2.3 below.
- De-multiplexing:  
This function provides de-multiplexing of MAC-i PDUs. For DTCH/DCCH transmission, MAC-is PDUs are forwarded to the associated MAC-d flow. For CCCH transmission (FDD and 1.28 Mcps TDD only), MAC-is PDUs are forwarded to the associated UL Common MAC flow.
- Read UE id (FDD only):  
In CELL\_DCH state, no UE ID is included in the MAC-PDU header.  
In CELL\_FACH, the E-RNTI is added in all MAC-i PDUs for DTCH and DCCH transmission at the UE side until the UE receives an E-AGCH with its E-RNTI (through an E-RNTI-specific CRC attachment).  
In CELL\_FACH state and in Idle mode, CCCH data can be transmitted only as no E-RNTI has been added in the MAC-i PDU for transmission from the UE.
- HARQ:



One HARQ entity is capable of supporting multiple instances (HARQ processes) of stop and wait HARQ protocols. Each process is responsible for generating ACKs or NACKs indicating delivery status of E-DCH transmissions. The HARQ entity handles all tasks that are required for the HARQ protocol.

The associated signalling shown in the figures illustrates the exchange of information between layer 1 and layer 2 provided by primitives.

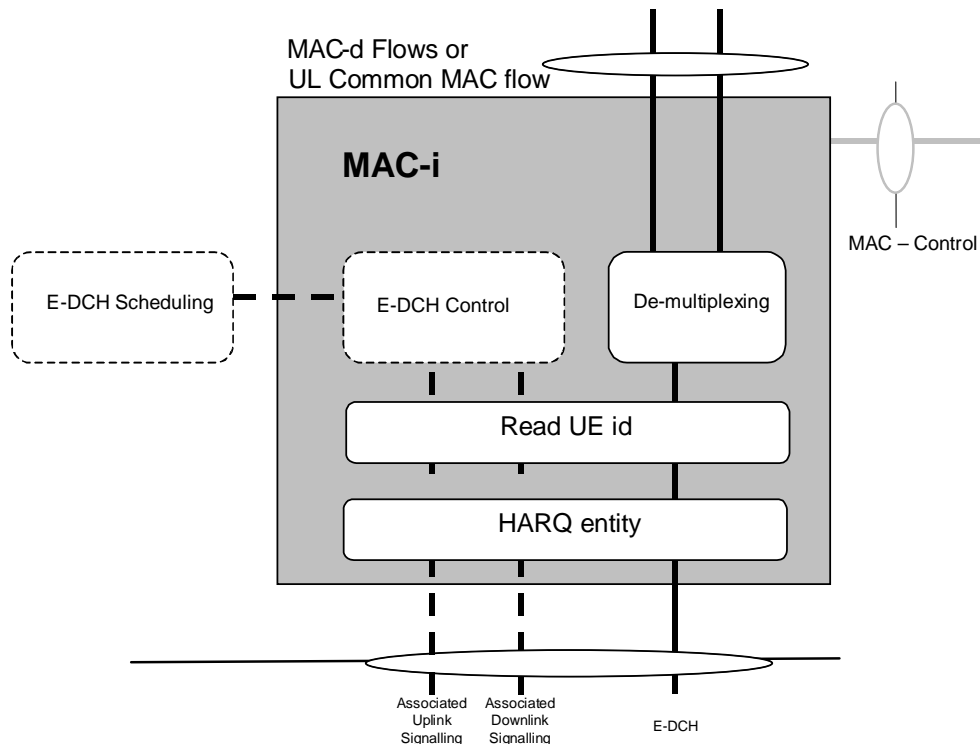


Figure 4.2.4.8-1: UTRAN side MAC architecture / MAC-i details (FDD)

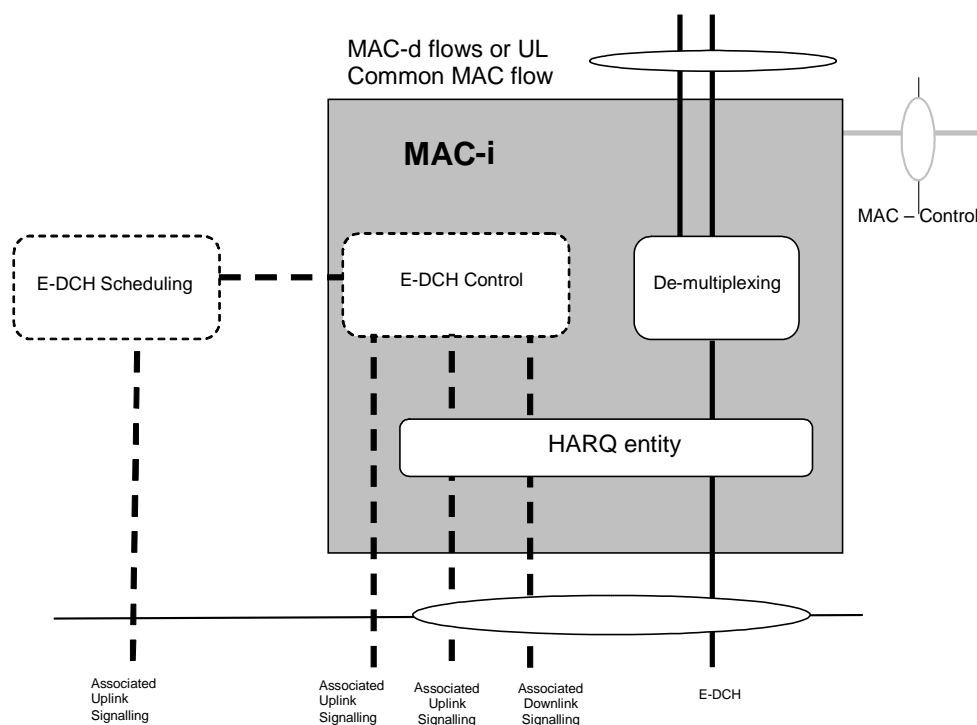


Figure 4.2.4.8-2: UTRAN side MAC architecture / MAC-i details (TDD)

## 4.3 Channel structure

The MAC operates on the channels defined below; the transport channels are described between MAC and Layer 1, the logical channels are described between MAC and RLC.

The following subclauses provide an overview, the normative description can be found in [2] and [3] respectively.

### 4.3.1 Transport channels

Common transport channel types are:

- Random Access Channel(s) (RACH);
- Forward Access Channel(s) (FACH);
- Downlink Shared Channel(s) (DSCH), for TDD operation only;
- High Speed Downlink Shared Channel(s) (HS-DSCH);
- Uplink Shared Channel(s) (USCH), for TDD operation only;
- Broadcast Channel (BCH);
- Paging Channel (PCH);
- Enhanced Dedicated Channel (E-DCH) for UL operation only (FDD and 1.28 Mcps TDD only).

Dedicated transport channel types are:

- Dedicated Channel (DCH);
- Enhanced Dedicated Channel (E-DCH) for UL operation only.

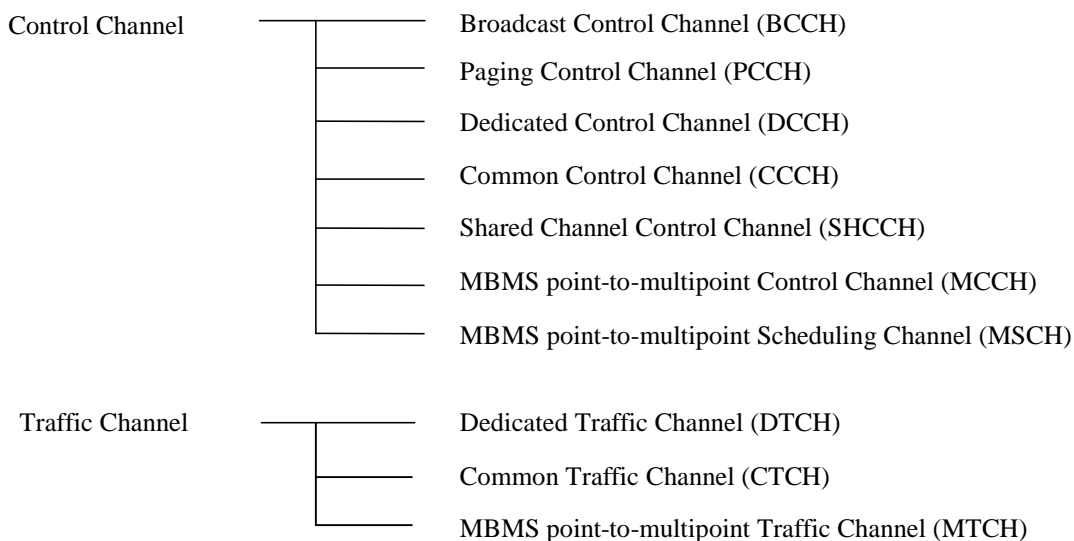
## 4.3.2 Logical Channels

The MAC layer provides data transfer services on logical channels. A set of logical channel types is defined for different kinds of data transfer services as offered by MAC.

Each logical channel type is defined by what type of information is transferred.

### 4.3.2.1 Logical channel structure

The configuration of logical channel types is depicted in figure 4.3.2.1.



**Figure 4.3.2.1: Logical channel structure**

### 4.3.2.2 Control Channels

Following control channels are used for transfer of control plane information only:

- Broadcast Control Channel (BCCH);
- Paging Control Channel (PCCH);
- Common Control Channel (CCCH);
- Dedicated Control Channel (DCCH);
- Shared Channel Control Channel (SHCCH);
- MBMS point-to-multipoint Control Channel (MCCH);
- MBMS point-to-multipoint Scheduling Channel (MSCH)

### 4.3.2.3 Traffic Channels

Following traffic channels are used for the transfer of user plane information only:

- Dedicated Traffic Channel (DTCH);
- Common Traffic Channel (CTCH);
- MBMS point-to-multipoint Traffic Channel (MTCH).

---

## 5 Services provided to upper layers

This clause describes the different services provided by the MAC to higher layers. For a detailed description of the following functions see [2].

### 5.1 Description of Services provided to upper layers

- Data transfer: This service provides unacknowledged transfer of MAC SDUs between peer MAC entities without data segmentation.
- Reallocation of radio resources and MAC parameters: This service performs on request of RRC execution of radio resource reallocation and change of MAC parameters.
- Reporting of measurements: Local measurements are reported to RRC.

---

## 6 Functions

### 6.1 Description of the MAC functions

The functions of MAC include:

- mapping between logical channels and transport channels;
- selection of appropriate Transport Format for each Transport Channel depending on instantaneous source rate;
- priority handling between data flows of one UE;
- priority handling between UEs by means of dynamic scheduling;
- identification of UEs on common transport channels;
- identification of MBMS services on common transport channels;
- multiplexing/demultiplexing of upper layer PDUs into/from transport blocks delivered to/from the physical layer on common transport channels;
- multiplexing/demultiplexing of upper layer PDUs into/from transport block sets delivered to/from the physical layer on dedicated transport channels;
- segmentation and reassembly of upper layer PDUs
- traffic volume measurement;
- Transport Channel type switching;
- ciphering for transparent mode RLC;
- Access Service Class selection for RACH transmission;
- control of HS-DSCH transmission and reception including support of HARQ;
- HS-DSCH Provided Bit Rate measurement;
- control of E-DCH transmission and reception including support of HARQ;
- generation of uplink scheduling information to assist with E-DCH resource allocation;
- E-DCH Provided Bit-rate measurement.

## 6.2 Relation between MAC Functions and Transport Channels

### 6.2.1 Relation between MAC Functions and Transport Channels in UTRAN

Table 6.2.1.1: UTRAN MAC functions corresponding to the transport channel

| Associated MAC Functions | Logical Ch | Transport Ch | TF Selection | Priority handling between UEs | Priority handling (one UE) | Scheduling | Identification of UEs or MBMS services | Mux/Demux on common transport channels | Mux/Demux on dedicated transport channels | HARQ support | Segmentation | CRC detection |
|--------------------------|------------|--------------|--------------|-------------------------------|----------------------------|------------|----------------------------------------|----------------------------------------|-------------------------------------------|--------------|--------------|---------------|
| Uplink (Rx)              | CCCH       | RACH         |              |                               |                            |            |                                        | X                                      |                                           |              |              |               |
|                          | CCCH       | E-DCH        |              |                               |                            |            |                                        | X                                      |                                           | X            | X            | X             |
|                          | DCCH       | RACH         |              |                               |                            |            | X                                      | X                                      |                                           |              |              |               |
|                          | DCCH       | DCH          |              |                               |                            |            |                                        |                                        | X                                         |              |              |               |
|                          | DTCH       | RACH         |              |                               |                            |            | X                                      | X                                      |                                           |              |              |               |
|                          | DTCH       | DCH          |              |                               |                            |            |                                        |                                        | X                                         |              |              |               |
|                          | SHCCH      | RACH         |              |                               |                            |            | X                                      | X                                      |                                           |              |              |               |
|                          | SHCCH      | USCH         |              |                               |                            |            |                                        | X                                      |                                           |              |              |               |
|                          | DTCH       | USCH         |              |                               |                            |            |                                        | X                                      |                                           |              |              |               |
|                          | DCCH       | USCH         |              |                               |                            |            |                                        | X                                      |                                           |              |              |               |
| Downlink (Tx)            | DTCH       | E-DCH        |              |                               |                            | X          |                                        |                                        | X                                         | X            | X            |               |
|                          | DCCH       | E-DCH        |              |                               |                            | X          |                                        |                                        | X                                         | X            | X            |               |
|                          | BCCH       | BCH          |              |                               |                            | X          |                                        |                                        |                                           |              |              |               |
|                          | BCCH       | FACH         | X            |                               |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | BCCH       | HS-DSCH      | X (1)        |                               |                            | X          |                                        | X                                      |                                           | X            | (2)          |               |
|                          | PCCH       | PCH          | X            |                               |                            | X          |                                        |                                        |                                           |              |              |               |
|                          | PCCH       | HS-DSCH      | X (1)        |                               |                            | X          |                                        | X                                      |                                           | X            | (2)          |               |
|                          | CCCH       | FACH         | X            | X                             |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | CCCH       | HS-DSCH      | X (1)        |                               |                            | X          |                                        | X                                      |                                           | X            | X            |               |
|                          | CTCH       | FACH         | X            |                               |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | MCCH       | FACH         | X            |                               |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | MSCH       | FACH         | X            |                               |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | MTCH       | FACH         | X            |                               |                            | X          | X                                      | X                                      |                                           |              |              |               |
|                          | CTCH       | FACH         | X            |                               |                            | X          |                                        | X                                      |                                           |              |              |               |
|                          | DCCH       | FACH         | X            | X                             |                            | X          | X                                      | X                                      |                                           |              |              |               |
|                          | DCCH       | DSCH         | X            | X                             |                            |            | X                                      | X                                      |                                           |              |              |               |
|                          | DCCH       | DCH          | X            |                               | X                          |            |                                        |                                        | X                                         |              |              |               |
|                          | DCCH       | HS-DSCH      | X (1)        | X                             | X                          | X          | X                                      | X                                      |                                           | X            | X            |               |
|                          | DTCH       | FACH         | X            | X                             |                            | X          | X                                      | X                                      |                                           |              |              |               |
|                          | DTCH       | DSCH         | X            | X                             |                            |            | X                                      | X                                      |                                           |              |              |               |
| DTCH                     | DCH        | X            |              | X                             |                            |            |                                        | X                                      |                                           |              |              |               |
| DTCH                     | HS-DSCH    | X (1)        | X            | X                             | X                          | X          | X                                      |                                        | X                                         | X            |              |               |
| SHCCH                    | FACH       | X            | X            |                               | X                          |            | X                                      |                                        |                                           |              |              |               |
| SHCCH                    | DSCH       | X            | X            |                               |                            |            | X                                      |                                        |                                           |              |              |               |

NOTE 1: In case of HS-DSCH the TF selection is replaced by TFRC selection.

NOTE 2: The UTRAN should not perform MAC-ehs segmentation for MAC-ehs SDUs from BCCH and PCCH logical channels.

## 6.2.2 Relation of MAC Functions and Transport Channels in UE

Table 6.2.2.1: UE MAC functions corresponding to the transport channel

| Associated MAC Functions | Logical Ch | Transport Ch | TF Selection | Priority handling (one UE) | Identification | Mux/Demux on common transport channels | Mux/Demux on dedicated transport channels | HARQ support | Segmentation | CRC attachment |
|--------------------------|------------|--------------|--------------|----------------------------|----------------|----------------------------------------|-------------------------------------------|--------------|--------------|----------------|
| Uplink (Tx)              | CCCH       | RACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | CCCH       | E-DCH        | X            |                            |                | X                                      |                                           | X            | X            | X              |
|                          | DCCH       | RACH         | X            | X                          | X              | X                                      |                                           |              |              |                |
|                          | DCCH       | DCH          | X            | X                          |                |                                        | X                                         |              |              |                |
|                          | DTCH       | RACH         | X            | X                          | X              | X                                      |                                           |              |              |                |
|                          | DTCH       | DCH          | X            | X                          |                |                                        | X                                         |              |              |                |
|                          | SHCCH      | RACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | SHCCH      | USCH         | X            | X                          |                | X                                      |                                           |              |              |                |
|                          | DCCH       | USCH         | X            | X                          |                | X                                      |                                           |              |              |                |
|                          | DTCH       | USCH         | X            | X                          |                | X                                      |                                           |              |              |                |
|                          | DCCH       | E-DCH        | X            | X                          |                |                                        | X                                         | X            | X            | X              |
| DTCH                     | E-DCH      | X            | X            |                            |                | X                                      | X                                         | X            | X            |                |
| Downlink (Rx)            | BCCH       | BCH          |              |                            |                |                                        |                                           |              |              |                |
|                          | BCCH       | FACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | BCCH       | HS-DSCH      |              |                            |                | X                                      |                                           | X            |              |                |
|                          | PCCH       | PCH          |              |                            |                |                                        |                                           |              |              |                |
|                          | PCCH       | HS-DSCH      |              |                            |                | X                                      |                                           | X            |              |                |
|                          | CCCH       | FACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | CCCH       | HS-DSCH      |              |                            |                | X                                      |                                           | X            | X            |                |
|                          | CTCH       | FACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | MCCH       | FACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | MSCH       | FACH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | MTCH       | FACH         |              |                            | X              | X                                      |                                           |              |              |                |
|                          | DCCH       | FACH         |              |                            | X              | X                                      |                                           |              |              |                |
|                          | DCCH       | DSCH         |              |                            |                | X                                      |                                           |              |              |                |
|                          | DCCH       | DCH          |              |                            |                |                                        | X                                         |              |              |                |
|                          | DCCH       | HS-DSCH      |              |                            | X              | X                                      |                                           | X            | X            |                |
|                          | DTCH       | FACH         |              |                            | X              | X                                      |                                           |              |              |                |
|                          | DTCH       | DSCH         |              |                            |                | X                                      |                                           |              |              |                |
| DTCH                     | DCH        |              |              |                            |                | X                                      |                                           |              |              |                |
| DTCH                     | HS-DSCH    |              |              | X                          | X              |                                        | X                                         | X            |              |                |
| SHCCH                    | FACH       |              |              |                            | X              |                                        |                                           |              |              |                |
| SHCCH                    | DSCH       |              |              |                            | X              |                                        |                                           |              |              |                |

## 7 Services expected from physical layer

The physical layer offers information transfer services to MAC. For detailed description, see [3].

## 8 Elements for layer-to-layer communication

The interaction between the MAC layer and other layers are described in terms of primitives where the primitives represent the logical exchange of information and control between the MAC layer and other layers. The primitives shall not specify or constrain implementations. The MAC is connected to layer 1, RLC and RRC. The following subclauses describe the primitives between these layers.

## 8.1 Primitives between layers 1 and 2

### 8.1.1 Primitives

The primitives are described in [3].

### 8.1.2 Parameters

- a) Transport Format Resource Indicator (TFRI) for HS-DSCH:
  - For HS-DSCH the Transport Block size is derived from the TFRI value signalled on the HS-SCCH. The mapping between TFRI value and Transport Block size is specified in subclause 9.2.3.
- b) HARQ information for E-DCH:
  - ACK/NACK information (details specified in subclause 9.2.5.1).
  - RSN information (details specified in subclause 9.2.5.1).
  - Power offset (details specified in subclauses 11.8.1.4 and 11.9.1.4).
  - E-TFCI (details specified in subclauses 11.8.1.4 and 11.9.1.4).
- c) Relative Grant information for E-DCH (FDD only):
  - Serving Relative Grant information (details specified in subclause 9.2.5.2.1).
  - Non-serving Relative Grant information (details specified in subclause 9.2.5.2.1).
- d) Absolute Grant information for E-DCH (details specified in subclause 9.2.5.2.2 for FDD and in 9.2.6.2.1 for TDD).
  - Identity Type for E-DCH (FDD only).
  - Absolute Grant Value.
  - Absolute Grant Scope (FDD only).
  - Absolute Grant Code Resource (TDD only)
  - Absolute Grant Timeslot Resource (TDD only)
  - Absolute Grant Resource Duration (TDD only)
  - E-HICH Indicator (1.28 Mcps TDD only)
  - E-UCCH Number Indicator (1.28 Mcps TDD only)
- e) Happy Bit (FDD only, details specified in subclause 9.2.5.2.2).
- f) Synchronization Command ( 1.28 Mcps TDD only, details specified in subclause 11.6.3.1).

## 8.2 Primitives between MAC and RLC

### 8.2.1 Primitives

The primitives between MAC layer and RLC layer are shown in table 8.2.1.1.

**Table 8.2.1.1: Primitives between MAC layer and RLC layer**

| Generic Name      | Parameter                                       |                                          |                     |         |
|-------------------|-------------------------------------------------|------------------------------------------|---------------------|---------|
|                   | Request                                         | Indication                               | Response            | Confirm |
| <b>MAC-DATA</b>   | Data, BO, UE-ID type indicator, RLC Entity Info | Data, No_TB, TD (note), Error indication |                     |         |
| <b>MAC-STATUS</b> |                                                 | No_PDU, PDU_Size, TX status              | BO, RLC Entity Info |         |
| NOTE: TDD only.   |                                                 |                                          |                     |         |

**MAC-DATA-Req/Ind:**

- MAC-DATA-Req primitive is used to request that an upper layer PDU be sent using the procedures for the information transfer service;
- MAC-DATA-Ind primitive indicates the arrival of upper layer PDUs received within one transmission time interval by means of the information transfer service.

**MAC-STATUS-Ind/Resp:**

- MAC-STATUS-Ind primitive indicates to RLC for each logical channel the rate at which it may transfer data to MAC. Parameters are the number of PDUs that can be transferred in each transmission time interval and the PDU size; it is possible that MAC would use this primitive to indicate that it expects the current buffer occupancy of the addressed logical channel in order to provide for optimised TFC selection on transport channels with long transmission time interval. At the UE, MAC-STATUS-Ind primitive is also used to indicate from MAC to RLC that MAC has requested data transmission by PHY (i.e. PHY-DATA-REQ has been submitted, see Fig. 11.2.2.1), or that transmission of an RLC PDU on RACH or that the common E-DCH resource acquisition of Enhanced Uplink in CELL\_FACH state or Idle mode has failed due to exceeded preamble ramping cycle counter.
- MAC-STATUS-Resp primitive enables RLC to acknowledge a MAC-STATUS-Ind. It is possible that RLC would use this primitive to indicate that it has nothing to send or that it is in a suspended state or to indicate the current buffer occupancy to MAC.

**8.2.2 Parameters**

## a) Data:

- it contains the RLC layer messages (RLC-PDU) to be transmitted, or the RLC layer messages that have been received by the MAC sub-layer.

## b) Number of transmitted transport blocks (No\_TB) :

- indicates the number of transport blocks transmitted by the peer entity within the transmission time interval, based on the TFI value.

## c) Buffer Occupancy (BO):

- the parameter Buffer Occupancy (BO) indicates for each logical channel the amount of data in number of bytes that is available for transmission and retransmission in RLC layer. When MAC is connected to an AM RLC entity, control PDUs to be transmitted and RLC PDUs outside the RLC Tx window shall also be included in the BO. RLC PDUs that have been transmitted but not negatively acknowledged by the peer entity shall not be included in the BO.

## d) RX Timing Deviation (TD), TDD only:

- it contains the RX Timing Deviation as measured by the physical layer for the physical resources carrying the data of the Message Unit. This parameter is optional and only for Indication. It is needed for the transfer of the RX Timing Deviation measurement of RACH transmissions carrying CCCH data to RRC.

## e) Number of PDU (No\_PDU):



- specifies the number of PDUs that the RLC is permitted to transfer to MAC within a transmission time interval.
- f) PDU Size (PDU\_Size):
- specifies the size of PDU that can be transferred to MAC within a transmission time interval.
- g) UE-ID Type Indicator:
- indicates the UE-ID type to be included in MAC for a DCCH and DTCH when they are mapped onto a common transport channel (i.e. FACH, RACH in FDD). On the UE side UE-ID Type Indicator shall always be set to C-RNTI.
- h) TX status:
- when set to value "transmission unsuccessful" this parameter indicates to RLC that transmission of an RLC PDU failed in the previous Transmission Time Interval, when set to value "transmission successful" this parameter indicates to RLC that the requested RLC PDU(s) has been submitted for transmission by the physical layer.
- i) RLC Entity Info
- indicates to MAC the configuration parameters that are critical to TFC selection depending on its mode and the amount of data that could be transmitted at the next TTI. This primitive is meant to insure that MAC can perform TFC selection (see subclause 11.4).
- j) Error indication
- When a MAC SDU is delivered to upper layer, an error indication is given for the SDU to upper layer if an error indication for the SDU has been received from lower layer.
- k) (Void)

## 8.3 Primitives between MAC and RRC

### 8.3.1 Primitives

The primitives between MAC and RRC are shown in table 8.3.1.1.

**Table 8.3.1.1: Primitives between MAC sub-layer and RRC**

| Generic Name            | Parameter                                                                                                                                                                                                      |                                                                                                                                                 |          |         |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------|
|                         | Request                                                                                                                                                                                                        | Indication                                                                                                                                      | Response | Confirm |
| <b>CMAC-CONFIG</b>      | UE information elements,<br>RB information elements,<br>TrCH information elements,<br>RACH transmission control elements,<br>Ciphering elements,<br>MBMS information elements,<br>E-DCH configuration elements |                                                                                                                                                 |          |         |
| <b>CMAC-MEASUREMENT</b> | Measurement information elements                                                                                                                                                                               | Measurement result                                                                                                                              |          |         |
| <b>CMAC-STATUS</b>      |                                                                                                                                                                                                                | Status info,<br>E-DCH resource index, Enhanced Uplink in CELL_FACH and Idle mode process termination,<br>E-RUCCH failure(only for 1.28Mcps TDD) |          |         |

**CMAC-CONFIG-Req:**

- CMAC-CONFIG-Req is used to request for setup, release and configuration of a logical channel, e.g. RNTI allocation, switching the connection between logical channels and transport channels, TFCS update or scheduling priority of logical channel.

**CMAC-MEASUREMENT-Req/Ind:**

- CMAC-MEASUREMENT-Req is used by RRC to request MAC to perform measurements, e.g. traffic volume measurements;
- CMAC-MEASUREMENT-Ind is used to notify RRC of the measurement result.

**CMAC-STATUS-Ind:**

- CMAC-STATUS-Ind primitive notifies RRC of status information.

## 8.3.2 Parameters

See [7] for a detailed description of the UE, RB and TrCH information elements.

- a) UE information elements
  - S-RNTI
  - SRNC identity
  - C-RNTI
  - Activation time
  - Primary E-RNTI configured
  - Secondary E-RNTI configured
- b) RB information elements
  - RB multiplexing info (Transport channel identity, Logical channel identity, MAC logical channel priority)
  - DDI mapping table for E-DCH transmission
  - Indication whether the Logical channel is considered when the Scheduling Information is generated
- c) TrCH information elements
  - Transport Format Combination Set
  - MAC-hs/ehs reset indicator
  - MAC-es/e/i/is reset indicator
  - Re-ordering release timer (T1)
  - HARQ Profile parameters (power offset, maximum number of re-transmissions and for 1.28 Mcps TDD retransmission timer)
  - E-DCH TTI duration (FDD only)
  - Allowed combinations for multiplexing of MAC-d flows into MAC-e/i PDUs or MAC-i PDUs
  - E-DCH grant type of MAC-d flows (scheduled or non-scheduled)
  - List of HARQ processes on which non-scheduled grants are allowed (for FDD only, this is if the grant type is non-scheduled and the E-DCH TTI duration is 2ms)
- d) Measurement information elements
  - Reporting Quantity identifiers
  - Time interval to take an average or a variance (applicable when Average or Variance is Reporting Quantity)
- e) Measurement result
  - Reporting Quantity
- f) Status info
  - when set to value "transmission unsuccessful" this parameter indicates to RRC that transmission of a TM RLC PDU failed (due to e.g. Maximum number of preamble ramping cycles reached for RACH in FDD), when set to value "transmission successful" this parameter indicates to RRC that the requested TM RLC PDU(s) has been submitted for transmission by the physical layer.
- g) RACH transmission control
  - Set of ASC parameters (identifier for PRACH partitions, persistence values)
  - Maximum number of preamble ramping cycles (FDD) or synchronisation attempts (1.28 Mcps TDD)  $M_{\max}$
  - Minimum and maximum number of time units between two preamble ramping cycles,  $N_{\text{BO1min}}$  and  $N_{\text{BO1max}}$  (FDD)

only)

ASC for RRC CONNECTION REQUEST message

Type of random access procedure (1.28 Mcps only)

Enhanced Uplink in CELL\_FACH and Idle mode support indicator (FDD and 1.28 Mcps TDD only)

h) Ciphering elements

Ciphering mode

Ciphering key

Ciphering sequence number

i) (Void)

j) MBMS information elements

MBMS Id

k) E-DCH configuration elements

E-DPCCH to DPCCH power offset (FDD only)

Happy bit delay condition (FDD only)

E-TFCI table index

minimum set E-TFCI (FDD only)

Reference E-TFCI (FDD only)

Periodicities for Scheduling Information with and without grant (FDD only)

The code, timeslots and maximum power available per TDD resource unit per slot in TTIs designated for non-scheduled use by a given UE (TDD only)

The frames designated for non-scheduled use by a given UE (specified by means of a start frame number, repetition period and repetition length) (3.84/7.68 Mcps TDD only)

The subframes designated for non-scheduled use by a given UE (specified by means of a start subframe number, repetition period and repetition length) (1.28 Mcps TDD only)

Scheduling Information power offset

List of HARQ processes on which scheduled grants are allowed (for FDD only, this is if the E-DCH TTI duration is 2ms)

Initial Serving Grant value and type (FDD only)

E-DCH maximum and minimum allowed coderates (3.84/7.68 Mcps TDD only)

A table of paired values, each pair consists of ENI value and E-DCH maximum allowed and minimum allowed coderates (1.28 Mcps TDD only)

A table of paired values, each pair consists of code rate and  $\beta$  normative value (TDD only).

Parameters controlling E-RUCCH operation, such as T-RUCCH, T-SCHED, and a set of persistence values (one for each ASC) associated with E-RUCCH (3.84/7.68 Mcps TDD only)

Symbol offset  $S_{\text{offset}}$  (FDD only in CELL\_FACH state and Idle mode)

Additional E-DCH transmission back off (FDD only in CELL\_FACH state or Idle mode)

E-DCH transmission continuation back off (FDD only in CELL\_FACH state or Idle mode)

Maximum period for collision resolution phase (FDD only in CELL\_FACH state and Idle mode)

Maximum E-DCH resource allocation for CCCH (FDD only in CELL\_FACH state and Idle mode)

Parameters controlling E-RUCCH operation, such as T-RUCCH, N-RUCCH, T-WAIT, T-SI associated with E-RUCCH (1.28 Mcps TDD only)

Common E-RNTIs list for CCCH transmission (1.28 Mcps TDD only in CELL\_FACH state and Idle mode)

l) DTX-DRX and HS-SCCH less Information Elements (FDD only)

MAC DTX Cycle

MAC Inactivity Threshold

UE DTX DRX Offset

HS-SCCH less mode of operation

Inactivity Threshold for UE Grant Monitoring

Inactivity Threshold for UE DTX cycle 2

Default SG in DTX Cycle 2

m) E-DCH resource index (FDD only).

n) Enhanced Uplink in CELL\_FACH and Idle mode process termination (FDD only)

o) Cell Reselection Indication process termination (1.28 Mcps TDD only)

p) E-RUCCH failure(only for 1.28Mcps TDD)

## 9 Elements for peer-to-peer communication

### 9.1 Protocol data units

#### 9.1.1 General

A MAC PDU is a bit string, with a length not necessarily a multiple of 8 bits. In the drawings in clause 9.1, bit strings are represented by tables in which the first bit is the leftmost one on the first line of the table, the last bit is the rightmost on the last line of the table, and more generally the bit string is to be read from left to right and then in the reading order of the lines.

Depending on the provided service, MAC SDUs are bit strings with any non-null length, or bit strings with an integer number of octets in length. An SDU is included into a MAC PDU from first bit onward.

In the UE for the uplink, all MAC PDUs delivered to the physical layer within one TTI are defined as Transport Block Set (TBS). It consists of one or several Transport Blocks, each containing one MAC PDU. The Transport Blocks, shall be transmitted in the order as delivered from RLC. When multiplexing of RLC PDUs from different logical channels is performed on MAC, the order of all Transport Blocks originating from the same logical channel shall be the same as the order of the sequence delivered from RLC. The order of the different logical channels in a TBS is set by the MAC protocol.

#### 9.1.2 MAC PDU (not HS-DSCH or E-DCH)

A MAC PDU consists of an optional MAC header and a MAC Service Data Unit (MAC SDU), see figure 9.1.2.1. Both the MAC header and the MAC SDU are of variable size.

The content and the size of the MAC header depends on the type of the logical channel, and in some cases none of the parameters in the MAC header are needed.

The size of the MAC-SDU depends on the size of the RLC-PDU, which is defined during the setup procedure.

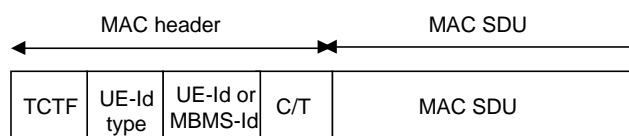


Figure 9.1.2.1: MAC PDU

#### 9.1.3 MAC-d PDU (HS-DSCH)

For HS-DSCH the MAC-d PDU format equals the MAC PDU format for the non HS-DSCH case.

#### 9.1.4 MAC PDU (HS-DSCH)

There are two different MAC PDU formats for HS-DSCH. Depending on configuration by higher layers the format is either MAC-hs or MAC-ehs. The MAC PDU format is determined by upper layer signalling [7].

When MAC-hs is configured, a MAC PDU for HS-DSCH consists of one MAC-hs header and one or more MAC-hs SDUs where each MAC-hs SDU equals a MAC-d PDU. A maximum of one MAC-hs PDU can be transmitted in a TTI per UE. The MAC-hs header is of variable size. The MAC-hs SDUs in one TTI belongs to the same reordering queue.

In 1.28 Mcps TDD multi-frequency HS-DSCH cell, TSN can be extended to 9bit as indicated by RRC signalling. When TSN is extended to 9bit, the 3 least significant bits are placed after the last MAC-hs SDU.

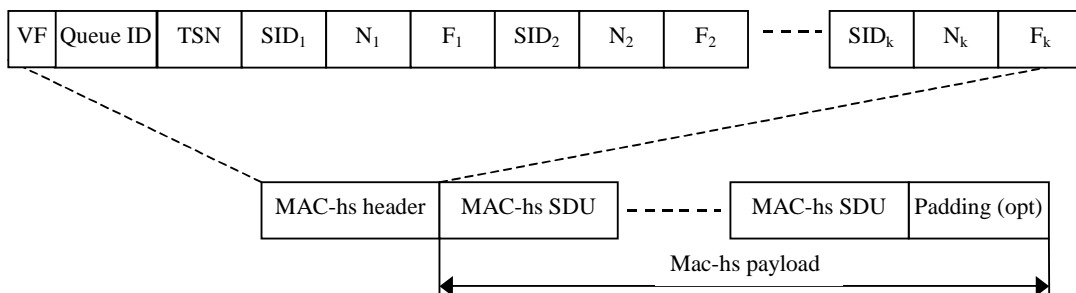


Figure 9.1.4.1: MAC-hs PDU

When MAC-ehs is configured, a MAC PDU for HS-DSCH consists of one MAC-ehs header and one or more reordering PDUs. Each reordering PDU consists of one or more reordering SDUs belonging to the same priority queue. All reordering SDUs belonging to the same priority queue in one TTI shall be mapped to the same reordering PDU. Each reordering SDU equals a complete MAC-ehs SDU or a segment of a MAC-ehs SDU. Each MAC-ehs SDU equals a MAC-d PDU or a MAC-c PDU (FDD only). The LCH-ID and L fields are repeated per reordering SDU. The TSN and SI fields are repeated per reordering PDU.

The presence of the  $TSN_i$  and  $SI_i$  fields is based on the value of the  $LCH-ID_i$ ; if the  $LCH-ID_i$  is mapped to the same reordering queue as  $LCH-ID_{i-1}$ , there is no  $TSN_i$  or  $SI_i$  field. The mapping of the LCH-ID to the reordering queue is provided by upper layers [7]. The  $TSN_i$  and  $SI_i$  fields are always present.

Depending on the HS-DSCH physical layer category, the maximum number of MAC-ehs PDUs that can be transmitted in a TTI per UE is one or two.

The reordering SDUs in one TTI can belong to different priority queues. The reordering SDUs in one TTI can belong to at most 3 priority queues. If reordering SDUs in one TTI belong to more than 3 priority queues or are in greater number than 26, the UE behaviour is unspecified. The MAC-ehs header is of variable size.

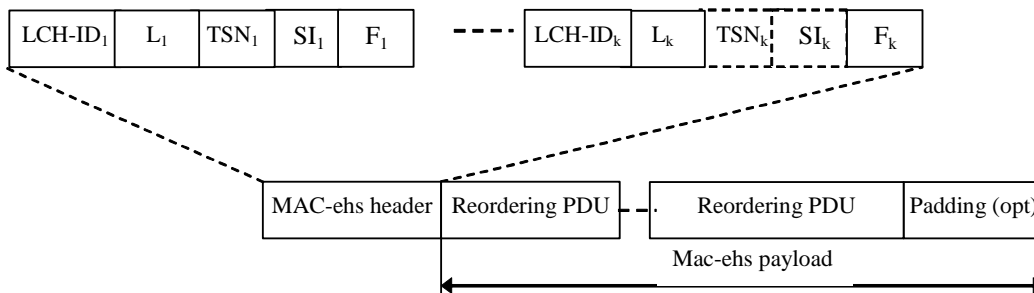


Figure 9.1.4.2: MAC-ehs PDU

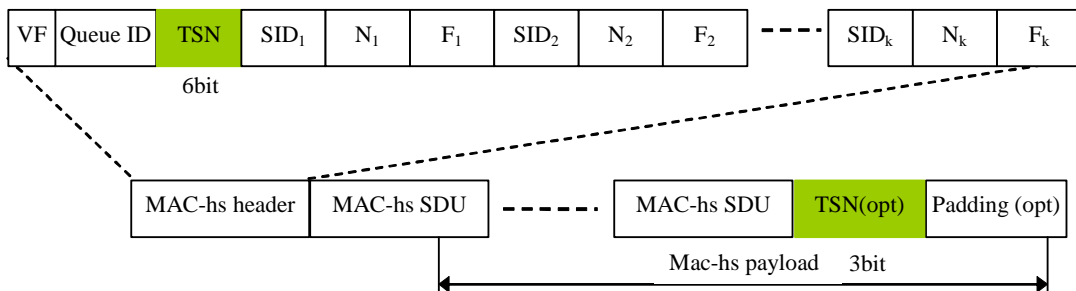


Figure 9.1.4.3: MAC-hs PDU (1.28Mcps TDD multi-frequency HS-DSCH operation mode only)

### 9.1.5 MAC PDU (E-DCH)

There are two different MAC PDU formats for E-DCH. Depending on configuration by upper layers the format is either MAC-e/es or MAC-i/is. The MAC PDU format is determined by upper layer signalling [7].

When MAC-e/es is configured, there are two MAC sublayers, MAC-e and MAC-es. MAC-es sits on top of MAC-e and receives PDUs directly from MAC-d. MAC-es SDUs (i.e. MAC-d PDUs) of the same size, coming from a particular logical channel are multiplexed together into a single MAC-es payload. There is one and only one MAC-es PDU per logical channel per TTI (since only one MAC-d PDU size is allowed per logical channel per TTI). To this payload is prepended the MAC-es header (see subclause 9.2.4.1). The number of PDUs, as well as the one DDI value identifying the logical channel, the MAC-d flow and the MAC-es SDU size are included as part of the MAC-e header. In case sufficient space is left in the E-DCH transport block or if Scheduling Information needs to be transmitted, an SI will be included at the end of the MAC-e PDU (see subclause 9.2.4.2). Multiple MAC-es PDUs from multiple logical channels, but only one MAC-e PDU can be transmitted in a TTI.

In the example MAC-e PDU shown in figure 9.1.5.2a, the field  $DDI_0$  is referring to the specific DDI value that indicates that there is an SI included in the MAC-e PDU (see subclause 9.2.4.2). This header will not be associated with a new MAC-es payload. Figure 9.1.5.2b shows the MAC-e PDU format when SI is sent alone. In this case  $DDI_0$  is not included in the MAC-e PDU and E-TFCI value 0 is used.

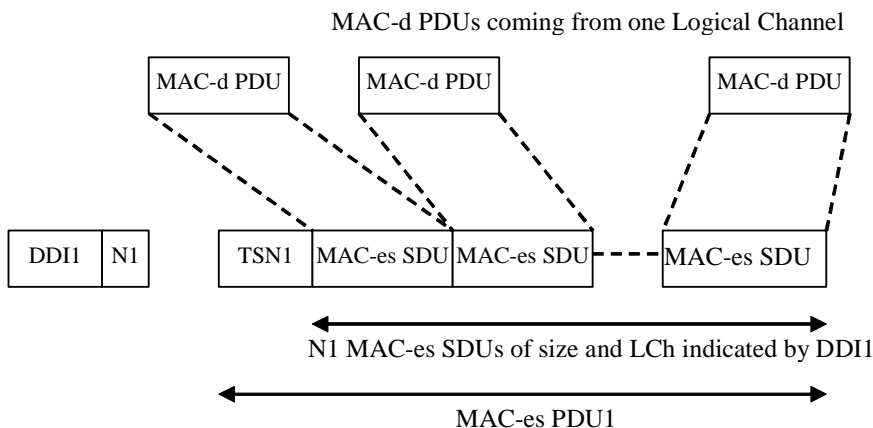


Figure 9.1.5.1 MAC-es PDU

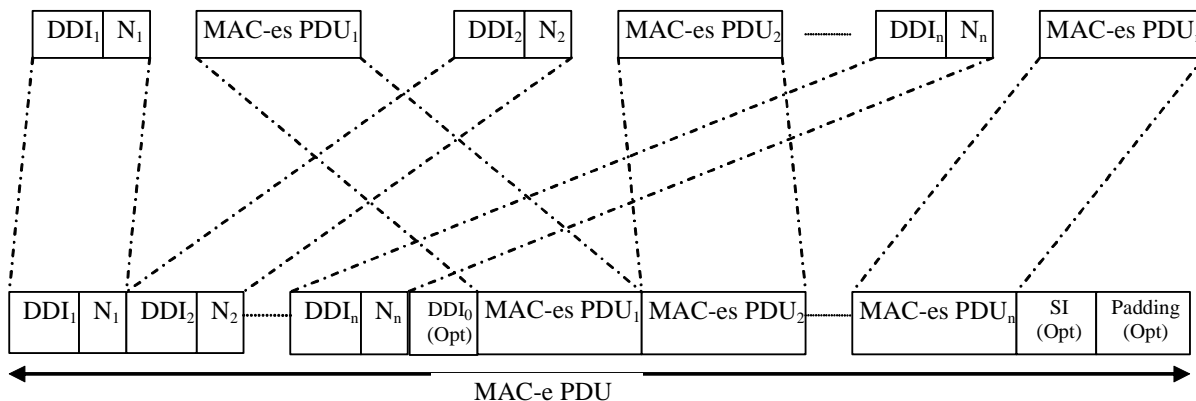


Figure 9.1.5.2a: MAC-e PDU

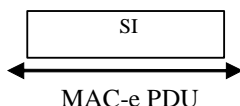


Figure 9.1.5.2b: MAC-e PDU (SI is sent alone)

When MAC-i/is is configured, there are two MAC sublayers, MAC-i and MAC-is. MAC-is sits on top of MAC-i and receives PDUs directly from MAC-d and MAC-c (FDD and 1.28 Mcps TDD only). When MAC-i/is is configured, a MAC PDU for E-DCH consists of one MAC-i header and one or more MAC-is PDUs. Each MAC-is PDU consists of one or more MAC-is SDUs belonging to the same logical channel. Each MAC-is SDU equals a complete or a segment of a MAC-d PDU or a MAC-c PDU (FDD and 1.28 Mcps TDD only). The MAC-is SDUs can have different sizes. The LCH-ID and L fields are repeated per MAC-is SDU. The TSN and SS fields are repeated per MAC-is PDU. Multiple MAC-is PDUs from multiple logical channels, but only one MAC-i PDU can be transmitted in a TTI. In case sufficient space is left in the E-DCH transport block or if Scheduling Information needs to be transmitted, an SI will be included at the end of the MAC-i PDU (see subclause 9.2.4.2). For FDD and in CELL\_FACH state only, the UE's E-RNTI can be included in the MAC-i header. Its inclusion is signalled with a reserved LCH-ID value.

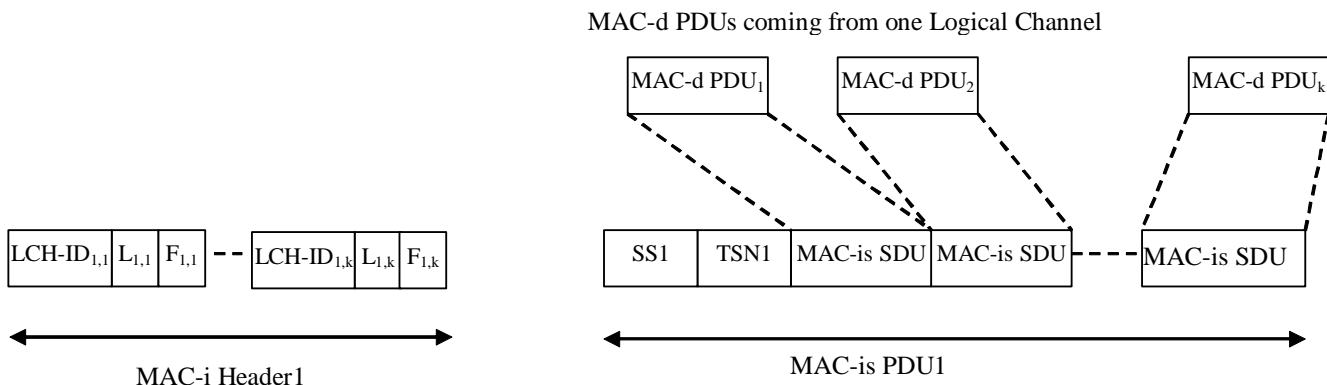


Figure 9.1.5.3 MAC-is PDU.

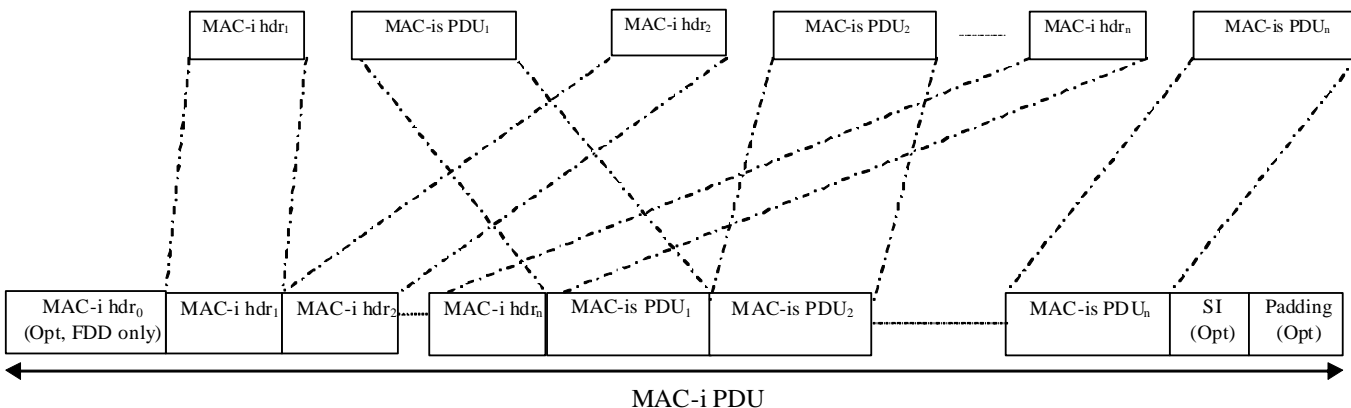
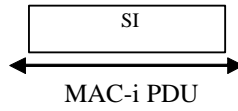
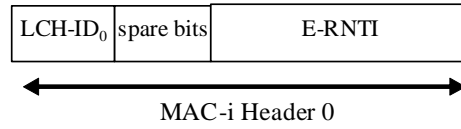


Figure 9.1.5.4a: MAC-i PDU.



**Figure 9.1.5.4b: MAC-i PDU (SI is sent alone)**



**Figure 9.1.5.4c: MAC-i header part for E-RNTI transmission (FDD only)**



**Figure 9.1.5.4d: MAC-c PDU with CRC for CCCH transmissions (FDD only)**



## 9.2 Formats and parameters

NOTE: MAC header field encodings as specified in this clause with designation "Reserved" are forbidden to be used by a sender in this version of the protocol.

### 9.2.1 MAC PDU: Parameters of the MAC PDU header (not HS-DSCH or E-DCH) and MAC-d PDU header (HS-DSCH and E-DCH)

The following fields are defined for the MAC header for transport channels other than HS-DSCH and for the MAC-d PDU header for HS-DSCH:

- Target Channel Type Field

The TCTF field is a flag that provides identification of the logical channel class on FACH, USCH (TDD only), DSCH (TDD only) and RACH transport channels, i.e. whether it carries BCCH, CCCH, CTCH, SHCCH, MCCH, MTCH, MSCH or dedicated logical channel information. The size and coding of TCTF for FDD and TDD are shown in tables 9.2.1.1, 9.2.1.2, 9.2.1.3, 9.2.1.4 and 9.2.1.5. Note that the size of the TCTF field of FACH for FDD is 2,4 or 8 bits and for TDD is either 3 or 5 bits depending on the value of the 3 most significant bits. The TCTF of the RACH for TDD is either 2 or 4 bits depending on the value of the 2 most significant bits.

**Table 9.2.1.1: Coding of the Target Channel Type Field on FACH for TDD**

| TCTF    | Designation                                                                                 |
|---------|---------------------------------------------------------------------------------------------|
| 000     | BCCH                                                                                        |
| 001     | CCCH                                                                                        |
| 010     | CTCH                                                                                        |
| 01100   | DCCH or DTCH<br>over FACH                                                                   |
| 01101   | MCCH                                                                                        |
| 01110   | MTCH                                                                                        |
| 01111   | MSCH                                                                                        |
| 100     | SHCCH                                                                                       |
| 101-111 | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |

**Table 9.2.1.2: Coding of the Target Channel Type Field on FACH for FDD**

| <b>TCTF</b>           | <b>Designation</b>                                                                          |
|-----------------------|---------------------------------------------------------------------------------------------|
| 00                    | BCCH                                                                                        |
| 01000000              | CCCH                                                                                        |
| 01000001-<br>01001111 | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |
| 01010000              | MCCH                                                                                        |
| 01010001-<br>01011110 | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |
| 01011111              | MSCH                                                                                        |
| 0110                  | MTCH                                                                                        |
| 0111                  | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |
| 10000000              | CTCH                                                                                        |
| 10000001-<br>10111111 | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |
| 11                    | DCCH or DTCH<br>over FACH                                                                   |

**Table 9.2.1.3: Coding of the Target Channel Type Field on USCH or DSCH (TDD only)**

| <b>TCTF</b> | <b>Designation</b>                |
|-------------|-----------------------------------|
| 0           | SHCCH                             |
| 1           | DCCH or DTCH over<br>USCH or DSCH |

**Table 9.2.1.4: Coding of the Target Channel Type Field on RACH for FDD**

| <b>TCTF</b> | <b>Designation</b>                                                                          |
|-------------|---------------------------------------------------------------------------------------------|
| 00          | CCCH                                                                                        |
| 01          | DCCH or DTCH<br>over RACH                                                                   |
| 10-11       | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |

**Table 9.2.1.5: Coding of the Target Channel Type Field on RACH for TDD**

| <b>TCTF</b>   | <b>Designation</b>                                                                          |
|---------------|---------------------------------------------------------------------------------------------|
| 00            | CCCH                                                                                        |
| 0100          | DCCH or DTCH<br>Over RACH                                                                   |
| 0101-<br>0111 | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |
| 10            | SHCCH                                                                                       |
| 11            | Reserved<br>(PDUs with this coding<br>will be discarded by this<br>version of the protocol) |

- C/T field

The C/T field provides identification of the logical channel instance when multiple logical channels are carried on the same transport channel (other than HS-DSCH) or same MAC-d flow (HS-DSCH). The C/T field is used also to provide identification of the logical channel type on dedicated transport channels and on FACH and RACH when used for user data transmission. The size of the C/T field is fixed to 4 bits for both common transport channels and dedicated transport channels. Table 9.2.1.5a shows the 4-bit C/T field.

**Table 9.2.1.5a: Structure of the C/T field**

| C/T field | Designation                                                                           |
|-----------|---------------------------------------------------------------------------------------|
| 0000      | Logical channel 1                                                                     |
| 0001      | Logical channel 2                                                                     |
| ...       | ...                                                                                   |
| 1110      | Logical channel 15                                                                    |
| 1111      | Reserved<br>(PDUs with this coding will be discarded by this version of the protocol) |

- UE-Id

The UE-Id field provides an identifier of the UE on common transport channels. The following types of UE-Id used on MAC are defined:

- UTRAN Radio Network Temporary Identity (U-RNTI) may be used in the MAC header of DCCH using RLC UM (SRB1), when mapped onto common transport channels in downlink direction; the U-RNTI is never used in uplink direction;
- Cell Radio Network Temporary Identity (C-RNTI) is used on DTCH and DCCH in uplink, and may be used on DCCH in downlink and is used on DTCH in downlink when mapped onto common transport channels, except when mapped onto DSCH transport channel in TDD;

**Table 9.2.1.6: Lengths of UE Id field**

| UE Id type | Length of UE Id field |
|------------|-----------------------|
| U-RNTI     | 32 bits               |
| C-RNTI     | 16 bits               |

- UE-Id Type

The UE-Id Type field is needed to ensure correct decoding of the UE-Id field in MAC Headers.

**Table 9.2.1.7: UE-Id Type field definition**

| UE-Id Type field 2 bits | UE-Id Type                                                                            |
|-------------------------|---------------------------------------------------------------------------------------|
| 00                      | U-RNTI                                                                                |
| 01                      | C-RNTI                                                                                |
| 10                      | Reserved<br>(PDUs with this coding will be discarded by this version of the protocol) |
| 11                      | Reserved<br>(PDUs with this coding will be discarded by this version of the protocol) |

- MBMS-Id

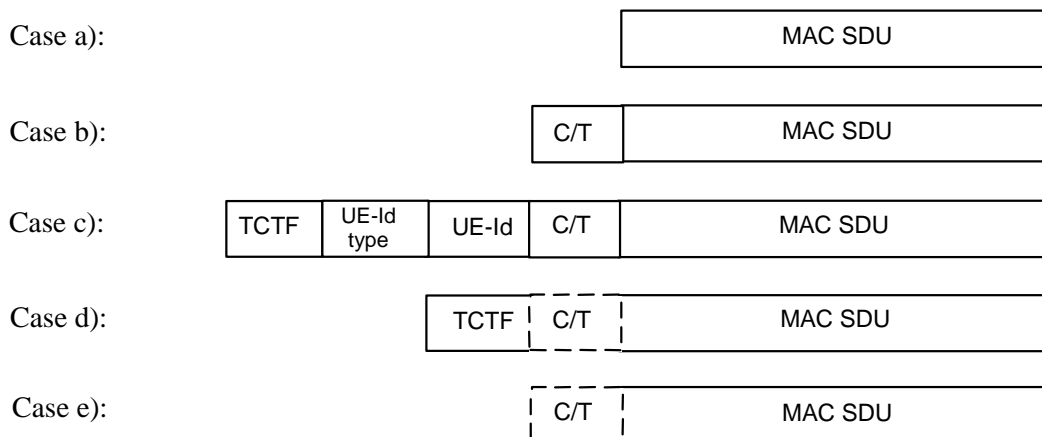
The MBMS-Id field provides an identifier of MTCH for an MBMS service carried on FACH. The MBMS-Id is used in the MAC header of MTCH mapped onto FACH in downlink direction; the MBMS-Id is never used in uplink direction. The MBMS Id to be used by MAC is configured through the MAC control SAP. The length of the MBMS-Id field is 4 bits. Table 9.2.1.7a shows the 4-bit MBMS-Id field.

**Table 9.2.1.8: Structure of the MBMS-Id field**

| MBMS-Id field | MBMS logical channel identity [7]                                                     |
|---------------|---------------------------------------------------------------------------------------|
| 0000          | 1                                                                                     |
| 0001          | 2                                                                                     |
| ...           | ...                                                                                   |
| 1110          | 15                                                                                    |
| 1111          | Reserved<br>(PDUs with this coding will be discarded by this version of the protocol) |

**9.2.1.1 MAC header for DTCH and DCCH (not mapped on HS-DSCH or E-DCH)**

- a) DTCH or DCCH mapped to DCH, no multiplexing of dedicated channels on MAC:
  - no MAC header is required.
- b) DTCH or DCCH mapped to DCH, with multiplexing of dedicated channels on MAC:
  - C/T field is included in MAC header.
- c) DTCH or DCCH mapped to RACH/FACH:
  - TCTF field, C/T field, UE-Id type field and UE-Id are included in the MAC header. For FACH, the UE-Id type field used is the C-RNTI or U-RNTI. For RACH, the UE-Id type field used is the C-RNTI.
- d) DTCH or DCCH mapped to DSCH or USCH:
  - the TCTF field is included in the MAC header. The C/T field is included if multiplexing on MAC is applied.
- e) DTCH or DCCH mapped to DSCH or USCH where DTCH or DCCH are the only logical channels:
  - The C/T field is included in the MAC header if multiplexing on MAC is applied.

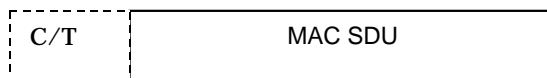


**Figure 9.2.1.1.1: MAC PDU formats for DTCH and DCCH**

**9.2.1.1a MAC-d Header for DTCH and DCCH (mapped on HS-DSCH)**

In CELL\_DCH state, the MAC-d PDU header for DTCH and DCCH mapped on HS-DSCH is as shown in figure 9.2.1.1a.1.

- C/T field is included in the MAC-d PDU header if multiplexing on MAC is applied.
- If MAC-ehs is configured by upper layers [7], no MAC-d PDU header is required.



**Figure 9.2.1.1a.1 MAC-d PDU format for DTCH and DCCH mapped on HS-DSCH**

### 9.2.1.1b MAC-d Header for DTCH and DCCH (mapped on E-DCH)

For DTCH and DCCH mapped on E-DCH there is no need for a MAC-d header. Therefore, the MAC-d PDU is as shown in figure 9.2.1.1b.1.

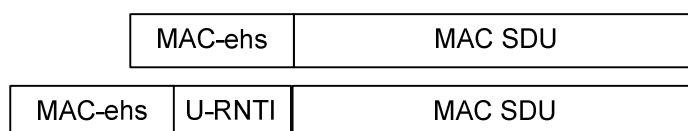


**Figure 9.2.1.1b.1 MAC-d PDU format for DTCH and DCCH mapped on E-DCH**

### 9.2.1.1c MAC Headers for DTCH and DCCH (mapped on HS-DSCH, FDD and 1.28 Mcps TDD only)

In FDD and 1.28 Mcps TDD, the MAC PDU header for DTCH and DCCH mapped on HS-DSCH CELL\_FACH, CELL\_PCH state is as shown in figure 9.2.1.1c-1.

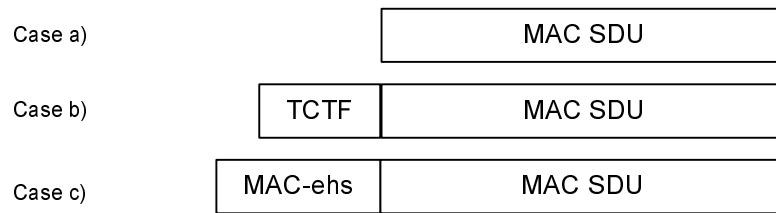
- there is no MAC-d header included for DTCH and DCCH.
- there is no MAC-c header included for DTCH and DCCH when UE dedicated H-RNTI is used.
- the U-RNTI is only included as MAC-c header to MAC-d PDU for DCCH (SRB#1 only) when common H-RNTI is used



**Figure 9.2.1.1c-1: MAC PDU format for DTCH and DCCH mapped on HS-DSCH (FDD and 1.28 Mcps TDD only)**

### 9.2.1.2 MAC header for BCCH

- BCCH mapped to BCH:
  - no MAC header is included.
- BCCH mapped to FACH:
  - the TCTF field is included in MAC header.
- in FDD and 1.28 Mcps TDD, when BCCH mapped to HS-DSCH
  - the MAC-ehs header is included.



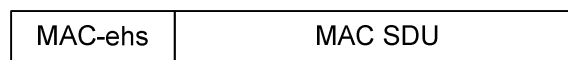
**Figure 9.2.1.2.1: MAC PDU formats for BCCH**

### 9.2.1.3 MAC header for PCCH

There is no MAC header for PCCH when mapped on PCH.

In FDD and 1.28 Mcps TDD when PCCH is mapped on HS-DSCH:

- the MAC-ehs header is included as depicted in Figure 9.2.1.3-1.



**Figure 9.2.1.3-1: MAC PDU format for PCCH (FDD and 1.28 Mcps TDD only)**

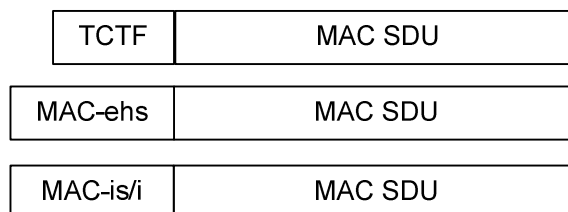
### 9.2.1.4 MAC header for CCCH

CCCH mapped to RACH/FACH:

- TCTF field is included in MAC header.

In FDD and 1.28 Mcps TDD, CCCH mapped to HS-DSCH and to E-DCH:

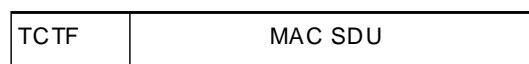
- no MAC-c header is included.



**Figure 9.2.1.4.1: MAC PDU formats for CCCH**

### 9.2.1.5 MAC Header for CTCH

The TCTF field is included as MAC header for CTCH as shown in figure 9.2.1.5.1.



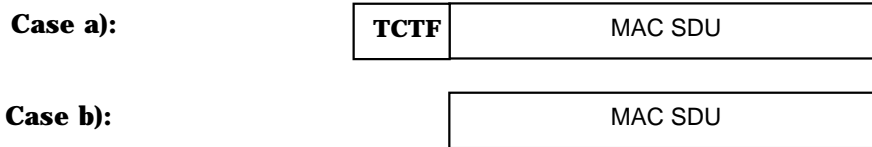
**Figure 9.2.1.5.1: MAC PDU format for CTCH**

### 9.2.1.6 MAC Header for SHCCH

The MAC header for SHCCH is as shown in figure 9.2.1.6.1.

- SHCCH mapped to RACH and USCH/FACH and DSCH:
  - TCTF has to be included.

b) SHCCH mapped to RACH and USCH/FACH and DSCH, where SHCCH is the only channel.



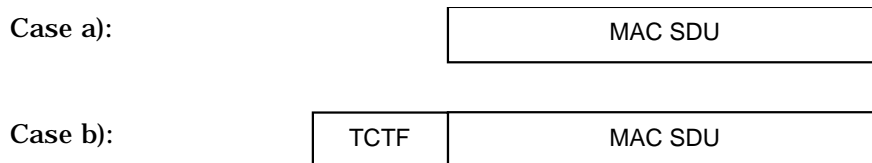
**Figure 9.2.1.6.1: MAC PDU format for SHCCH**

### 9.2.1.7 MAC Header for MCCH

The MAC PDU format for MCCH is as shown in figure 9.2.1.7.1.

- a) If the MAC header for MCCH is not configured through the MAC control SAP:
- there is no MAC header for MCCH.
- b) If the MAC header for MCCH is configured through the MAC control SAP:
- TCTF field is included in the MAC header for MCCH.

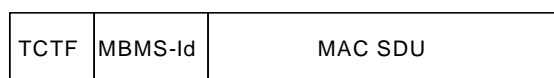
NOTE: If MCCH is not the only channel on the FACH, the MAC header shall be configured for the MCCH.



**Figure 9.2.1.7.1: MAC PDU format for MCCH**

### 9.2.1.8 MAC Header for MTCH

The TCTF field and MBMS-Id field are included in the MAC header for MTCH as shown in figure 9.2.1.8.1.



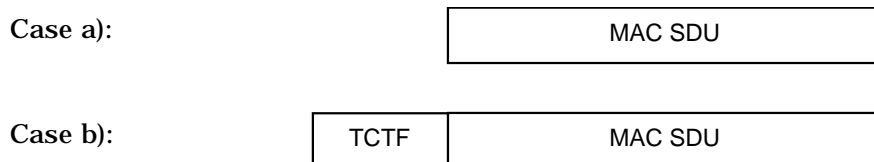
**Figure 9.2.1.8.1: MAC PDU format for MTCH**

### 9.2.1.9 MAC Header for MSCH

The MAC PDU format for MSCH is as shown in figure 9.2.1.9.1.

- a) If the MAC header for MSCH is not configured through the MAC control SAP:
- there is no MAC header for MSCH.
- b) If the MAC header for MSCH is configured through the MAC control SAP:
- TCTF field is included in the MAC header for MSCH.

NOTE: If MSCH is not the only channel on the FACH, the MAC header shall be configured for the MSCH.



**Figure 9.2.1.9.1: MAC PDU format for MSCH**

## 9.2.2 MAC PDU: Parameters of the MAC header (HS-DSCH)

If MAC-hs is configured by upper layers [7], the parameters for the MAC header are:

- Version Flag (VF):  
The VF field is a one bit flag providing extension capabilities of the MAC-hs PDU format. The VF field shall be set to zero and the value one is reserved in this version of the protocol.
- Queue identifier (Queue ID):  
The Queue ID field provides identification of the reordering queue in the receiver, in order to support independent buffer handling of data belonging to different reordering queues. The length of the Queue ID field is 3 bit.
- Transmission Sequence Number (TSN):  
The TSN field provides an identifier for the transmission sequence number on the HS-DSCH. The TSN field is used for reordering purposes to support in-sequence delivery to higher layers. For 1.28 Mcps TDD multi-frequency HS-DSCH operation mode, the length of the TSN field can be 6 bits or 9 bits, which is configured by higher layer. For other operation modes, the length of the TSN field is 6 bit.
- Size index identifier (SID):  
The SID fields identifies the size of a set of consecutive MAC-d PDUs. The MAC-d PDU size for a given SID is configured by higher layers and is independent for each Queue ID. The length of the SID field is 3 bit.
- Number of MAC-D PDUs (N):  
The number of consecutive MAC-d PDUs with equal size is identified with the N field. The length of the N field is 7 bits. In FDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 70. In 1.28 Mcps TDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 45. In 3.84 Mcps TDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 318. In 7.68 Mcps TDD mode, the maximum number of PDUs transmitted in a single TTI shall be assumed to be 636. If more PDUs than the defined maximum number of PDUs for the corresponding mode are received, the UE behaviour is unspecified.
- Flag (F):  
The F field is a flag indicating if more fields are present in the MAC-hs header or not. If the F field is set to "0" the F field is followed by an additional set of SID, N and F fields. If the F field is set to "1" the F field is followed by a MAC-d PDU. The maximum number of MAC-hs header extensions, i.e. number of fields F set to "0", in a single TTI shall be assumed to be 7. If more extensions than the maximum defined for the corresponding mode are included in a TTI, the UE behaviour is unspecified.

If MAC-ehs is configured by upper layers [7], the parameters for the MAC header are:

- Logical channel identifier (LCH-ID):

The LCH-ID field provides identification of the logical channel at the receiver and the re-ordering buffer destination of a reordering SDU.

The length of the LCH-ID is 4 bits.

In FDD, when SDU from BCCH or PCCH logical channel is transmitted on HS-DSCH the LCH-ID field in MAC-ehs header is set to 1111. The identification of the logical channel is done based on H-RNTI value used for broadcast information in or for paging in HS-SCCH. Table 9.2.2-0 shows the 4-bit LCH-ID field.



**Table 9.2.2-0: Structure of the LCH-ID field**

| LCH-ID field | Designation                                                               |
|--------------|---------------------------------------------------------------------------|
| 0000         | Logical channel 1                                                         |
| 0001         | Logical channel 2                                                         |
| ...          | ...                                                                       |
| 1110         | Logical channel 15                                                        |
| 1111         | Used when SDU from BCCH or PCCH logical channel is transmitted on HS-DSCH |

- Transmission Sequence Number (TSN):

The TSN field provides an identifier for the transmission sequence number on the HS-DSCH. The TSN field is used for reordering purposes to support in-sequence delivery to higher layers. The length of the TSN field is 6 bit.

- Segmentation Indication (SI)

The SI field indicates if the MAC-ehs SDU has been segmented. Table 9.2.2-1 shows the 2 bit SI field.

**Table 9.2.2-1: Structure of the SI field**

| SI Field | Segmentation indication                                                                                                                                                                                                                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00       | The first reordering SDU of the reordering PDU is a complete MAC-ehs SDU.<br>The last reordering SDU of the reordering PDU is a complete MAC-ehs SDU.                                                                                                                                                                                                             |
| 01       | If there are more than one reordering SDUs in the reordering PDU, the last reordering SDU of the reordering PDU is a complete MAC-ehs SDU.<br>The first reordering SDU of the reordering PDU is the last segment of a MAC-ehs SDU.                                                                                                                                |
| 10       | If there are more than one reordering SDUs in the reordering PDU, the first reordering SDU of the reordering PDU is a complete MAC-ehs SDU.<br>The last reordering SDU of the reordering PDU is the first segment of a MAC-ehs SDU.                                                                                                                               |
| 11       | If there are more than one reordering SDUs in the reordering PDU, the first reordering SDU of the reordering PDU is the last segment of a MAC-ehs SDU and the last reordering SDU of reordering PDU is the first segment of a MAC-ehs SDU.<br>If there is only one reordering SDU in the reordering PDU, the reordering SDU is a middle segment of a MAC-ehs SDU. |

- Length (L)

The L field provides the length of the reordering SDU in octets. The reordering SDU size can vary for each reordering SDU in the MAC-ehs PDU, and is set for each reordering SDU individually. The length of the Length field is 11 bits.

- Flag (F)

The F field is a flag indicating if more fields are present in the MAC-ehs header or not. If the F field is set to "0" the F field is followed by an additional set of LCH-ID and L fields and optionally (as described in section 9.1.4) TSN and SI fields. If the F field is set to "1" the F field is followed by a reordering PDU. Each header extension corresponds to one reordering SDU.

### 9.2.2.1 MAC header for DTCH and DCCH

If MAC-hs is configured by upper layers [7]:

a) DTCH or DCCH mapped to HS-DSCH:

- The Queue ID field and TSN field are always included in the MAC-hs header. One SID field, N field and F field is included for each MAC-d PDU size included in the MAC-hs PDU. Padding is not explicitly indicated but is included in the end of the MAC-hs PDU if the total size of the MAC-hs payload plus the MAC-hs header is smaller than the transport block set size.

If MAC-ehs is configured by upper layers [7]:

a) DTCH or DCCH mapped to HS-DSCH:

- There is always one LCH ID field and L field for each reordering SDU included in the MAC-ehs PDU and one TSN and SI field for each reordering PDU included in the MAC-ehs PDU. Padding is not explicitly indicated but is included in the end of the MAC-ehs PDU if the total size of the MAC-ehs payload plus the MAC-ehs header is smaller than the transport block set size.

## 9.2.3 Signalling of Transport Block size for HS-DSCH

For HS-DSCH the transport block size is derived from the TFRI value signalled on the HS-SCCH. The mapping between the TFRI value and the transport block size for each mode is specified below:

### 9.2.3.1 Transport block size for FDD

For all transmissions of a transport block, the transport block size is derived from the TFRI value as specified below, except only in those cases of retransmissions where the Node-B selects a combination for which no mapping exists between the original transport block size and the selected combination of channelisation Code set and modulation type. In such cases, the transport block size index value signalled to the UE shall be set to 111111, i.e.,  $k_i=63$ .

Let  $k_i$  be the TFRI signalled on the HS-SCCH value and let  $k_{0,i}$  be the value in table 9.2.3.1 or table 9.2.3.2 (as configured by higher layers) corresponding to the modulation and the number of codes signalled on the HS-SCCH. Let  $k_t$  be the sum of the two values:  $k_t = k_i + k_{0,i}$ . The transport block size  $L(k_t)$  can be obtained by accessing the position  $k_t$  in one of the tables in Annex A (normative) or by using one of the corresponding formulas below (informative).

The use of table 9.2.3.2 requires MAC-ehs.

Formula corresponding to table 9.2.3.1:

If  $k_t < 40$

$$L(k_t) = 125 + 12 \cdot k_t$$

else

$$L(k_t) = \lfloor L_{\min} p^{k_t} \rfloor$$

$$p = 2085 / 2048$$

$$L_{\min} = 296$$

end

**Table 9.2.3.1: Values of  $k_{0,i}$  for different numbers of channelization codes and modulation schemes, bit aligned (QPSK and 16QAM)**

| Combination $i$ | Modulation scheme | Number of channelization codes | $k_{0,i}$ |
|-----------------|-------------------|--------------------------------|-----------|
| 0               | QPSK              | 1                              | 1         |
| 1               |                   | 2                              | 40        |
| 2               |                   | 3                              | 63        |
| 3               |                   | 4                              | 79        |
| 4               |                   | 5                              | 92        |
| 5               |                   | 6                              | 102       |

|    |       |    |     |
|----|-------|----|-----|
| 6  |       | 7  | 111 |
| 7  |       | 8  | 118 |
| 8  |       | 9  | 125 |
| 9  |       | 10 | 131 |
| 10 |       | 11 | 136 |
| 11 |       | 12 | 141 |
| 12 |       | 13 | 145 |
| 13 |       | 14 | 150 |
| 14 |       | 15 | 153 |
| 15 | 16QAM | 1  | 40  |
| 16 |       | 2  | 79  |
| 17 |       | 3  | 102 |
| 18 |       | 4  | 118 |
| 19 |       | 5  | 131 |
| 20 |       | 6  | 141 |
| 21 |       | 7  | 150 |
| 22 |       | 8  | 157 |
| 23 |       | 9  | 164 |
| 24 |       | 10 | 169 |
| 25 |       | 11 | 175 |
| 26 |       | 12 | 180 |
| 27 |       | 13 | 184 |
| 28 |       | 14 | 188 |
| 29 |       | 15 | 192 |

NOTE: Some UE categories are only required to support values of  $K_r$  up to the value of 52 for the first HARQ transmission, as described in [23].

Formula corresponding to table 9.2.3.2:

If  $k_r < 40$

$$L(k_r) = (14 + k_r) * 8$$

else

$$L(k_r) = \lfloor L_{\min} p^{k_r} \rfloor * 8$$

$$p = \left( \frac{5274}{27} \right)^{\frac{1}{296-1}}$$

$$L_{\min} = 27$$

end

**Table 9.2.3.2: Values of  $k_{0,i}$  for different numbers of channelization codes and modulation schemes, octet aligned (QPSK, 16QAM and 64QAM)**

| Combination $i$ | Modulation scheme | Number of channelization codes | $k_{0,i}$ |
|-----------------|-------------------|--------------------------------|-----------|
| 0               | QPSK              | 1                              | 1         |
| 1               |                   | 2                              | 58        |
| 2               |                   | 3                              | 81        |
| 3               |                   | 4                              | 97        |
| 4               |                   | 5                              | 109       |
| 5               |                   | 6                              | 119       |

|    |       |    |     |
|----|-------|----|-----|
| 6  |       | 7  | 128 |
| 7  |       | 8  | 136 |
| 8  |       | 9  | 142 |
| 9  |       | 10 | 148 |
| 10 |       | 11 | 153 |
| 11 |       | 12 | 158 |
| 12 |       | 13 | 163 |
| 13 |       | 14 | 167 |
| 14 |       | 15 | 171 |
| 15 | 16QAM | 1  | 58  |
| 16 |       | 2  | 97  |
| 17 |       | 3  | 119 |
| 18 |       | 4  | 136 |
| 19 |       | 5  | 148 |
| 20 |       | 6  | 158 |
| 21 |       | 7  | 167 |
| 22 |       | 8  | 174 |
| 23 |       | 9  | 181 |
| 24 |       | 10 | 187 |
| 25 |       | 11 | 192 |
| 26 |       | 12 | 197 |
| 27 |       | 13 | 201 |
| 28 |       | 14 | 206 |
| 29 |       | 15 | 209 |
| 30 | 64QAM | 1  | 81  |
| 31 |       | 2  | 119 |
| 32 |       | 3  | 142 |
| 33 |       | 4  | 158 |
| 34 |       | 5  | 171 |
| 35 |       | 6  | 181 |
| 36 |       | 7  | 190 |
| 37 |       | 8  | 197 |
| 38 |       | 9  | 204 |
| 39 |       | 10 | 209 |
| 40 |       | 11 | 215 |
| 41 |       | 12 | 220 |
| 42 |       | 13 | 224 |
| 43 |       | 14 | 228 |
| 44 |       | 15 | 233 |

NOTE: Some UE categories are only required to support values of  $K_i$  up to the value of 52 for the first HARQ transmission, as described in [23].

### 9.2.3.2 Transport block size for 3.84 Mcps TDD

Let  $k$  be the signalled TFRI value, then the corresponding HS-DSCH transport block size  $L_k$  is given by :

If  $k=1..510$

$$L_k = \lfloor L_{\min} P^k \rfloor$$

$$P = \frac{8313}{8192}$$

$$L_{\min} = 57$$

If  $k = 511$

$$L_k = 102000$$

If  $k=0$ ,  $L_k$  indicates NULL and shall not be used to signal a transport block size in the TFRI.

Transport block sizes calculated by this formula shall equal the values indicated in Table 9.2.3.2.1

**Table 9.2.3.2.1: HSDPA Transport Block Sizes for 3.84 Mcps TDD**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 128          | 372            | 256          | 2432           | 384          | 15890          |
| 1            | 57             | 129          | 377            | 257          | 2468           | 385          | 16124          |
| 2            | 58             | 130          | 383            | 258          | 2504           | 386          | 16362          |
| 3            | 59             | 131          | 389            | 259          | 2541           | 387          | 16604          |
| 4            | 60             | 132          | 394            | 260          | 2579           | 388          | 16849          |
| 5            | 61             | 133          | 400            | 261          | 2617           | 389          | 17098          |
| 6            | 62             | 134          | 406            | 262          | 2656           | 390          | 17351          |
| 7            | 63             | 135          | 412            | 263          | 2695           | 391          | 17607          |
| 8            | 64             | 136          | 418            | 264          | 2735           | 392          | 17867          |
| 9            | 65             | 137          | 424            | 265          | 2775           | 393          | 18131          |
| 10           | 66             | 138          | 431            | 266          | 2816           | 394          | 18399          |
| 11           | 66             | 139          | 437            | 267          | 2858           | 395          | 18671          |
| 12           | 67             | 140          | 443            | 268          | 2900           | 396          | 18946          |
| 13           | 68             | 141          | 450            | 269          | 2943           | 397          | 19226          |
| 14           | 69             | 142          | 457            | 270          | 2986           | 398          | 19510          |
| 15           | 71             | 143          | 463            | 271          | 3030           | 399          | 19798          |
| 16           | 72             | 144          | 470            | 272          | 3075           | 400          | 20091          |
| 17           | 73             | 145          | 477            | 273          | 3121           | 401          | 20388          |
| 18           | 74             | 146          | 484            | 274          | 3167           | 402          | 20689          |
| 19           | 75             | 147          | 491            | 275          | 3213           | 403          | 20994          |
| 20           | 76             | 148          | 499            | 276          | 3261           | 404          | 21304          |
| 21           | 77             | 149          | 506            | 277          | 3309           | 405          | 21619          |
| 22           | 78             | 150          | 514            | 278          | 3358           | 406          | 21938          |
| 23           | 79             | 151          | 521            | 279          | 3408           | 407          | 22263          |
| 24           | 81             | 152          | 529            | 280          | 3458           | 408          | 22591          |
| 25           | 82             | 153          | 537            | 281          | 3509           | 409          | 22925          |
| 26           | 83             | 154          | 545            | 282          | 3561           | 410          | 23264          |
| 27           | 84             | 155          | 553            | 283          | 3613           | 411          | 23607          |
| 28           | 85             | 156          | 561            | 284          | 3667           | 412          | 23956          |
| 29           | 87             | 157          | 569            | 285          | 3721           | 413          | 24310          |
| 30           | 88             | 158          | 578            | 286          | 3776           | 414          | 24669          |
| 31           | 89             | 159          | 586            | 287          | 3832           | 415          | 25033          |
| 32           | 91             | 160          | 595            | 288          | 3888           | 416          | 25403          |
| 33           | 92             | 161          | 604            | 289          | 3946           | 417          | 25778          |
| 34           | 93             | 162          | 613            | 290          | 4004           | 418          | 26159          |
| 35           | 95             | 163          | 622            | 291          | 4063           | 419          | 26545          |
| 36           | 96             | 164          | 631            | 292          | 4123           | 420          | 26938          |
| 37           | 98             | 165          | 640            | 293          | 4184           | 421          | 27335          |

|    |     |     |      |     |      |     |       |
|----|-----|-----|------|-----|------|-----|-------|
| 38 | 99  | 166 | 650  | 294 | 4246 | 422 | 27739 |
| 39 | 100 | 167 | 659  | 295 | 4309 | 423 | 28149 |
| 40 | 102 | 168 | 669  | 296 | 4372 | 424 | 28565 |
| 41 | 103 | 169 | 679  | 297 | 4437 | 425 | 28987 |
| 42 | 105 | 170 | 689  | 298 | 4502 | 426 | 29415 |
| 43 | 107 | 171 | 699  | 299 | 4569 | 427 | 29849 |
| 44 | 108 | 172 | 709  | 300 | 4636 | 428 | 30290 |
| 45 | 110 | 173 | 720  | 301 | 4705 | 429 | 30738 |
| 46 | 111 | 174 | 730  | 302 | 4774 | 430 | 31192 |
| 47 | 113 | 175 | 741  | 303 | 4845 | 431 | 31652 |
| 48 | 115 | 176 | 752  | 304 | 4916 | 432 | 32120 |
| 49 | 116 | 177 | 763  | 305 | 4989 | 433 | 32594 |
| 50 | 118 | 178 | 775  | 306 | 5063 | 434 | 33076 |
| 51 | 120 | 179 | 786  | 307 | 5138 | 435 | 33564 |
| 52 | 122 | 180 | 798  | 308 | 5213 | 436 | 34060 |
| 53 | 123 | 181 | 809  | 309 | 5290 | 437 | 34563 |
| 54 | 125 | 182 | 821  | 310 | 5369 | 438 | 35074 |
| 55 | 127 | 183 | 834  | 311 | 5448 | 439 | 35592 |
| 56 | 129 | 184 | 846  | 312 | 5528 | 440 | 36117 |
| 57 | 131 | 185 | 858  | 313 | 5610 | 441 | 36651 |
| 58 | 133 | 186 | 871  | 314 | 5693 | 442 | 37192 |
| 59 | 135 | 187 | 884  | 315 | 5777 | 443 | 37742 |
| 60 | 137 | 188 | 897  | 316 | 5862 | 444 | 38299 |
| 61 | 139 | 189 | 910  | 317 | 5949 | 445 | 38865 |
| 62 | 141 | 190 | 924  | 318 | 6037 | 446 | 39439 |
| 63 | 143 | 191 | 937  | 319 | 6126 | 447 | 40021 |
| 64 | 145 | 192 | 951  | 320 | 6217 | 448 | 40613 |
| 65 | 147 | 193 | 965  | 321 | 6308 | 449 | 41212 |
| 66 | 150 | 194 | 980  | 322 | 6402 | 450 | 41821 |
| 67 | 152 | 195 | 994  | 323 | 6496 | 451 | 42439 |
| 68 | 154 | 196 | 1009 | 324 | 6592 | 452 | 43066 |
| 69 | 156 | 197 | 1024 | 325 | 6689 | 453 | 43702 |
| 70 | 159 | 198 | 1039 | 326 | 6788 | 454 | 44347 |
| 71 | 161 | 199 | 1054 | 327 | 6889 | 455 | 45002 |
| 72 | 163 | 200 | 1070 | 328 | 6990 | 456 | 45667 |
| 73 | 166 | 201 | 1085 | 329 | 7094 | 457 | 46342 |
| 74 | 168 | 202 | 1101 | 330 | 7198 | 458 | 47026 |
| 75 | 171 | 203 | 1118 | 331 | 7305 | 459 | 47721 |
| 76 | 173 | 204 | 1134 | 332 | 7413 | 460 | 48426 |
| 77 | 176 | 205 | 1151 | 333 | 7522 | 461 | 49141 |
| 78 | 178 | 206 | 1168 | 334 | 7633 | 462 | 49867 |
| 79 | 181 | 207 | 1185 | 335 | 7746 | 463 | 50603 |
| 80 | 184 | 208 | 1203 | 336 | 7860 | 464 | 51351 |
| 81 | 186 | 209 | 1221 | 337 | 7976 | 465 | 52109 |
| 82 | 189 | 210 | 1239 | 338 | 8094 | 466 | 52879 |
| 83 | 192 | 211 | 1257 | 339 | 8214 | 467 | 53660 |
| 84 | 195 | 212 | 1276 | 340 | 8335 | 468 | 54453 |
| 85 | 198 | 213 | 1294 | 341 | 8458 | 469 | 55257 |
| 86 | 201 | 214 | 1313 | 342 | 8583 | 470 | 56073 |
| 87 | 204 | 215 | 1333 | 343 | 8710 | 471 | 56901 |

|     |     |     |      |     |       |     |        |
|-----|-----|-----|------|-----|-------|-----|--------|
| 88  | 207 | 216 | 1353 | 344 | 8839  | 472 | 57742  |
| 89  | 210 | 217 | 1373 | 345 | 8969  | 473 | 58595  |
| 90  | 213 | 218 | 1393 | 346 | 9102  | 474 | 59460  |
| 91  | 216 | 219 | 1413 | 347 | 9236  | 475 | 60338  |
| 92  | 219 | 220 | 1434 | 348 | 9373  | 476 | 61230  |
| 93  | 222 | 221 | 1456 | 349 | 9511  | 477 | 62134  |
| 94  | 226 | 222 | 1477 | 350 | 9652  | 478 | 63052  |
| 95  | 229 | 223 | 1499 | 351 | 9794  | 479 | 63983  |
| 96  | 232 | 224 | 1521 | 352 | 9939  | 480 | 64928  |
| 97  | 236 | 225 | 1543 | 353 | 10086 | 481 | 65887  |
| 98  | 239 | 226 | 1566 | 354 | 10235 | 482 | 66860  |
| 99  | 243 | 227 | 1589 | 355 | 10386 | 483 | 67848  |
| 100 | 246 | 228 | 1613 | 356 | 10539 | 484 | 68850  |
| 101 | 250 | 229 | 1637 | 357 | 10695 | 485 | 69867  |
| 102 | 254 | 230 | 1661 | 358 | 10853 | 486 | 70899  |
| 103 | 258 | 231 | 1685 | 359 | 11013 | 487 | 71946  |
| 104 | 261 | 232 | 1710 | 360 | 11176 | 488 | 73009  |
| 105 | 265 | 233 | 1736 | 361 | 11341 | 489 | 74087  |
| 106 | 269 | 234 | 1761 | 362 | 11508 | 490 | 75182  |
| 107 | 273 | 235 | 1787 | 363 | 11678 | 491 | 76292  |
| 108 | 277 | 236 | 1814 | 364 | 11851 | 492 | 77419  |
| 109 | 281 | 237 | 1840 | 365 | 12026 | 493 | 78563  |
| 110 | 285 | 238 | 1868 | 366 | 12204 | 494 | 79723  |
| 111 | 290 | 239 | 1895 | 367 | 12384 | 495 | 80901  |
| 112 | 294 | 240 | 1923 | 368 | 12567 | 496 | 82095  |
| 113 | 298 | 241 | 1952 | 369 | 12752 | 497 | 83308  |
| 114 | 303 | 242 | 1981 | 370 | 12941 | 498 | 84539  |
| 115 | 307 | 243 | 2010 | 371 | 13132 | 499 | 85787  |
| 116 | 312 | 244 | 2039 | 372 | 13326 | 500 | 87054  |
| 117 | 316 | 245 | 2070 | 373 | 13523 | 501 | 88340  |
| 118 | 321 | 246 | 2100 | 374 | 13722 | 502 | 89645  |
| 119 | 326 | 247 | 2131 | 375 | 13925 | 503 | 90969  |
| 120 | 331 | 248 | 2163 | 376 | 14131 | 504 | 92313  |
| 121 | 336 | 249 | 2195 | 377 | 14340 | 505 | 93676  |
| 122 | 340 | 250 | 2227 | 378 | 14551 | 506 | 95060  |
| 123 | 346 | 251 | 2260 | 379 | 14766 | 507 | 96464  |
| 124 | 351 | 252 | 2293 | 380 | 14984 | 508 | 97889  |
| 125 | 356 | 253 | 2327 | 381 | 15206 | 509 | 99335  |
| 126 | 361 | 254 | 2362 | 382 | 15430 | 510 | 100802 |
| 127 | 366 | 255 | 2397 | 383 | 15658 | 511 | 102000 |

### 9.2.3.2a Transport block size for 7.68 Mcps TDD

Let  $k$  be the signalled TFRI value, then the corresponding HS-DSCH transport block size  $L_k$  is given by :

If  $k=1..510$

$$L_k = \lfloor L_{\min} p^k \rfloor$$

$$p = \frac{33297}{32768}$$

$$L_{\min} = 57$$

If  $k = 511$

$$L_k = 204000$$

If  $k=0$ ,  $L_k$  indicates NULL and shall not be used to signal a transport block size in the TFRI.

Transport block sizes calculated by this formula shall equal the values indicated in Table 9.2.3.2.1

**Table 9.2.3.2a.1: HSDPA Transport Block Sizes for 7.68 Mcps TDD**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 128          | 442            | 256          | 3438           | 384          | 26709          |
| 1            | 57             | 129          | 449            | 257          | 3494           | 385          | 27140          |
| 2            | 58             | 130          | 457            | 258          | 3550           | 386          | 27578          |
| 3            | 59             | 131          | 464            | 259          | 3607           | 387          | 28023          |
| 4            | 60             | 132          | 472            | 260          | 3666           | 388          | 28476          |
| 5            | 61             | 133          | 479            | 261          | 3725           | 389          | 28935          |
| 6            | 62             | 134          | 487            | 262          | 3785           | 390          | 29402          |
| 7            | 63             | 135          | 495            | 263          | 3846           | 391          | 29877          |
| 8            | 64             | 136          | 503            | 264          | 3908           | 392          | 30360          |
| 9            | 65             | 137          | 511            | 265          | 3971           | 393          | 30850          |
| 10           | 66             | 138          | 519            | 266          | 4035           | 394          | 31348          |
| 11           | 67             | 139          | 528            | 267          | 4101           | 395          | 31854          |
| 12           | 69             | 140          | 536            | 268          | 4167           | 396          | 32368          |
| 13           | 70             | 141          | 545            | 269          | 4234           | 397          | 32891          |
| 14           | 71             | 142          | 553            | 270          | 4302           | 398          | 33422          |
| 15           | 72             | 143          | 562            | 271          | 4372           | 399          | 33961          |
| 16           | 73             | 144          | 572            | 272          | 4443           | 400          | 34509          |
| 17           | 74             | 145          | 581            | 273          | 4514           | 401          | 35066          |
| 18           | 76             | 146          | 590            | 274          | 4587           | 402          | 35633          |
| 19           | 77             | 147          | 600            | 275          | 4661           | 403          | 36208          |
| 20           | 78             | 148          | 609            | 276          | 4736           | 404          | 36792          |
| 21           | 79             | 149          | 619            | 277          | 4813           | 405          | 37386          |
| 22           | 81             | 150          | 629            | 278          | 4891           | 406          | 37990          |
| 23           | 82             | 151          | 639            | 279          | 4970           | 407          | 38603          |
| 24           | 83             | 152          | 650            | 280          | 5050           | 408          | 39226          |
| 25           | 85             | 153          | 660            | 281          | 5131           | 409          | 39860          |
| 26           | 86             | 154          | 671            | 282          | 5214           | 410          | 40503          |
| 27           | 87             | 155          | 682            | 283          | 5298           | 411          | 41157          |
| 28           | 89             | 156          | 693            | 284          | 5384           | 412          | 41822          |
| 29           | 90             | 157          | 704            | 285          | 5471           | 413          | 42497          |
| 30           | 92             | 158          | 715            | 286          | 5559           | 414          | 43183          |
| 31           | 93             | 159          | 727            | 287          | 5649           | 415          | 43880          |
| 32           | 95             | 160          | 739            | 288          | 5740           | 416          | 44588          |
| 33           | 96             | 161          | 751            | 289          | 5833           | 417          | 45308          |
| 34           | 98             | 162          | 763            | 290          | 5927           | 418          | 46040          |
| 35           | 99             | 163          | 775            | 291          | 6023           | 419          | 46783          |
| 36           | 101            | 164          | 787            | 292          | 6120           | 420          | 47538          |
| 37           | 103            | 165          | 800            | 293          | 6219           | 421          | 48306          |



|    |     |     |      |     |       |     |        |
|----|-----|-----|------|-----|-------|-----|--------|
| 38 | 104 | 166 | 813  | 294 | 6319  | 422 | 49085  |
| 39 | 106 | 167 | 826  | 295 | 6421  | 423 | 49878  |
| 40 | 108 | 168 | 840  | 296 | 6525  | 424 | 50683  |
| 41 | 109 | 169 | 853  | 297 | 6630  | 425 | 51501  |
| 42 | 111 | 170 | 867  | 298 | 6737  | 426 | 52333  |
| 43 | 113 | 171 | 881  | 299 | 6846  | 427 | 53178  |
| 44 | 115 | 172 | 895  | 300 | 6957  | 428 | 54036  |
| 45 | 117 | 173 | 910  | 301 | 7069  | 429 | 54908  |
| 46 | 119 | 174 | 924  | 302 | 7183  | 430 | 55795  |
| 47 | 120 | 175 | 939  | 303 | 7299  | 431 | 56696  |
| 48 | 122 | 176 | 954  | 304 | 7417  | 432 | 57611  |
| 49 | 124 | 177 | 970  | 305 | 7537  | 433 | 58541  |
| 50 | 126 | 178 | 986  | 306 | 7658  | 434 | 59486  |
| 51 | 128 | 179 | 1001 | 307 | 7782  | 435 | 60446  |
| 52 | 131 | 180 | 1018 | 308 | 7908  | 436 | 61422  |
| 53 | 133 | 181 | 1034 | 309 | 8035  | 437 | 62414  |
| 54 | 135 | 182 | 1051 | 310 | 8165  | 438 | 63421  |
| 55 | 137 | 183 | 1068 | 311 | 8297  | 439 | 64445  |
| 56 | 139 | 184 | 1085 | 312 | 8431  | 440 | 65486  |
| 57 | 142 | 185 | 1103 | 313 | 8567  | 441 | 66543  |
| 58 | 144 | 186 | 1120 | 314 | 8705  | 442 | 67617  |
| 59 | 146 | 187 | 1138 | 315 | 8846  | 443 | 68709  |
| 60 | 148 | 188 | 1157 | 316 | 8988  | 444 | 69818  |
| 61 | 151 | 189 | 1175 | 317 | 9134  | 445 | 70945  |
| 62 | 153 | 190 | 1194 | 318 | 9281  | 446 | 72091  |
| 63 | 156 | 191 | 1214 | 319 | 9431  | 447 | 73254  |
| 64 | 158 | 192 | 1233 | 320 | 9583  | 448 | 74437  |
| 65 | 161 | 193 | 1253 | 321 | 9738  | 449 | 75639  |
| 66 | 164 | 194 | 1274 | 322 | 9895  | 450 | 76860  |
| 67 | 166 | 195 | 1294 | 323 | 10055 | 451 | 78101  |
| 68 | 169 | 196 | 1315 | 324 | 10217 | 452 | 79361  |
| 69 | 172 | 197 | 1336 | 325 | 10382 | 453 | 80643  |
| 70 | 174 | 198 | 1358 | 326 | 10550 | 454 | 81945  |
| 71 | 177 | 199 | 1380 | 327 | 10720 | 455 | 83267  |
| 72 | 180 | 200 | 1402 | 328 | 10893 | 456 | 84612  |
| 73 | 183 | 201 | 1425 | 329 | 11069 | 457 | 85978  |
| 74 | 186 | 202 | 1448 | 330 | 11248 | 458 | 87366  |
| 75 | 189 | 203 | 1471 | 331 | 11429 | 459 | 88776  |
| 76 | 192 | 204 | 1495 | 332 | 11614 | 460 | 90209  |
| 77 | 195 | 205 | 1519 | 333 | 11801 | 461 | 91666  |
| 78 | 198 | 206 | 1543 | 334 | 11992 | 462 | 93145  |
| 79 | 201 | 207 | 1568 | 335 | 12185 | 463 | 94649  |
| 80 | 205 | 208 | 1594 | 336 | 12382 | 464 | 96177  |
| 81 | 208 | 209 | 1619 | 337 | 12582 | 465 | 97730  |
| 82 | 211 | 210 | 1646 | 338 | 12785 | 466 | 99308  |
| 83 | 215 | 211 | 1672 | 339 | 12992 | 467 | 100911 |
| 84 | 218 | 212 | 1699 | 340 | 13201 | 468 | 102540 |
| 85 | 222 | 213 | 1727 | 341 | 13414 | 469 | 104195 |
| 86 | 225 | 214 | 1755 | 342 | 13631 | 470 | 105877 |
| 87 | 229 | 215 | 1783 | 343 | 13851 | 471 | 107587 |

|     |     |     |      |     |       |     |        |
|-----|-----|-----|------|-----|-------|-----|--------|
| 88  | 233 | 216 | 1812 | 344 | 14075 | 472 | 109324 |
| 89  | 237 | 217 | 1841 | 345 | 14302 | 473 | 111088 |
| 90  | 240 | 218 | 1871 | 346 | 14533 | 474 | 112882 |
| 91  | 244 | 219 | 1901 | 347 | 14767 | 475 | 114704 |
| 92  | 248 | 220 | 1932 | 348 | 15006 | 476 | 116556 |
| 93  | 252 | 221 | 1963 | 349 | 15248 | 477 | 118438 |
| 94  | 256 | 222 | 1994 | 350 | 15494 | 478 | 120350 |
| 95  | 260 | 223 | 2027 | 351 | 15744 | 479 | 122293 |
| 96  | 265 | 224 | 2059 | 352 | 15999 | 480 | 124267 |
| 97  | 269 | 225 | 2093 | 353 | 16257 | 481 | 126273 |
| 98  | 273 | 226 | 2126 | 354 | 16519 | 482 | 128312 |
| 99  | 278 | 227 | 2161 | 355 | 16786 | 483 | 130383 |
| 100 | 282 | 228 | 2196 | 356 | 17057 | 484 | 132488 |
| 101 | 287 | 229 | 2231 | 357 | 17332 | 485 | 134627 |
| 102 | 291 | 230 | 2267 | 358 | 17612 | 486 | 136800 |
| 103 | 296 | 231 | 2304 | 359 | 17897 | 487 | 139009 |
| 104 | 301 | 232 | 2341 | 360 | 18185 | 488 | 141253 |
| 105 | 306 | 233 | 2379 | 361 | 18479 | 489 | 143533 |
| 106 | 311 | 234 | 2417 | 362 | 18777 | 490 | 145850 |
| 107 | 316 | 235 | 2456 | 363 | 19081 | 491 | 148205 |
| 108 | 321 | 236 | 2496 | 364 | 19389 | 492 | 150597 |
| 109 | 326 | 237 | 2536 | 365 | 19702 | 493 | 153029 |
| 110 | 331 | 238 | 2577 | 366 | 20020 | 494 | 155499 |
| 111 | 337 | 239 | 2619 | 367 | 20343 | 495 | 158010 |
| 112 | 342 | 240 | 2661 | 368 | 20671 | 496 | 160560 |
| 113 | 348 | 241 | 2704 | 369 | 21005 | 497 | 163152 |
| 114 | 353 | 242 | 2748 | 370 | 21344 | 498 | 165786 |
| 115 | 359 | 243 | 2792 | 371 | 21689 | 499 | 168463 |
| 116 | 365 | 244 | 2837 | 372 | 22039 | 500 | 171182 |
| 117 | 371 | 245 | 2883 | 373 | 22395 | 501 | 173946 |
| 118 | 377 | 246 | 2929 | 374 | 22756 | 502 | 176754 |
| 119 | 383 | 247 | 2977 | 375 | 23124 | 503 | 179608 |
| 120 | 389 | 248 | 3025 | 376 | 23497 | 504 | 182507 |
| 121 | 395 | 249 | 3074 | 377 | 23876 | 505 | 185454 |
| 122 | 402 | 250 | 3123 | 378 | 24262 | 506 | 188447 |
| 123 | 408 | 251 | 3174 | 379 | 24653 | 507 | 191490 |
| 124 | 415 | 252 | 3225 | 380 | 25051 | 508 | 194581 |
| 125 | 421 | 253 | 3277 | 381 | 25456 | 509 | 197722 |
| 126 | 428 | 254 | 3330 | 382 | 25867 | 510 | 200914 |
| 127 | 435 | 255 | 3384 | 383 | 26284 | 511 | 204000 |

### 9.2.3.3 Transport block size for 1.28 Mcps TDD

The mapping of transport block size, in bits, to TFRI value is dependent upon the UE's HS-DSCH capability class.

If  $k$  is the signalled TFRI value then the corresponding HS-DSCH transport block size  $L_k$  is given by:

If  $k = 1..62$

$$L_k = \lfloor L_{\min} p^{k-1} \rfloor$$

where

$$p = \frac{6214}{5973} \text{ if the HS-DSCH physical layer category is between 1 and 3 inclusively,}$$

$$p = \frac{1292}{1228} \text{ if the HS-DSCH physical layer category is between 4 and 6 inclusively,}$$

$$p = \frac{1901}{1795} \text{ if the HS-DSCH physical layer category is between 7 and 9 inclusively,}$$

$$p = \frac{9445}{8877} \text{ if the HS-DSCH physical layer category is between 10 and 12 inclusively,}$$

$$p = \frac{2345}{2196} \text{ if the HS-DSCH physical layer category is between 13 and 15 inclusively,}$$

$$p = \frac{4053}{3802} \text{ if the HS-DSCH physical layer category is between 16 and 18 inclusively,}$$

$$p = \frac{9807}{9157} \text{ if the HS-DSCH physical layer category is between 16 and 18 inclusively,}$$

$$p = \frac{359}{334} \text{ if the HS-DSCH physical layer category is between 19 and 21 inclusively,}$$

and

$$L_{\min} = 240$$

If  $k = 63$  then,

$$L_k = 2788 \text{ if the HS-DSCH physical layer category is between 1 and 3 inclusively,}$$

$$5600 \text{ if the HS-DSCH physical layer category is between 4 and 6 inclusively,}$$

$$8416 \text{ if the HS-DSCH physical layer category is between 7 and 9 inclusively,}$$

$$11226 \text{ if the HS-DSCH physical layer category is between 10 and 12 inclusively,}$$

$$14043 \text{ if the HS-DSCH physical layer category is between 13 and 15 inclusively,}$$

$$12636 \text{ if the HS-DSCH physical layer category is between 16 and 18 inclusively,}$$

$$16856 \text{ if the HS-DSCH physical layer category is between 19 and 21 inclusively,}$$

$$21075 \text{ if the HS-DSCH physical layer category is between 22 and 24 inclusively.}$$

If  $k=0$ ,  $L_k$  indicates NULL and shall not be used to signal a transport block size in the TFRI.

Transport block sizes calculated by this formula shall equal the values indicated in the following tables: –

**Table 9.2.3.3.1: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [1, 3]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 434            | 32           | 817            | 48           | 1540           |
| 1            | 240            | 17           | 451            | 33           | 851            | 49           | 1602           |
| 2            | 249            | 18           | 470            | 34           | 885            | 50           | 1667           |

|    |     |    |     |    |      |    |      |
|----|-----|----|-----|----|------|----|------|
| 3  | 259 | 19 | 489 | 35 | 921  | 51 | 1734 |
| 4  | 270 | 20 | 508 | 36 | 958  | 52 | 1804 |
| 5  | 281 | 21 | 529 | 37 | 996  | 53 | 1877 |
| 6  | 292 | 22 | 550 | 38 | 1037 | 54 | 1952 |
| 7  | 304 | 23 | 572 | 39 | 1078 | 55 | 2031 |
| 8  | 316 | 24 | 596 | 40 | 1122 | 56 | 2113 |
| 9  | 329 | 25 | 620 | 41 | 1167 | 57 | 2198 |
| 10 | 342 | 26 | 645 | 42 | 1214 | 58 | 2287 |
| 11 | 356 | 27 | 671 | 43 | 1263 | 59 | 2380 |
| 12 | 370 | 28 | 698 | 44 | 1314 | 60 | 2476 |
| 13 | 385 | 29 | 726 | 45 | 1367 | 61 | 2575 |
| 14 | 401 | 30 | 755 | 46 | 1423 | 62 | 2679 |
| 15 | 417 | 31 | 786 | 47 | 1480 | 63 | 2788 |

**Table 9.2.3.3.2: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [4, 6]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 514            | 32           | 1159           | 48           | 2613           |
| 1            | 240            | 17           | 541            | 33           | 1219           | 49           | 2749           |
| 2            | 252            | 18           | 569            | 34           | 1283           | 50           | 2893           |
| 3            | 265            | 19           | 598            | 35           | 1350           | 51           | 3043           |
| 4            | 279            | 20           | 630            | 36           | 1420           | 52           | 3202           |
| 5            | 294            | 21           | 662            | 37           | 1494           | 53           | 3369           |
| 6            | 309            | 22           | 697            | 38           | 1572           | 54           | 3544           |
| 7            | 325            | 23           | 733            | 39           | 1654           | 55           | 3729           |
| 8            | 342            | 24           | 772            | 40           | 1740           | 56           | 3924           |
| 9            | 360            | 25           | 812            | 41           | 1831           | 57           | 4128           |
| 10           | 379            | 26           | 854            | 42           | 1926           | 58           | 4343           |
| 11           | 398            | 27           | 899            | 43           | 2027           | 59           | 4570           |
| 12           | 419            | 28           | 946            | 44           | 2132           | 60           | 4808           |
| 13           | 441            | 29           | 995            | 45           | 2244           | 61           | 5058           |
| 14           | 464            | 30           | 1047           | 46           | 2361           | 62           | 5322           |
| 15           | 488            | 31           | 1101           | 47           | 2484           | 63           | 5600           |

**Table 9.2.3.3.3: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [7, 9]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 567            | 32           | 1421           | 48           | 3559           |
| 1            | 240            | 17           | 601            | 33           | 1505           | 49           | 3769           |
| 2            | 254            | 18           | 636            | 34           | 1594           | 50           | 3991           |
| 3            | 269            | 19           | 674            | 35           | 1688           | 51           | 4227           |
| 4            | 285            | 20           | 713            | 36           | 1787           | 52           | 4477           |
| 5            | 301            | 21           | 756            | 37           | 1893           | 53           | 4741           |
| 6            | 319            | 22           | 800            | 38           | 2005           | 54           | 5021           |
| 7            | 338            | 23           | 848            | 39           | 2123           | 55           | 5318           |
| 8            | 358            | 24           | 898            | 40           | 2249           | 56           | 5632           |
| 9            | 379            | 25           | 951            | 41           | 2381           | 57           | 5964           |
| 10           | 402            | 26           | 1007           | 42           | 2522           | 58           | 6317           |
| 11           | 425            | 27           | 1066           | 43           | 2671           | 59           | 6690           |
| 12           | 451            | 28           | 1129           | 44           | 2829           | 60           | 7085           |
| 13           | 477            | 29           | 1196           | 45           | 2996           | 61           | 7503           |
| 14           | 505            | 30           | 1267           | 46           | 3173           | 62           | 7946           |
| 15           | 535            | 31           | 1341           | 47           | 3360           | 63           | 8416           |

**Table 9.2.3.3.4: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [10, 12]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 608            | 32           | 1641           | 48           | 4427           |
| 1            | 240            | 17           | 647            | 33           | 1746           | 49           | 4711           |
| 2            | 255            | 18           | 688            | 34           | 1858           | 50           | 5012           |
| 3            | 271            | 19           | 732            | 35           | 1977           | 51           | 5333           |
| 4            | 289            | 20           | 779            | 36           | 2103           | 52           | 5674           |
| 5            | 307            | 21           | 829            | 37           | 2238           | 53           | 6037           |
| 6            | 327            | 22           | 882            | 38           | 2381           | 54           | 6424           |
| 7            | 348            | 23           | 939            | 39           | 2533           | 55           | 6835           |
| 8            | 370            | 24           | 999            | 40           | 2695           | 56           | 7272           |
| 9            | 394            | 25           | 1063           | 41           | 2868           | 57           | 7737           |
| 10           | 419            | 26           | 1131           | 42           | 3051           | 58           | 8232           |
| 11           | 446            | 27           | 1203           | 43           | 3247           | 59           | 8759           |
| 12           | 474            | 28           | 1280           | 44           | 3455           | 60           | 9320           |
| 13           | 505            | 29           | 1362           | 45           | 3676           | 61           | 9916           |
| 14           | 537            | 30           | 1449           | 46           | 3911           | 62           | 10550          |
| 15           | 571            | 31           | 1542           | 47           | 4161           | 63           | 11226          |

**Table 9.2.3.3.5 : HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [13,15]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 642            | 32           | 1836           | 48           | 5250           |
| 1            | 240            | 17           | 686            | 33           | 1961           | 49           | 5606           |
| 2            | 256            | 18           | 732            | 34           | 2094           | 50           | 5987           |
| 3            | 273            | 19           | 782            | 35           | 2236           | 51           | 6393           |
| 4            | 292            | 20           | 835            | 36           | 2388           | 52           | 6827           |
| 5            | 312            | 21           | 892            | 37           | 2550           | 53           | 7290           |

|    |     |    |      |    |      |    |       |
|----|-----|----|------|----|------|----|-------|
| 6  | 333 | 22 | 952  | 38 | 2723 | 54 | 7785  |
| 7  | 355 | 23 | 1017 | 39 | 2908 | 55 | 8313  |
| 8  | 380 | 24 | 1086 | 40 | 3105 | 56 | 8877  |
| 9  | 405 | 25 | 1160 | 41 | 3316 | 57 | 9479  |
| 10 | 433 | 26 | 1238 | 42 | 3541 | 58 | 10123 |
| 11 | 462 | 27 | 1322 | 43 | 3781 | 59 | 10809 |
| 12 | 494 | 28 | 1412 | 44 | 4037 | 60 | 11543 |
| 13 | 527 | 29 | 1508 | 45 | 4311 | 61 | 12326 |
| 14 | 563 | 30 | 1610 | 46 | 4604 | 62 | 13162 |
| 15 | 601 | 31 | 1719 | 47 | 4916 | 63 | 14043 |

**Table 9.2.3.3.5a : HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [16,18]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 626            | 32           | 1741           | 48           | 4843           |
| 1            | 240            | 17           | 667            | 33           | 1856           | 49           | 5163           |
| 2            | 255            | 18           | 711            | 34           | 1978           | 50           | 5503           |
| 3            | 272            | 19           | 758            | 35           | 2109           | 51           | 5867           |
| 4            | 290            | 20           | 808            | 36           | 2248           | 52           | 6254           |
| 5            | 309            | 21           | 861            | 37           | 2397           | 53           | 6667           |
| 6            | 330            | 22           | 918            | 38           | 2555           | 54           | 7107           |
| 7            | 352            | 23           | 979            | 39           | 2724           | 55           | 7576           |
| 8            | 375            | 24           | 1044           | 40           | 2904           | 56           | 8077           |
| 9            | 400            | 25           | 1113           | 41           | 3095           | 57           | 8610           |
| 10           | 426            | 26           | 1186           | 42           | 3300           | 58           | 9178           |
| 11           | 454            | 27           | 1264           | 43           | 3518           | 59           | 9784           |
| 12           | 484            | 28           | 1348           | 44           | 3750           | 60           | 10430          |
| 13           | 516            | 29           | 1437           | 45           | 3998           | 61           | 11119          |
| 14           | 550            | 30           | 1532           | 46           | 4261           | 62           | 11853          |
| 15           | 587            | 31           | 1633           | 47           | 4543           | 63           | 12636          |

**Table 9.2.3.3.6: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [19,21]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 671            | 32           | 2011           | 48           | 6025           |
| 1            | 240            | 17           | 719            | 33           | 2154           | 49           | 6453           |
| 2            | 257            | 18           | 770            | 34           | 2307           | 50           | 6911           |
| 3            | 275            | 19           | 824            | 35           | 2470           | 51           | 7402           |
| 4            | 294            | 20           | 883            | 36           | 2646           | 52           | 7927           |
| 5            | 315            | 21           | 945            | 37           | 2833           | 53           | 8490           |
| 6            | 338            | 22           | 1013           | 38           | 3035           | 54           | 9093           |
| 7            | 362            | 23           | 1085           | 39           | 3250           | 55           | 9738           |
| 8            | 387            | 24           | 1162           | 40           | 3481           | 56           | 10429          |
| 9            | 415            | 25           | 1244           | 41           | 3728           | 57           | 11170          |
| 10           | 444            | 26           | 1332           | 42           | 3993           | 58           | 11962          |
| 11           | 476            | 27           | 1427           | 43           | 4276           | 59           | 12812          |
| 12           | 510            | 28           | 1528           | 44           | 4580           | 60           | 13721          |
| 13           | 546            | 29           | 1637           | 45           | 4905           | 61           | 14695          |
| 14           | 585            | 30           | 1753           | 46           | 5253           | 62           | 15738          |
| 15           | 626            | 31           | 1878           | 47           | 5626           | 63           | 16856          |

**Table 9.2.3.3.7: HSDPA Transport Block Sizes for 1.28 Mcps TDD, for HS-DSCH physical layer category [22,24]**

| TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] | TB index (k) | TB size [bits] |
|--------------|----------------|--------------|----------------|--------------|----------------|--------------|----------------|
| 0            | NULL           | 16           | 708            | 32           | 2249           | 48           | 7137           |
| 1            | 240            | 17           | 761            | 33           | 2417           | 49           | 7672           |
| 2            | 257            | 18           | 818            | 34           | 2598           | 50           | 8246           |
| 3            | 277            | 19           | 879            | 35           | 2792           | 51           | 8863           |
| 4            | 298            | 20           | 945            | 36           | 3001           | 52           | 9527           |
| 5            | 320            | 21           | 1016           | 37           | 3226           | 53           | 10240          |
| 6            | 344            | 22           | 1092           | 38           | 3468           | 54           | 11006          |
| 7            | 370            | 23           | 1174           | 39           | 3727           | 55           | 11830          |
| 8            | 397            | 24           | 1262           | 40           | 4006           | 56           | 12715          |
| 9            | 427            | 25           | 1356           | 41           | 4306           | 57           | 13667          |
| 10           | 459            | 26           | 1458           | 42           | 4628           | 58           | 14690          |
| 11           | 493            | 27           | 1567           | 43           | 4975           | 59           | 15790          |
| 12           | 530            | 28           | 1685           | 44           | 5347           | 60           | 16972          |
| 13           | 570            | 29           | 1811           | 45           | 5748           | 61           | 18242          |
| 14           | 613            | 30           | 1946           | 46           | 6178           | 62           | 19608          |
| 15           | 659            | 31           | 2092           | 47           | 6640           | 63           | 21076          |

## 9.2.4 MAC PDU: Parameters of the MAC header (E-DCH)

### 9.2.4.1 MAC-es header parameters

- Transmission Sequence Number (TSN):

The TSN field provides the transmission sequence number for the MAC-es PDU. This information is used for reordering purposes to support in-sequence delivery to higher layers. The length of the TSN field is 6 bits.

### 9.2.4.2 MAC-e header parameters

- Data description indicator (DDI):  
The DDI field identifies the logical channel, MAC-d flow and size of the MAC-d PDUs concatenated into the associated MAC-es PDU. The mapping between the DDI values and the logical channel ID, MAC-d flow and PDU size is provided by higher layers. The length of the DDI field is 6 bits.
- For FDD: When, due to the quantization in the transport block sizes that can be supported or triggering of the Scheduling Information, the size of the data plus header is less than or equal to the TB size of the E-TFC selected by the UE minus 24 bits, the DDI value [111111] shall be appended at the end of the MAC-e header and a Scheduling Information shall be concatenated into this MAC-e PDU, where DDI value [111111] indicates that there is a Scheduling Information concatenated in this MAC-e PDU. Otherwise, if the size of the data plus header is less than or equal to the TB size of the E-TFC selected by the UE minus 18 bits, a Scheduling Information shall be concatenated into this MAC-e PDU. In any other case it is understood that another MAC-es PDU or Scheduling Information does not fit and it is therefore not necessary to reserve room in the transport block for an additional DDI field.
- For TDD: When, due to the quantization in the transport block sizes that can be supported or triggering of the Scheduling Information (due to timer expiry, see subclauses 11.9.1.4a and 11.9.1.5), the size of the data plus header is less than or equal to the TB size of the E-TFC selected by the UE minus 29bits, the DDI value [111111] shall be appended at the end of the MAC-e header and a Scheduling Information shall be concatenated into this MAC-e PDU, where DDI value [111111] indicates that there is a Scheduling Information concatenated in this MAC-e PDU. Otherwise, if the size of the data plus header is less than or equal to the TB size of the E-TFC selected by the UE minus 23 bits, a Scheduling Information shall be concatenated into this MAC-e PDU. In any other case it is understood that another MAC-es PDU or Scheduling Information does not fit and it is therefore not necessary to reserve room in the transport block for an additional DDI field.
- Number of MAC-d PDUs (N):  
The number of consecutive MAC-d PDUs corresponding to the same DDI value. The length of the N field is 6 bits.

### 9.2.4.3 MAC-is header parameters

- Transmission Sequence Number (TSN):  
The TSN field provides the transmission sequence number for the MAC-is PDU. This information is used for reordering purposes to support in-sequence delivery to higher layers. The length of the TSN field is 6 bits.
- Segmentation Status (SS):  
The Segmentation Status (SS) field provides indication of the segmentation status of the MAC SDU or segment of MAC SDU belonging to the logical channel identified by the LCH-ID field. The length of the SS field is 2 bits.



**Table 9.2.4.3-1: Structure of the SS field**

| SS Field | Segmentation status                                                                                                                                                                                                                                                                                                                                            |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00       | The first MAC-is SDU of the MAC-is PDU is a complete MAC-d PDU or MAC-c PDU.<br>The last MAC-is SDU of the MAC-is PDU is a complete MAC-d PDU or MAC-c PDU.                                                                                                                                                                                                    |
| 01       | If there are more than one MAC-is SDUs in the MAC-is PDU, the last MAC-is SDU of the MAC-is PDU is a complete MAC-d PDU or MAC-c PDU.<br>The first MAC-is SDU of the MAC-is PDU is the last segment of a MAC-d PDU or MAC-c PDU.                                                                                                                               |
| 10       | If there are more than one MAC-is SDUs in the MAC-is PDU, the first MAC-is SDU of the MAC-is PDU is a complete MAC-d PDU or MAC-c PDU.<br>The last MAC-is SDU of the MAC-is PDU is the first segment of a MAC-d PDU or MAC-c PDU.                                                                                                                              |
| 11       | If there are more than one MAC-is SDUs in the MAC-is PDU, the first MAC-is SDU of the MAC-is PDU is the last segment of a MAC-d PDU or MAC-c PDU and the last MAC-is SDU of MAC-is PDU is the first segment of a MAC-d PDU or MAC-c PDU.<br>If there is only one MAC-is SDU in the MAC-is PDU, the MAC-is SDU is a middle segment of a MAC-d PDU or MAC-c PDU. |

#### 9.2.4.4 MAC-i header parameters

- Length (L):  
The L field provides the length of the MAC-is SDU in octets. The size can vary for each SDU in the MAC-is PDU, and is set for each SDU individually. The length of the Length field is 11 bits.
- Logical channel identifier (LCH-ID):  
The LCH-ID field provides identification of the logical channel at the receiver and the re-ordering buffer destination of a MAC-is SDU. In FDD, one LCH-ID value is reserved to indicate that the UE's E-RNTI is included in the MAC-i header. The length of the LCH-ID is 4 bits.

**Table 9.2.4.4-1: Structure of the LCH-ID field (FDD only)**

| LCH-ID Field | Designation                              |
|--------------|------------------------------------------|
| 0000         | Logical channel 1                        |
| 0001         | Logical channel 2                        |
| ...          | ...                                      |
| 1101         | Logical channel 14                       |
| 1110         | Identification of CCCH (SRB0)            |
| 1111         | Identification of E-RNTI being included. |

**Table 9.2.4.4-2: Structure of the LCH-ID field (1.28 Mcps TDD only)**

| LCH-ID Field | Designation                   |
|--------------|-------------------------------|
| 0000         | Logical channel 1             |
| 0001         | Logical channel 2             |
| ...          | ...                           |
| 1101         | Logical channel 14            |
| 1110         | Identification of CCCH (SRB0) |
| 1111         | Reserved                      |

- Flag (F):  
The F field is a flag indicating if more fields are present in the MAC-i header or not. If the F field is set to "0" the F field is followed by an additional set of LCH-ID, L and F fields. If the F field is set to "1" the F field is followed by a MAC-is PDU. Each header extension corresponds to one MAC-is SDU.

- E-RNTI (FDD only)  
The E-RNTI field provides the UE's E-RNTI value.
- Spare (S) (FDD only):  
The S field is needed to achieve octet alignment in case the UE's E-RNTI is included in the MAC-i header. In this version of the specification, the spare field shall be set to "0000".

## 9.2.5 Signaling of control information for FDD E-DCH

### 9.2.5.1 HARQ information

This control information is used in support of the uplink hybrid ARQ functionality.

- ACK/NACK information:  
Transmitted on downlink on the E-HICH from each cell in the E-DCH active set, the ACK/NACK information indicates the successful or un-successful decoding of the corresponding uplink transmission. This information allows the UE to know whether to make another transmission for the same MAC-e or MAC-i PDU or to start the transmission of a new one. The length of the ACK/NACK field is 1 bit.
- RSN:  
Transmitted on the E-DPCCH, the RSN is used to convey the uplink HARQ transmission number. Because of the limitation in the field size, the RSN saturates to the maximum value once that is reached. The combination of the RSN and the transmission timing allows the receiver to determine the exact transmission number (see [16]). The length of the RSN field is 2 bits.

### 9.2.5.2 DL Scheduling information

This control information is used by Node-Bs in a UE's E-DCH active set in order to control its use of E-DCH system resources.

#### 9.2.5.2.1 Relative Grants

- Serving Relative Grant:  
Transmitted on downlink on the E-RGCH from all cells in the serving E-DCH RLS, the serving relative grant allows the Node B scheduler to incrementally adjust the serving grant of UEs under its control. By definition, there can only be one serving relative grant command received at any one time. This indication can take three different values, "UP", "DOWN" or "HOLD".
- Non-serving Relative Grant:  
Transmitted on downlink on the E-RGCH from a non-serving E-DCH RL, the non-serving relative grant allows neighboring Node Bs to adjust the transmitted rate of UEs that are not under their control in order to avoid overload situations. By definition, there could be multiple non-serving relative grant commands received by MAC at any time. This indication can take two different values, "DOWN" or "HOLD".

The handling of the Relative Grant signalling is based on the Scheduling Grant table configured by higher layers and shown in Tables 9.2.5.2.1.1 and 9.2.5.2.1.2.

**Table 9.2.5.2.1.1: Scheduling Grant Table 1 (SG-table)**

| Index | Scheduled Grant  |
|-------|------------------|
| 37    | $(168/15)^{2*6}$ |
| 36    | $(150/15)^{2*6}$ |
| 35    | $(168/15)^{2*4}$ |
| 34    | $(150/15)^{2*4}$ |
| 33    | $(134/15)^{2*4}$ |
| 32    | $(119/15)^{2*4}$ |
| 31    | $(150/15)^{2*2}$ |
| 30    | $(95/15)^{2*4}$  |
| 29    | $(168/15)^2$     |
| 28    | $(150/15)^2$     |

|    |              |
|----|--------------|
| 27 | $(134/15)^2$ |
| 26 | $(119/15)^2$ |
| 25 | $(106/15)^2$ |
| 24 | $(95/15)^2$  |
| 23 | $(84/15)^2$  |
| 22 | $(75/15)^2$  |
| 21 | $(67/15)^2$  |
| 20 | $(60/15)^2$  |
| 19 | $(53/15)^2$  |
| 18 | $(47/15)^2$  |
| 17 | $(42/15)^2$  |
| 16 | $(38/15)^2$  |
| 15 | $(34/15)^2$  |
| 14 | $(30/15)^2$  |
| 13 | $(27/15)^2$  |
| 12 | $(24/15)^2$  |
| 11 | $(21/15)^2$  |
| 10 | $(19/15)^2$  |
| 9  | $(17/15)^2$  |
| 8  | $(15/15)^2$  |
| 7  | $(13/15)^2$  |
| 6  | $(12/15)^2$  |
| 5  | $(11/15)^2$  |
| 4  | $(9/15)^2$   |
| 3  | $(8/15)^2$   |
| 2  | $(7/15)^2$   |
| 1  | $(6/15)^2$   |
| 0  | $(5/15)^2$   |

Table 9.2.5.2.1.2: Scheduling Grant Table 2 (SG-table)

| Index | Scheduled Grant       |
|-------|-----------------------|
| 37    | $(377/15)^2 \times 4$ |
| 36    | $(336/15)^2 \times 4$ |
| 35    | $(237/15)^2 \times 6$ |
| 34    | $(212/15)^2 \times 6$ |
| 33    | $(237/15)^2 \times 4$ |
| 32    | $(168/15)^{2*6}$      |
| 31    | $(150/15)^{2*6}$      |
| 30    | $(168/15)^{2*4}$      |
| 29    | $(150/15)^2 \times 4$ |
| 28    | $(134/15)^2 \times 4$ |
| 27    | $(119/15)^2 \times 4$ |
| 26    | $(150/15)^2 \times 2$ |
| 25    | $(95/15)^2 \times 4$  |
| 24    | $(168/15)^2$          |
| 23    | $(150/15)^2$          |
| 22    | $(134/15)^2$          |
| 21    | $(119/15)^2$          |
| 20    | $(106/15)^2$          |
| 19    | $(95/15)^2$           |
| 18    | $(84/15)^2$           |
| 17    | $(75/15)^2$           |
| 16    | $(67/15)^2$           |
| 15    | $(60/15)^2$           |
| 14    | $(53/15)^2$           |
| 13    | $(47/15)^2$           |

|    |             |
|----|-------------|
| 12 | $(42/15)^2$ |
| 11 | $(38/15)^2$ |
| 10 | $(34/15)^2$ |
| 9  | $(30/15)^2$ |
| 8  | $(27/15)^2$ |
| 7  | $(24/15)^2$ |
| 6  | $(21/15)^2$ |
| 5  | $(19/15)^2$ |
| 4  | $(17/15)^2$ |
| 3  | $(15/15)^2$ |
| 2  | $(13/15)^2$ |
| 1  | $(12/15)^2$ |
| 0  | $(11/15)^2$ |

When the Serving\_Grant needs to be determined due to E-RGCH signalling (see subclause 11.8.1.3.2), the UE shall:

- if the UE received a Serving Relative Grant in CELL\_DCH state or in CELL\_FACH state after collision resolution (FDD only):
  - Determine the lowest power ratio in the configured SG-table (table 9.2.5.2.1.1 or table 9.2.5.2.1.2) that is equal or higher to the reference\_ETPR, and determine the corresponding index in the SG-table:  $SG_{LUPR}$ ;
  - If the UE received a Serving Relative Grant "UP", based on the thresholds "3-index-step threshold" and "2-index-step threshold" configured by higher layers, determine the Serving\_Grant as follows:
    - if  $SG_{LUPR} < \text{"3-index-step threshold"}$ :
      - Serving\_Grant =  $SG[\text{MIN}(SG_{LUPR} + 3, 37)]$ .
    - if  $\text{"3-index-step threshold"} \leq SG_{LUPR} < \text{"2-index-step threshold"}$ :
      - Serving\_Grant =  $SG[\text{MIN}(SG_{LUPR} + 2, 37)]$ .
    - if  $\text{"2-index-step threshold"} \leq SG_{LUPR}$ :
      - Serving\_Grant =  $SG[\text{MIN}(SG_{LUPR} + 1, 37)]$ .
  - If the UE received a Serving Relative Grant "DOWN", determine the Serving\_Grant:
    - Serving\_Grant =  $SG[\text{MAX}(SG_{LUPR} - 1, 0)]$ .
- if the UE received a Non-serving Relative Grant:
  - Determine the lowest power ratio in the configured SG-table (table 9.2.5.2.1.1 or table 9.2.5.2.1.2) that is equal or higher to the maximum of reference\_ETPR2 of all active HARQ processes, and determine the corresponding index in the SG-table:  $SG_{LUPR2}$ ;
  - If the UE received a Non-serving Relative Grant "DOWN", determine the Serving\_Grant:
    - Serving\_Grant =  $SG[\text{MAX}(SG_{LUPR} - 1, 0)]$
  - if the UE received a Serving Relative Grant in in CELL\_FACH state before collision resolution (FDD only) or in Idle mode:
    - the Serving\_Grant is unchanged (i.e. kept from previous TTI).

### 9.2.5.2.2 Absolute Grant

The absolute grant message is sent on downlink, on the configured E-AGCH, from the serving E-DCH cell and allows the Node B scheduler to directly adjust the granted rate of UEs under its control. In FDD, the channel is also used for collision resolution and release of common E-DCH resources.

The E-AGCH is a shared channel that uses an E-RNTI specific CRC in order to address messages to specific users (see [16]). The RRC may configure the MAC-e or MAC-i with two different E-RNTIs, one primary and one secondary.

Based on the identity that is used, the following information will be conveyed implicitly when an absolute grant message is received:

- Identity Type:  
This variable will take the value "Primary" or "Secondary" respectively based on whether the message was addressed to the primary or the secondary E-RNTI.

The absolute grant message itself includes multiple fields that are multiplexed together into 6 bits inside the MAC-e or MAC-i of the Node B and then submitted to the physical layer for transmission on the E-AGCH. These fields are:

- Absolute Grant Value:  
This field indicates the maximum E-DCH traffic to pilot ratio (E-DPDCH/DPCCH) that the UE is allowed to use in the next transmission. The length of the Absolute Grant Value field is 5 bits.
- Absolute Grant Scope:  
This field indicates the applicability of the Absolute Grant. It can take two different values, "Per HARQ process" or "All HARQ processes", allowing to indicate whether the HARQ process activation/de-activation will affect one or all processes. The Absolute Grant Scope is encoded in 1 bit. In CELL\_DCH state, when the E-DCH is configured with 10ms TTI, only the value "All HARQ processes" is valid (see subclause 10). In case Identity Type is "Secondary", only the value "All HARQ processes" is valid in this version of the protocol. In CELL\_FACH state, only the value "All HARQ processes" is valid (see subclause 10).
- Common E-DCH resource release (FDD only in CELL\_FACH):  
An AG with value set to 'INACTIVE' is used by the Node B to release common E-DCH resources.

### 9.2.5.3 UL Scheduling information

This control information is used by UEs to indicate to their serving E-DCH Node-B the amount of resources they require.

#### 9.2.5.3.1 Happy Bit

The happy bit is a single bit field that is passed from MAC to the physical layer for inclusion on the E-DPCCH. This field takes two values, "Not Happy" and "Happy" indicating respectively whether the UE could use more resources or not. The setting of the Happy Bit is defined in subclause 11.8.1.5.

#### 9.2.5.3.2 Scheduling Information

The Scheduling Information is located at the end of the MAC-e or MAC-i PDU and is used to provide the serving Node B with a better view of the amount of system resources needed by the UE and the amount of resources it can actually make use of. The transmission of this information will be initiated due to the quantization of the transport block sizes that can be supported or based on the triggers defined in subclause 11.8.1.6. When a Scheduling Information is transmitted, its contents shall always be updated in new transmissions with the buffer status after application of the E-TFC selection procedure described in subclause 11.8.1.4. The logical channels for which a non-scheduled grant is configured shall never be taken into account when putting together this information. In addition, the RRC may restrict applicability for logical channels for which no non-scheduled grant was configured.

This information includes the following fields:

- Highest priority Logical channel ID (HLID):  
The HLID field identifies unambiguously the highest priority logical channel with available data. If multiple logical channels exist with the highest priority, the one corresponding to the highest buffer occupancy will be reported. The length of the HLID is 4 bits. In case the TEBS is indicating index 0 (0 byte), the HLID shall indicate the value "0000".
- Fields related to amount of available data:
- Total E-DCH Buffer Status (TEBS):  
The TEBS field identifies the total amount of data available across all logical channels for which reporting has been requested by the RRC and indicates the amount of data in number of bytes that is available for transmission and retransmission in RLC layer. If MAC-i/is is configured, it also includes the amount of data that is available for transmission in the MAC-i/is segmentation entity. When MAC is connected to an AM RLC entity, control PDUs to be transmitted and RLC PDUs outside the RLC Tx window shall also be included in the TEBS. RLC

PDU's that have been transmitted but not negatively acknowledged by the peer entity shall not be included in the TEBS.

The length of this field is 5 bits. The values taken by TEBS are shown in Table 9.2.5.3.2.1.

**Table 9.2.5.3.2-1: TEBS Values**

| Index | TEBS Value (bytes)               |
|-------|----------------------------------|
| 0     | TEBS = 0                         |
| 1     | $0 < \text{TEBS} \leq 10$        |
| 2     | $10 < \text{TEBS} \leq 14$       |
| 3     | $14 < \text{TEBS} \leq 18$       |
| 4     | $18 < \text{TEBS} \leq 24$       |
| 5     | $24 < \text{TEBS} \leq 32$       |
| 6     | $32 < \text{TEBS} \leq 42$       |
| 7     | $42 < \text{TEBS} \leq 55$       |
| 8     | $55 < \text{TEBS} \leq 73$       |
| 9     | $73 < \text{TEBS} \leq 97$       |
| 10    | $97 < \text{TEBS} \leq 129$      |
| 11    | $129 < \text{TEBS} \leq 171$     |
| 12    | $171 < \text{TEBS} \leq 228$     |
| 13    | $228 < \text{TEBS} \leq 302$     |
| 14    | $302 < \text{TEBS} \leq 401$     |
| 15    | $401 < \text{TEBS} \leq 533$     |
| 16    | $533 < \text{TEBS} \leq 708$     |
| 17    | $708 < \text{TEBS} \leq 940$     |
| 18    | $940 < \text{TEBS} \leq 1248$    |
| 19    | $1248 < \text{TEBS} \leq 1658$   |
| 20    | $1658 < \text{TEBS} \leq 2202$   |
| 21    | $2202 < \text{TEBS} \leq 2925$   |
| 22    | $2925 < \text{TEBS} \leq 3884$   |
| 23    | $3884 < \text{TEBS} \leq 5160$   |
| 24    | $5160 < \text{TEBS} \leq 6853$   |
| 25    | $6853 < \text{TEBS} \leq 9103$   |
| 26    | $9103 < \text{TEBS} \leq 12092$  |
| 27    | $12092 < \text{TEBS} \leq 16062$ |
| 28    | $16062 < \text{TEBS} \leq 21335$ |
| 29    | $21335 < \text{TEBS} \leq 28339$ |
| 30    | $28339 < \text{TEBS} \leq 37642$ |
| 31    | $37642 < \text{TEBS}$            |

- Highest priority Logical channel Buffer Status (HLBS):  
The HLBS field indicates the amount of data available from the logical channel identified by HLID, relative to the highest value of the buffer size range reported by TEBS when the reported TEBS index is not 31, and relative to 50000 bytes when the reported TEBS index is 31. The length of HLBS is 4 bits. The values taken by HLBS are shown in table 9.2.5.3.2.2. In case the TEBS field is indicating index 0 (0 byte), the HLBS field shall indicate index 0.

**Table 9.2.5.3.2-2: HLBS Values**

| Index | HLBS values (%)            |
|-------|----------------------------|
| 0     | $0 < \text{HLBS} \leq 4$   |
| 1     | $4 < \text{HLBS} \leq 6$   |
| 2     | $6 < \text{HLBS} \leq 8$   |
| 3     | $8 < \text{HLBS} \leq 10$  |
| 4     | $10 < \text{HLBS} \leq 12$ |
| 5     | $12 < \text{HLBS} \leq 14$ |
| 6     | $14 < \text{HLBS} \leq 17$ |
| 7     | $17 < \text{HLBS} \leq 21$ |
| 8     | $21 < \text{HLBS} \leq 25$ |
| 9     | $25 < \text{HLBS} \leq 31$ |
| 10    | $31 < \text{HLBS} \leq 37$ |
| 11    | $37 < \text{HLBS} \leq 45$ |
| 12    | $45 < \text{HLBS} \leq 55$ |
| 13    | $55 < \text{HLBS} \leq 68$ |
| 14    | $68 < \text{HLBS} \leq 82$ |
| 15    | $82 < \text{HLBS}$         |

- UE Power Headroom (UPH):

The UPH field indicates the ratio of the maximum UE transmission power and the corresponding DPCCCH code power defined in [17]. The length of UPH is 5 bits.

The Scheduling Information message is represented in figure 9.2.5.3.2-1 where for each field, the LSB is the rightmost bit in the figure and the MSB is the leftmost bit.

|                |                 |                 |                 |
|----------------|-----------------|-----------------|-----------------|
| UPH<br>(5bits) | TEBS<br>(5bits) | HLBS<br>(4bits) | HLID<br>(4bits) |
|----------------|-----------------|-----------------|-----------------|

**Figure 9.2.5.3.2-1: Scheduling Information format**

#### 9.2.5.4 Transport block size

RRC can configure the MAC-e or MAC-i to use one of two Transport block size sets for the 10ms TTI duration and one of four Transport block size sets for the 2ms TTI duration. The normative description of the mapping between the E-TFCI and the corresponding transport block size is provided in Annex B:

- If the UE is configured with E-TFCI table 0 (see [7]) and 2ms TTI, it shall use the mapping defined in Annex B.1
- If the UE is configured with E-TFCI table 1 (see [7]) and 2ms TTI, it shall use the mapping defined in Annex B.2
- If the UE is configured with E-TFCI table 2 (see [7]) and 2ms TTI, it shall use the mapping defined in Annex B.2a
- If the UE is configured with E-TFCI table 3 (see [7]) and 2ms TTI, it shall use the mapping defined in Annex B.2b
- If the UE is configured with E-TFCI table 0 (see [7]) and 10ms TTI, it shall use the mapping defined in Annex B.3
- If the UE is configured with E-TFCI table 1 (see [7]) and 10ms TTI, it shall use the mapping defined in Annex B.4

The mapping in Transport block size table 0 for 2ms TTI (see table in Annex B.1) can also be obtained using the formula below.

Let  $k$  be the chosen E-TFCI, then the corresponding E-DCH transport block size  $L_k$  is given by the following formula (informative):

$$L_0 = 18$$

$$\text{if } k = 0..118, 120..126$$

$$L_{k+1} = \lfloor 120 * (\rho)^k \rfloor$$

where

$$\rho = \left( \frac{11484}{120} \right)^{\frac{1}{127-1}}$$

The mapping in Transport block size table 2 for 2ms TTI (see table in Annex B.2a) can also be obtained using the formula below.

Let  $k$  be the chosen E-TFCI, then the corresponding E-DCH transport block size  $L_k$  is given by the following formula (informative):

$$L_0 = 18$$

$$\text{if } k = 0..119, 121..126$$

$$L_{k+1} = \lfloor 120 * (\rho)^k \rfloor$$

where

$$\rho = \left( \frac{22996}{120} \right)^{\frac{1}{127-1}}$$

The mapping in Transport block size table 0 for 10ms TTI (see table in Annex B.3) can also be obtained using the formula below.

Let  $k$  be the chosen E-TFCI, then the corresponding E-DCH transport block size  $L_k$  is given by the following formula (informative):

$$L_0 = 18$$

$$\text{if } k = 0..126$$

$$L_{k+1} = \lfloor 120 * (\rho)^k \rfloor$$

where

$$\rho = \left( \frac{20000}{120} \right)^{\frac{1}{127-1}}$$

## 9.2.6 Signaling of control information for TDD E-DCH

### 9.2.6.1 HARQ information

This control information is used in support of the uplink hybrid ARQ functionality.

- ACK/NACK information:

Transmitted on the E-HICH in the serving E-DCH cell, the ACK/NACK information indicates the successful or unsuccessful decoding of the corresponding uplink transmission. If NACK is received then the UE may



retransmit if appropriate physical resources are available, otherwise it must receive a further Grant before it can retransmit the MAC-e or MAC-i PDU. The length of the ACK/NACK field is 1 bit.

- RSN:  
Transmitted on the E-UCCH, the RSN is used to convey the uplink HARQ transmission number. Because of the limitation in the field size, the maximum value that the RSN can represent is equal to 3. Once the RSN reaches this value, the RSN shall alternate between the values of 2 and 3 for any subsequent consecutive retransmissions. Thus, the RSN sequence follows the pattern 0,1,2,3,2,3,2,3,...(see subclause 11.9.1.1.2). The length of the RSN field is 2 bits.
- HARQ Process Identifier  
Transmitted on the E-UCCH, the HARQ process identifier is selected by the UE and identifies the HARQ process for which the MAC-e or MAC-i PDU is being transmitted/retransmitted. The length of the HARQ process identifier field is 3 bits. For TDD, the MSB of the HARQ Process Identifier is not transmitted by the physical layer but may be inferred by the Node-B according to the nature of the physical resources used (scheduled or unscheduled). HARQ processes associated with scheduled transmission utilise HARQ Process Identifiers 0 to 3.

## 9.2.6.2 DL Scheduling information

This control information is used by a Node-B in order to control its use of E-DCH system resources.

### 9.2.6.2.1 Absolute Grant

The Absolute Grant is sent on downlink on a set of configured E-AGCHs from the serving E-DCH cell and allows the Node B scheduler to directly adjust the granted rate and assigned physical resources for UEs under its control. The physical resource assignment indicates to the UE the maximum amount of uplink resources that it may use for a scheduled transmission.

The E-AGCH is a shared channel that uses an E-RNTI specific CRC in order to address messages to specific UEs (see [19]). For TDD, the RRC shall configure the MAC with a primary E-RNTI only.

A UE is required to monitor a set of E-AGCHs. The RRC signals to the UE details of the set of E-AGCHs that are to be monitored. The UE decodes an Absolute Grant intended for it on the basis of the E-RNTI sent to it by the Node B via the SRNC and by RRC. The following information will be conveyed in an absolute grant message:

- Absolute Grant Value – maximum power granted per resource unit (per slot)
- The physical resources to be used for transmission
  - Channelisation Code
  - Timeslots
  - Resource Duration (optional)

The absolute grant message itself includes multiple fields that are multiplexed together into between 14 and 28 bits for 3.84/7.68 Mcps TDD and between 23 and 26 bits for 1.28 Mcps TDD (depending on the system configuration) inside the MAC-e or MAC-i of the Node B and then submitted to the physical layer for transmission on the E-AGCH. These fields are:

- Absolute Grant Value:  
For TDD, this field indicates the maximum E-PUCH transmission power E-DCH traffic to reference power ratio per TDD resource unit that the UE is allowed to use on the E-DCH resources associated with the Absolute Grant. A TDD resource unit is defined as one sixteenth of the OVSF codespace in one timeslot. The length of the Absolute Grant Value field for TDD is 5 bits.
- Channelisation Code:  
This field describes the code component of the physical resource grant. For 1.28/3.84 Mcps TDD it comprises an enumerated value of length 5 bits indicating which node on the OVSF code tree has been allocated. For 7.68 Mcps TDD it comprises an enumerated value of length 6 bits indicating which node on the OVSF tree has been allocated. The mapping between the allocated OVSF and the enumerated node 0...30 for 1.28/3.84 Mcps and 0...62 for 7.68 Mcps is as given in [19].
- Timeslot Resource Related Information:  
This field describes the timeslot component of the physical resource grant and comprises a bitmap of length  $n_{\text{TRRI}}$ . For 3.84/7.68 Mcps TDD, the TRRI field indicates which of the timeslots configured for E-DCH use by RRC have been allocated with the LSB corresponding to the lowest numbered E-DCH timeslot and the MSB

corresponding to the highest numbered timeslot. The length of the TRRI field ( $n_{\text{TRRI}}$ ) is 5 bits and is configurable by RRC on a per-cell basis between 1 and 12 bits for 3.84/7.68 Mcps TDD. For 1.28 Mcps TDD, the length of the TRRI field ( $n_{\text{TRRI}}$ ) is 5 bits with MSB corresponding to TS1 and LSB corresponding to TS5.

- Resource Duration Indicator:  
Optionally, RRC may configure, on a per-cell basis the presence of a resource duration indicator field on E-AGCH for TDD. If configured as present in a cell, 3 bits are used to indicate the number of TTI's allocated and the spacing between the allocated TTIs via a single grant according to table 9.2.6.2.1-2. If the field is configured as not present on E-AGCH in the cell, a value of 0 is implicitly assumed by the UE corresponding to 1 TTI.

**Table 9.2.6.2.1-2 – Resource Duration Indicator (RDI) interpretation**

| Resource Duration Indicator<br>(3 bits) | TTIs allocated | TTI spacing |
|-----------------------------------------|----------------|-------------|
| 0                                       | 1              | 1           |
| 1                                       | 2              | 1           |
| 2                                       | 2              | 2           |
| 3                                       | 2              | 4           |
| 4                                       | 4              | 1           |
| 5                                       | 4              | 2           |
| 6                                       | 4              | 4           |
| 7                                       | 8              | 1           |

- E-AGCH Cyclic Sequence Number (ECSN):  
The ECSN is a 3-bit field used to assist the UE with outer-loop power control of E-AGCH (cf. HCSN for HS-SCCH).
- E-HICH Indicator(EI) (1.28 Mcps TDD only)  
The E-HICH indicator (EI) consists of 2 bits and is used to indicate which E-HICH will convey the acknowledgement indicator for the scheduled UEs.
- E-UCCH Number Indicator (ENI) (1.28 Mcps TDD only)  
The E-UCCH Number Indicator (ENI) is a 3-bit field used to indicate the detailed number of E-UCCH.

### 9.2.6.3 UL Scheduling Information

This control information is used by UEs to indicate to the Node B the amount of resources they require. Scheduling Information is sent via the E-PUCH in the MAC-e or MAC-i header when the UE is granted resource and by the E-RUCCH when no resource has been granted. Scheduling Information consists of three components as defined below.

- Buffer Information: This consists of:
  - Highest priority Logical Channel (HLID)  
The HLID field identifies unambiguously the highest priority logical channel with available data. If multiple logical channels exist with the highest priority, the one corresponding to the highest buffer occupancy will be reported. The length of the HLID is 4 bits. In case the TEBS is indicating index 0 (0 byte), the HLID shall indicate the value "0000".
  - Total E-DCH Buffer Status (TEBS)  
The TEBS field identifies the total amount of data available across all logical channels for which reporting has been requested by the RRC and indicates the amount of data in number of bytes that is available for transmission and retransmission in RLC layer. If MAC-i/is is configured, it also includes the amount of data that is available for transmission in the MAC-i/is segmentation entity. When MAC is connected to an AM RLC entity, control PDUs to be transmitted and RLC PDUs outside the RLC Tx window shall also be included in the TEBS. RLC PDUs that have been transmitted but not negatively acknowledged by the peer entity shall not be included in the TEBS.
  - Highest priority Logical channel Buffer Status (HLBS)

The HLBS field indicates the amount of data available from the logical channel identified by HLID, relative to the highest value of the buffer size range reported by TEBS when the reported TEBS index is not 31, and relative to 50000 bytes when the reported TEBS index is 31.

- UE Power Headroom (UPH): The UPH field indicates the ratio of the maximum UE transmission power and the calculated UE transmit power defined as in [18] that would result for  $\beta_e$  equal to 0. The length of UPH is 5 bits.
- Serving and Neighbour Cell Pathloss (SNPL): This may be used by the Node-B to assist with its estimation of the degree of intercell interference each UE will generate and hence the absolute grant power value and physical resources to assign. The length of SNPL is 5 bits.

The length of TEBS field is 5 bits, the values taken by TEBS are shown in Table 9.2.5.3.2-1. The length of HLBS is 4 bits, the values taken by HLBS are shown in table 9.2.5.3.2-2.

The Scheduling Information message is represented in figure 9.2.6.3-1 where for each field, the LSB is the rightmost bit in the figure and the MSB is the leftmost bit:

|                 |                 |                 |                 |                 |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| <b>SNPL</b>     | <b>UPH</b>      | <b>TEBS</b>     | <b>HLBS</b>     | <b>HLID</b>     |
| <b>(5 bits)</b> | <b>(5 bits)</b> | <b>(5 bits)</b> | <b>(4 bits)</b> | <b>(4 bits)</b> |

**Figure 9.2.6.3.-1: Scheduling Information format**

If Scheduling Information is sent via the E-RUCCH then the E-RNTI is also sent via the E-RUCCH, as shown by Figure 9.2.6.3-2 where the LSB is the rightmost bit in the figure and the MSB is the leftmost bit:

|                                         |                         |
|-----------------------------------------|-------------------------|
| <b>Scheduling Information (23 bits)</b> | <b>E-RNTI (16 bits)</b> |
|-----------------------------------------|-------------------------|

**Figure 9.2.6.3-2: Format of information sent on E-RUCCH**

#### 9.2.6.4 Transport block size

For 1.28 Mcps TDD, the normative description of the mapping between the TB index and the corresponding transport block size is provided in Annex BC.

For 3.84 Mcps TDD, the normative description of the mapping between the E-TFC index and the corresponding transport block size is provided in Annex BA.

For 7.68 Mcps TDD, the normative description of the mapping between the E-TFC index and the corresponding transport block size is provided in Annex BB.

##### 9.2.6.4.1 3.84 Mcps TDD Transport Block Size

For 3.84 Mcps TDD, the mapping of transport block size  $L$  to signalled index  $k_i = \{0,1,\dots,127\}$  (see Annex BA.1) is given by the formula:

$$L = \left\lfloor 60 \times \rho^{k_n + k_i} \right\rfloor$$

In the above formula  $\rho = 128^{\frac{1}{127}}$ ,  $k_i$  is the TBS index (0...127) and  $k_n$  is an integer selected based upon the number of timeslots allocated ( $n$ ). Values for  $k_n$  are tabulated in Table 9.2.6.4.1.

**Table 9.2.6.4.1:  $k_n$  tabulated as a function of the number of timeslots ( $n$ )**

|          |                         |
|----------|-------------------------|
| <b>n</b> | <b><math>k_n</math></b> |
| 1        | 0                       |

|    |    |
|----|----|
| 2  | 18 |
| 3  | 28 |
| 4  | 36 |
| 5  | 42 |
| 6  | 46 |
| 7  | 50 |
| 8  | 54 |
| 9  | 57 |
| 10 | 60 |
| 11 | 62 |
| 12 | 65 |

9.2.6.4.2 7.68 Mcps TDD Transport Block Size

For 7.68 Mcps TDD, the mapping of transport block size  $L$  to signalled index  $k_i = \{0,1,\dots,127\}$  (see Annex BB.1) is given by the formula:

$$L = \lfloor 60 \times \rho^{k_n+k_i} \rfloor$$

In the above formula,  $\rho = 256^{\frac{1}{127}}$   $k_i$  is the TBS index (0...127) and  $k_n$  is an integer selected based upon the number of timeslots allocated ( $n$ ). Values for  $k_n$  are tabulated in Table 9.2.6.4.2.

**Table 9.2.6.4.2:  $k_n$  tabulated as a function of the number of timeslots ( $n$ )**

|     |       |
|-----|-------|
| $n$ | $k_n$ |
| 1   | 0     |
| 2   | 15    |
| 3   | 25    |
| 4   | 31    |
| 5   | 36    |
| 6   | 41    |
| 7   | 44    |
| 8   | 47    |
| 9   | 50    |
| 10  | 52    |
| 11  | 54    |
| 12  | 56    |

9.2.6.4.3 1.28 Mcps TDD Transport Block Size

For 1.28 Mcps TDD, the mapping of transport block size  $L$  to TB index  $k$  ( $k = \{0,1,\dots,63\}$ ;) (see Annex BC.1) is given by the formula:

**Table 9.2.6.4.3: formula used to calculate the Transport Block Size**

| Category 1-2                                                                                 |             |             | Category 3-6 |             |             |               |
|----------------------------------------------------------------------------------------------|-------------|-------------|--------------|-------------|-------------|---------------|
| 1 Timeslot                                                                                   | 2 Timeslots | 3 Timeslots | 1 Timeslot   | 2 Timeslots | 3 Timeslots | 4&5 Timeslots |
| $L_0 = 23, L_1 = 116, L_{\min} = 162, L_k = \lfloor L_{\min} p^{k-2} \rfloor, k \in [2, 62]$ |             |             |              |             |             |               |

|                                             |                                             |                                             |                                             |                                             |                                             |                                              |
|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|
| $L_{63} = 1346,$<br>$p = \frac{7768}{7503}$ | $L_{63} = 2754,$<br>$p = \frac{2578}{2461}$ | $L_{63} = 4162,$<br>$p = \frac{8934}{8471}$ | $L_{63} = 2720,$<br>$p = \frac{9781}{9339}$ | $L_{63} = 5532,$<br>$p = \frac{2934}{2769}$ | $L_{63} = 8348,$<br>$p = \frac{3052}{2861}$ | $L_{63} = 11160,$<br>$p = \frac{9652}{9005}$ |
|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|---------------------------------------------|----------------------------------------------|

## 9.2.6.5 Timing Advance and Synchronisation (3.84/7.68 Mcps TDD only)

### 9.2.6.5.1 Unsynchronised Handover

In the case of unsynchronised handover (e.g. from FDD or from GERAN) and if no uplink DPCH is allocated the UE shall obtain timing advance in the new 3.84/7.68 Mcps TDD cell by transmission of Timing Advance Request on the E-RUCCH and by receiving Timing Advance Response on the E-AGCH.

### 9.2.6.5.2 Synchronisation

In the case that no uplink DPCH is allocated and after a period T-adv (configured by higher layers [7]) of no uplink transmission on the E-DCH or E-RUCCH and the UE has information to send on the E-DCH or HS-SICH, then the UE shall obtain timing advance and synchronisation by transmission of Timing Advance Request on the E-RUCCH and by receiving Timing Advance Response on the E-AGCH.

### 9.2.6.5.3 Timing Advance Request

Timing Advance Request is sent on the E-RUCCH using the general message format shown by Figure 9.2.6.3-1 and by having TEBS set to 0.

### 9.2.6.5.4 Timing Advance Response

Timing Advance Response is sent by the Node B on the E-AGCH in response to a Timing Advance Request and is indicated by Timeslot Resource Related Information (see Section 9.2.6.2.1) being set to 0. The value to be used for timing adjustment is carried by the Absolute Grant Value and Channelisation Code fields in the E-AGCH as shown by tables 9.2.6.5-1 and 9.2.6.5-2:

**Table 9.2.6.5-1: 3.84 Mcps TDD**

| Absolute Grant Value (most significant 3 bits of timing advance) |   |   |   |   | Channelisation Code (least significant 5 bits of timing advance) |   |   |   |   |
|------------------------------------------------------------------|---|---|---|---|------------------------------------------------------------------|---|---|---|---|
| 0                                                                | 0 | X | X | X | X                                                                | X | X | X | X |

**Table 9.2.6.5-2: 7.64 Mcps TDD**

| Absolute Grant Value (most significant 3 bits of timing advance) |   |   |   |   | Channelisation Code (least significant 6 bits of timing advance) |   |   |   |   |   |   |
|------------------------------------------------------------------|---|---|---|---|------------------------------------------------------------------|---|---|---|---|---|---|
| 0                                                                | 0 | X | X | X | X                                                                | X | X | X | X | X | X |

On receipt of Timing Advance Response the UE shall adjust its transmissions based on the the received timing advance adjustment [18]. If Timing Advance Response is not received within a period T-RUCCH then the UE shall retransmit Timing Advance Request.

---

## 10 Handling of unknown, unforeseen and erroneous protocol data

The list of error cases is reported below:

a) Use of reserved coding in the MAC header

If the MAC entity receives a MAC PDU with a header field using a value marked as reserved for this version of the protocol, it shall discard the PDU, unless explicitly mentioned otherwise.

b) Inconsistent MAC header

If the MAC entity receives a MAC PDU with a header inconsistent with the configuration received from RRC, it shall discard the PDU. E.g.: In case DTCH is mapped to RACH/FACH, the MAC entity shall discard a PDU with a C/T field indicating a logical channel number that is not configured.

c) Erroneous MAC header fields

The MAC PDU shall be discarded if the lower layer gives an error indication for a MAC PDU and a MAC header is included in the MAC PDU.

d) Inconsistent information received on MAC control channels

If the MAC entity receives inconsistent information on the E-AGCH, it shall ignore the entire message. The following conditions constitute inconsistent information:

- The Absolute Grant Scope is "Per HARQ process" and the E-DCH TTI is configured to 10ms.
- The UE is in CELL\_DCH, the Identity Type is "Secondary" and the Absolute Grant Value is "INACTIVE".
- The Identity Type is "Secondary" and the Absolute Grant Scope is "Per HARQ process" in this version of the protocol.
- The UE is in CELL\_DCH, the Identity type is "Primary", the Absolute Grant value is "INACTIVE", the Absolute Grant Scope is "All HARQ processes", the E-DCH TTI is configured to 10ms and a secondary E-RNTI was not configured.
- The UE is in CELL\_FACH and the Absolute Grant Scope is "Per HARQ process".

---

## 11 Specific functions

### 11.1 Traffic volume measurement for dynamic radio bearer control

Dynamic radio bearer control is performed by RRC, based on the traffic volume measurements reported by MAC. Traffic volume information is measured in MAC layer and the results are reported from MAC layer to RRC layer.

At least every TTI, the MAC layer shall receive from each RLC entity the value of its Buffer Occupancy (BO), expressed in bytes. RRC can configure MAC to keep track of statistics (i.e. raw BO, average of BO and variance of BO) on the BO (see [7]) values of all Radio Bearers mapped onto a given transport channel. When the average or variance are requested, an averaging interval duration will also be provided.

Every time the BO values are reported to MAC, the UE shall verify whether an event was triggered or if a periodic report is required (see [7]). If reporting is required (multiple reports may be triggered in a single TTI), the MAC shall deliver to RRC the reporting quantities required for the corresponding RBs. In the case of average and variance of BO, the averaging should be performed for the interval with the configured duration ending at the time when the event was triggered.

RRC requests MAC measurement report with the primitive CMAC-Measure-REQ including following parameters.

Measurement information elements.

- Reporting Quantity identifiers  
Indicates what should be reported to RRC layer  
For each RB, BO (optional), Average of BO (optional), or Variance of BO(optional)
- Time interval to take an average or a variance (applicable when Average or Variance is Reporting Quantity)  
Indicates time interval to take an average or a variance of BO  
The calculation of average and variance of BO shall be based on one sample of BO per 10ms during the time interval given in this information element. All samples taken in the time interval shall have equal weight in the calculation.

MAC receives RLC PDUs with the primitive MAC-Data-REQ including following parameters.

- Buffer Occupancy (BO)  
The parameter Buffer Occupancy (BO) indicates for each logical channel the amount of data in number of bytes that is available for transmission and retransmission in RLC layer. When MAC is connected to an AM RLC entity, control PDUs to be transmitted and RLC PDUs outside the RLC Tx window shall also be included in the BO. RLC PDUs that have been transmitted but not negatively acknowledged by the peer entity shall not be included in the BO.

## 11.2 Control of RACH transmissions and Enhanced Uplink in CELL\_FACH state and Idle mode transmissions

The MAC sublayer is in charge of controlling the timing of RACH transmissions on transmission time interval level (the timing on access slot level is controlled by L1). Note that retransmissions in case of erroneously received RACH message part are under control of higher layers, i.e. RLC, or RRC for CCCH (and SHCCH for TDD).

In FDD, the MAC sublayer is in charge of controlling the timing of Enhanced Uplink transmissions in CELL\_FACH state and Idle mode on transmission time interval level (the timing on access slot level is controlled by L1). Note that after common EDCH resource allocation the transmission, retransmission and collision resolution is under control of MAC. Retransmissions in case of erroneously received MAC-is PDUs are under control of higher layers, i.e. RLC, or RRC for CCCH.

### 11.2.1 Access Service Class selection

The physical RACH resources (i.e. access slots and preamble signatures for FDD, timeslot and channelisation code for 3.84 Mcps TDD and 7.68 Mcps TDD, SYNC1 code for 1.28 Mcps TDD) may be divided between different Access Service Classes in order to provide different priorities of RACH usage. In FDD, the physical resources for Enhanced Uplink in CELL\_FACH state and Idle mode (i.e. access slots and preamble signatures) may be divided between different Access Service Classes in order to provide different priorities of the usage of the Enhanced Uplink in CELL\_FACH state and Idle mode. It is possible for more than one ASC or for all ASCs to be assigned to the same access slot/signature space or SYNC1 code.

Access Service Classes are numbered in the range  $0 \leq i \leq \text{NumASC} \leq 7$  (i.e. the maximum number of ASCs is 8). An ASC is defined by an identifier  $i$  that defines a certain partition of the PRACH resources and an associated persistence value  $P_i$ . A set of ASC parameters consists of NumASC+1 such parameters  $(i, P_i)$ ,  $i = 0, \dots, \text{NumASC}$ . The PRACH partitions and the persistence values  $P_i$  are derived by the RRC protocol from system information (see [7]). The set of ASC parameters is provided to MAC with the CMAC-Config-REQ primitive. The ASC enumeration is such that it corresponds to the order of priority (ASC 0 = highest priority, ASC 7 = lowest priority). ASC 0 shall be used in case of Emergency Call or for reasons with equivalent priority.

At radio bearer setup/reconfiguration each involved logical channel is assigned a MAC Logical channel Priority (MLP) in the range 1,...,8. When the MAC sublayer is configured for RACH transmission in the UE, these MLP levels shall be employed for ASC selection on MAC.

The following ASC selection scheme shall be applied, where NumASC is the highest available ASC number and MinMLP the highest logical channel priority assigned to one logical channel:

- in case all TBs in the TB set have the same MLP, select  $\text{ASC} = \min(\text{NumASC}, \text{MLP})$ ;

- in case TBs in a TB set have different priority, determine the highest priority level MinMLP and select  $ASC = \min(\text{NumASC}, \text{MinMLP})$ .

When an RRC CONNECTION REQUEST message is sent RRC determines ASC by means of the access class [7]. The ASC to be used in these circumstances is signalled to MAC by means of the CMAC-CONFIG-REQ message.

If MAC has knowledge of a U-RNTI then the ASC is determined in the MAC entity. If no U-RNTI has been indicated to MAC then MAC will use the ASC indicated in the CMAC-CONFIG-REQ primitive.

## 11.2.2 Control of RACH transmissions for FDD mode

The RACH transmissions are controlled by the UE MAC sublayer as outlined in figure 11.2.2.1.

NOTE: The figure shall illustrate the operation of the transmission control procedure as specified below. It shall not impose restrictions on implementation. MAC controls the timing of each initial preamble ramping cycle as well as successive preamble ramping cycles in case that none or a negative acknowledgement is received on AICH.

NOTE: In Cell-FACH state, the UE should co-ordinate the UL transmission schedule with the measurement schedule in FACH measurement occasions so as to minimise any delays associated with inter-frequency measurements.

MAC receives the following RACH transmission control parameters from RRC with the CMAC-CONFIG-Req primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  an identification of a PRACH partition and a persistence value  $P_i$  (transmission probability);
- maximum number of preamble ramping cycles  $M_{\max}$ ;
- range of backoff interval for timer  $T_{\text{BO1}}$ , given in terms of numbers of transmission 10 ms time intervals  $N_{\text{BO1max}}$  and  $N_{\text{BO1min}}$ , applicable when negative acknowledgement on AICH is received.

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a certain PRACH partition and an associated persistence value  $P_i$ . The procedure to be applied for ASC selection is described in subclause 11.2.1.

Based on the persistence value  $P_i$ , the UE decides whether to start the L1 PRACH transmission procedure (see [13]) in the present transmission time interval or not. If transmission is allowed, the PRACH transmission procedure (starting with a preamble power ramping cycle) is initiated by sending of a PHY-ACCESS-REQ primitive. MAC then waits for access information from L1 via PHY-ACCESS-CNF primitive. If transmission is not allowed, a new persistency check is performed in the next transmission time interval. The persistency check is repeated until transmission is permitted.

When the preamble has been acknowledged on AICH, L1 access information with parameter value "ready for data transmission" is indicated to MAC with PHY-ACCESS-CNF primitive. Then data transmission is requested with PHY-DATA-REQ primitive, and the PRACH transmission procedure shall be completed with transmission of the PRACH message part according to L1 specifications. Successful completion (TX status) of the MAC transmission control procedure shall be indicated to higher layer.

When PHY indicates that no acknowledgement on AICH is received while the maximum number of preamble retransmissions is reached (defined by parameter `Preamble_Retrans_Max` on L1), a new persistency test is performed in the next transmission time interval. The timer  $T_2$  ensures that two successive persistency tests are separated by at least one 10 ms time interval.

In case that a negative acknowledgement has been received on AICH a backoff timer  $T_{\text{BO1}}$  is started. After expiry of the timer, persistence check is performed again. Backoff timer  $T_{\text{BO1}}$  is set to an integer number  $N_{\text{BO1}}$  of 10 ms time intervals, randomly drawn within an interval  $0 \leq N_{\text{BO1min}} \leq N_{\text{BO1}} \leq N_{\text{BO1max}}$  (with uniform distribution).  $N_{\text{BO1min}}$  and  $N_{\text{BO1max}}$  may be set equal when a fixed delay is desired, and even to zero when no delay other than the one due to persistency is desired.

Before a persistency test is performed it shall be checked whether any new RACH transmission control parameters have been received from RRC with CMAC-CONFIG-Req primitive. The latest set of RACH transmission control parameters shall be applied.



If the maximum number of preamble ramping cycles  $M_{\max}$  is exceeded, failure of RACH transmission shall be reported to higher layer.

Both, transmission failure and successful completion of the MAC transmission control procedure, shall be indicated individually for each logical channel of which data was included in the transport block set of that access attempt. When transparent mode RLC is employed (i.e. for CCCH), transmission status is reported to RRC with CMAC-STATUS-Ind primitive. For logical channels employing acknowledged or unacknowledged mode RLC, transmission status is reported to RLC with MAC-STATUS-Ind primitive.

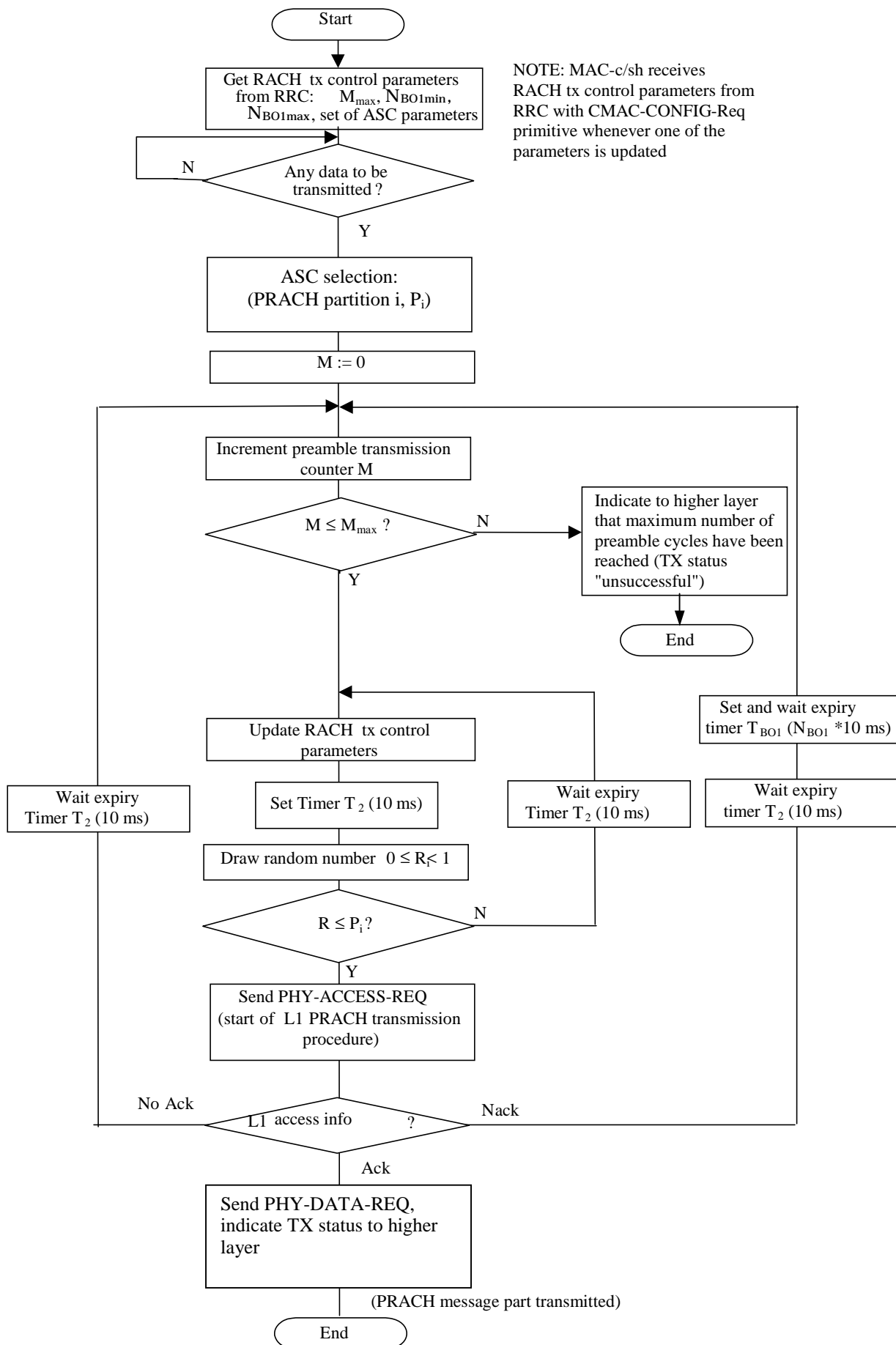


Figure 11.2.2.1: RACH transmission control procedure (UE side, informative)

## 11.2.2A Control of Enhanced Uplink in CELL\_FACH state and Idle mode for FDD mode

The transmissions in Enhanced Uplink in CELL\_FACH state and Idle mode are controlled by the UE MAC sublayer as outlined in figures 11.2.2A-1, 11.2.2A-2 and 11.2.2A-3.

NOTE: The figures shall illustrate the operation of the transmission control procedure as specified below. It shall not impose restrictions on implementation. MAC controls the timing of each initial preamble ramping cycle as well as successive preamble ramping cycles in case that no or a negative acknowledgement is received carried with an AI on AICH, if the use of E-AIs is not configured, and in case that none is received carried with an AI or a negative acknowledgement is received carried with an E-AI, if the use of E-AIs is configured. MAC receives the following random access transmission control parameters from RRC with the CMAC-CONFIG-Req primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  an identification of a PRACH partition and a persistence value  $P_i$  (transmission probability);
- maximum number of preamble ramping cycles  $M_{\max}$ ;
- range of backoff interval for timer  $T_{\text{BO1}}$ , given in terms of numbers of transmission 10 ms time intervals  $N_{\text{BO1max}}$  and  $N_{\text{BO1min}}$ , applicable when negative acknowledgement is received carried with an E-AI, or carried with an AI, when the use of E-AIs is not configured.

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a certain PRACH partition for Enhanced Uplink in CELL\_FACH state and Idle mode and an associated persistence value  $P_i$ . The procedure to be applied for ASC selection is described in subclause 11.2.1.

Based on the persistence value  $P_i$ , the UE decides whether to start the L1 physical random access procedure for E-DCH (see [13]) in the present transmission time interval. If transmission is allowed, the physical random access procedure for E-DCH (starting with a preamble power ramping cycle) is initiated by sending of a PHY-ACCESS-REQ primitive. MAC then waits for access information from L1 via PHY-ACCESS-CNF primitive. If transmission is not allowed, a new persistency check is performed in the next transmission time interval. The persistency check is repeated until transmission is permitted.

When PHY indicates that neither a positive nor negative acknowledgement on AICH is received while the maximum number of preamble retransmissions is reached (defined by parameter `Preamble_Retrans_Max` on L1), a new persistency test is performed in the next transmission time interval. The timer  $T_2$  ensures that two successive persistency tests are separated by at least one 10 ms time interval.

In case that a negative acknowledgement has been received on AICH if no Extended AICH set is configured, or in case a negative acknowledgement has been detected on the Extended AICH, the timer  $T_2$  is started. After the expiry of  $T_2$  a backoff timer  $T_{\text{BO1}}$  is started. After expiry of the timer, persistence check is performed again. Backoff timer  $T_{\text{BO1}}$  is set to an integer number  $N_{\text{BO1}}$  of 10 ms time intervals, randomly drawn within an interval  $0 \leq N_{\text{BO1min}} \leq N_{\text{BO1}} \leq N_{\text{BO1max}}$  (with uniform distribution).  $N_{\text{BO1min}}$  and  $N_{\text{BO1max}}$  may be set equal when a fixed delay is desired, and even to zero when no delay other than the one due to persistency is desired.

Before a persistency test is performed it shall be checked whether any new access transmission control parameters for Enhanced Uplink in CELL\_FACH and Idle mode have been received from RRC with the CMAC-CONFIG-Req primitive. The latest set of random access transmission control parameters shall be applied.

If the maximum number of preamble ramping cycles  $M_{\max}$  is exceeded, failure of an Enhanced Uplink transmission in CELL\_FACH state or Idle mode shall be reported to higher layer.

When the preamble has been acknowledged on AICH, then L1 access information with parameter "E-DCH resource index" corresponding to the selected signature as defined in [24] is indicated to MAC with PHY-ACCESS-CNF primitive. MAC provides the "E-DCH resource index" with the the CMAC-STATUS primitive to the RRC and receives following control parameters from RRC with the CMAC-CONFIG-Req primitive:

- Symbol offset  $S_{\text{offset}}$ ;
- Additional E-DCH transmission back off;

- E-DCH and UL DPCCCH configuration elements;
- the maximum period for collision resolution phase, where a common E-DCH resource can be used before collision resolution;
- the maximum E-DCH resource allocation for CCCH (Timer  $T_{max}$  in figures 11.2.2A-2);
- E-DCH transmission continuation back off.

Then DPCCCH/E-DPCCCH/E-DPDCH transmission is started with sending the PHY-DATA-REQ primitive every Transmission Time Interval. The PHY-Data-REQ primitive is used to request SDUs used for communications passed to the physical layer. Hereby, if TTI length is 10 ms, then for the first (1 + "Additional E-DCH transmission back off") Transmission Time Intervals no SDU is passed to the physical layer, i.e. only DPCCCH transmission takes place. If TTI length is 2 ms, then for the first (2 + "Additional E-DCH transmission back off") Transmission Time Intervals no SDU is passed to the physical layer.

The allocated common E-DCH resource shall be used by MAC to carry either only CCCH transmission or only DTCH/DCCH transmission, but not both.

The E-DCH enhanced physical random access transmission procedure is completed with release of the allocated common E-DCH resource, if one of the following conditions is fulfilled:

- If the UE according to subclause 8.5.4A in [7] failed to establish the physical channels, or if the criteria for radio link failure are met as specified in subclause 8.5.6 in [7], then the timer  $T_2$  is started. After the expiry of  $T_2$  a backoff timer  $T_{BO1}$  is started. Backoff timer  $T_{BO1}$  is set to an integer number  $N_{BO1}$  of 10 ms time intervals, randomly drawn within an interval  $0 \leq N_{BO1min} \leq N_{BO1} \leq N_{BO1max}$  (with uniform distribution).  $N_{BO1min}$  and  $N_{BO1max}$  may be set equal when a fixed delay is desired, and even to zero when no delay other than the one due to persistency is desired. The procedure ends if timer TBO1 expires or the UE performs cell reselection while timer TBO1 is running, whatever occurs first. In case of a cell reselection, the timer TBO1 is stopped.
- In case of CCCH transmission, if the maximum E-DCH resource allocation for CCCH has been reached, then this triggers a CMAC-STATUS which informs the RRC about end of the Enhanced Uplink for CELL\_FACH state and Idle mode.
- In case of CCCH transmission, if the transmission E-DCH Buffer status is 0 bytes and no MAC-i PDUs are left for (re-)transmission in MAC, then this triggers a CMAC-STATUS which informs the RRC about the end of the Enhanced Uplink for CELL\_FACH state and Idle mode.
- In case of DTCH/DCCH transmission, if no E-AGCH with UE's E-RNTI has been received (through an E-RNTI-specific CRC attachment) within the maximum period for collision resolution phase, then this triggers a CMAC-STATUS which informs the RRC about the end of the Enhanced Uplink for CELL\_FACH state and Idle mode. Then the timer  $T_2$  is started. After the expiry of  $T_2$  a backoff timer  $T_{BO1}$  is started. Backoff timer  $T_{BO1}$  is set to an integer number  $N_{BO1}$  of 10 ms time intervals, randomly drawn within an interval  $0 \leq N_{BO1min} \leq N_{BO1} \leq N_{BO1max}$  (with uniform distribution).  $N_{BO1min}$  and  $N_{BO1max}$  may be set equal when a fixed delay is desired, and even to zero when no delay other than the one due to persistency is desired. The procedure ends when  $T_{BO1}$  expires.
- Explicit common E-DCH resource release:  
In case of DTCH/DCCH transmission, if an E-AGCH with UE's E-RNTI has been received (through an E-RNTI-specific CRC attachment) with absolute grant value set to 'INACTIVE', then this triggers a CMAC-STATUS which informs the RRC about end of the Enhanced Uplink for CELL\_FACH state and Idle mode.
- Implicit release with E-DCH transmission continuation backoff  
Implicit resource release is enabled only if "E-DCH transmission continuation back off" is not set to "infinity". If implicit resource release is enabled, then in case of DTCH/DCCH transmission, the timer  $T_b$  is set to "E-DCH transmission continuation back off" value, when TEBS is 0 byte and the last generated MAC-i PDU with higher layer data is provided with the PHY-data-REQ primitive to the physical layer for transmission. If  $TEBS < 0$  byte is detected while timer  $T_b$  is running, then the timer is stopped and uplink data transmission on the common E-DCH resource continues. If a MAC-ehs PDU is received while timer  $T_b$  is running, then the timer is re-started. At expiry of timer  $T_b$  the MAC-STATUS-Ind primitive indicates to RLC for each logical channel that no PDUs shall be transferred to MAC.  $TEBS = 0$  byte is reported to the Node B MAC as SI in a MAC-i PDU. If the "E-DCH transmission continuation back off" value is set to "0", then the SI should be transmitted with the MAC-i PDU carrying the last DCCH/DTCH data, given the serving grant is sufficient to carry the SI in the same MAC-i PDU together with the remaining DCCH/DTCH data. Otherwise, the empty buffer status report is transmitted

separately with the next MAC-i PDU.

If after the expiry of timer  $T_b$  no MAC-i PDU is left in a HARQ process for (re-)transmission, then this triggers a CMAC-STATUS which informs the RRC about end of the Enhanced Uplink for CELL\_FACH state and Idle mode.

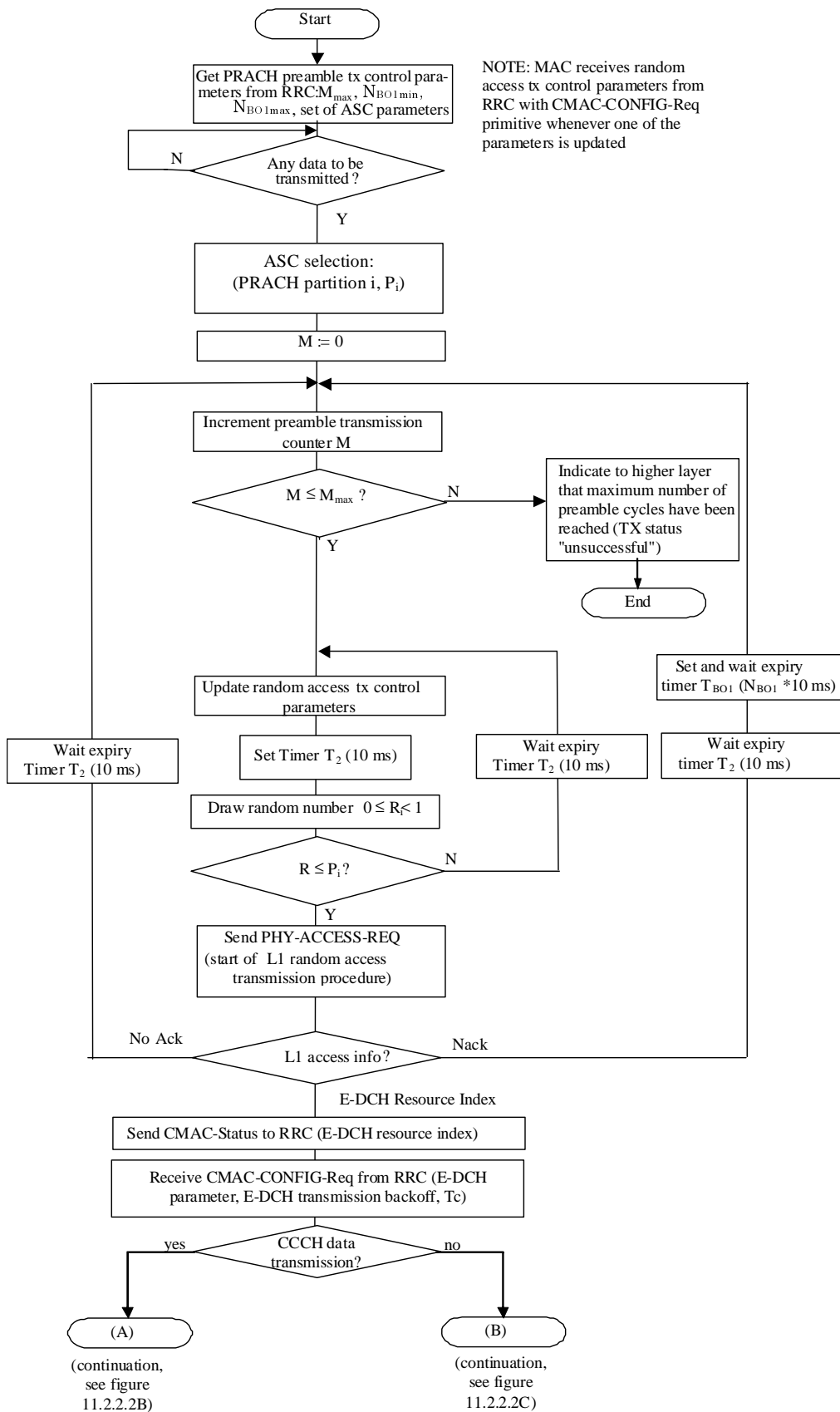


Figure 11.2.2A-1: Enhanced Uplink in CELL\_FACH state and Idle mode transmission control procedure (UE side, informative), Part I

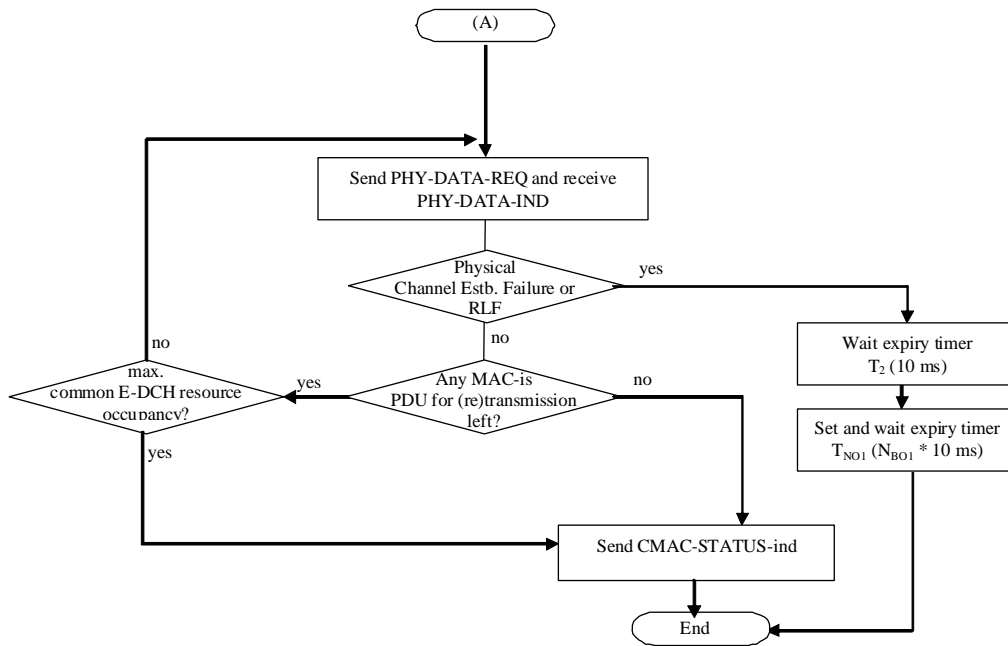


Figure 11.2.2A-2: Enhanced Uplink in CELL\_FACH state and Idle mode transmission control procedure (UE side, informative), Part II for CCCH transmission

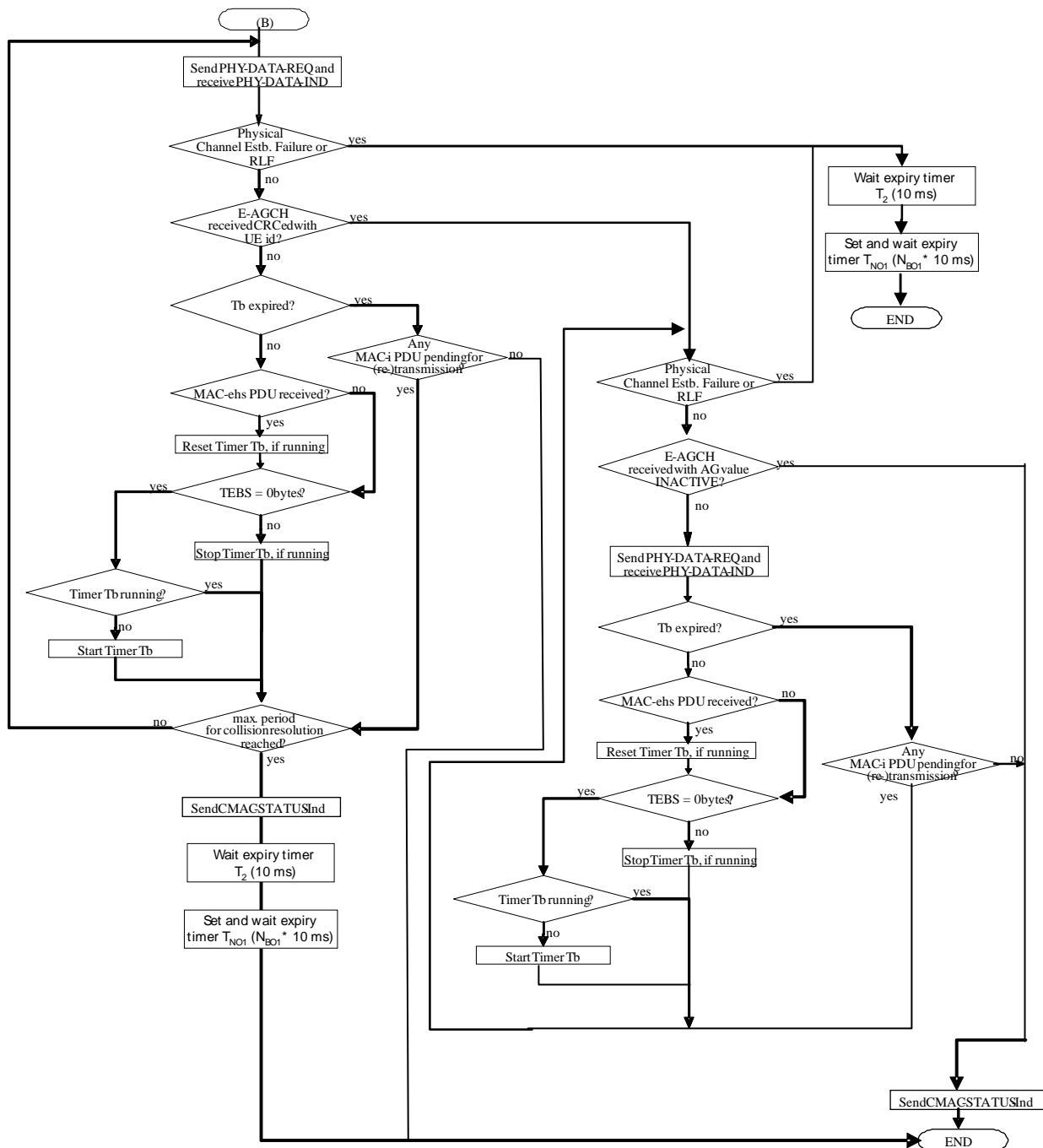


Figure 11.2.2A-3: Enhanced Uplink for CELL\_FACH state and Idle mode transmission control procedure (UE side, informative), Part II for DTCH/DCCH transmission

### 11.2.3 Control of RACH transmissions for TDD

#### 11.2.3.1 Control of RACH transmissions for 3.84 Mcps TDD and 7.68 Mcps TDD

The RACH transmissions are performed by the UE as shown in figure 11.2.3.2.

NOTE: The figure shall illustrate the operation of the transmission control procedure as specified below. It shall not impose restrictions on implementation.



MAC receives the following RACH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  an identification of a PRACH partition and a persistence value  $P_i$  (transmission probability).

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a certain PRACH partition and an associated persistence value  $P_i$ . The procedure to be applied for ASC selection is described in subclause 11.2.1.

In order to separate different ASCs each PRACH has  $N$  sub-channels associated with it (numbered from 0 to  $N-1$ ).  $N$  may be assigned the value 1,2,4, or 8 by higher layer signalling. Sub-channel  $i$  for a PRACH defined in timeslot  $k$  is defined as the  $k$ :th slot in the frames where  $\text{SFN mod } N = i$ . Therefore follows the definition:

- Sub-channel  $i$  associated to a PRACH defined in timeslot  $k$  is defined as the  $k$ :th timeslot in the frames where  $\text{SFN mod } N = i$ .

Figure 11.2.3.1 illustrates the eight possible subchannels for the case,  $N=8$ . For illustration, the figure assumes that the PRACH is assigned timeslot 3.

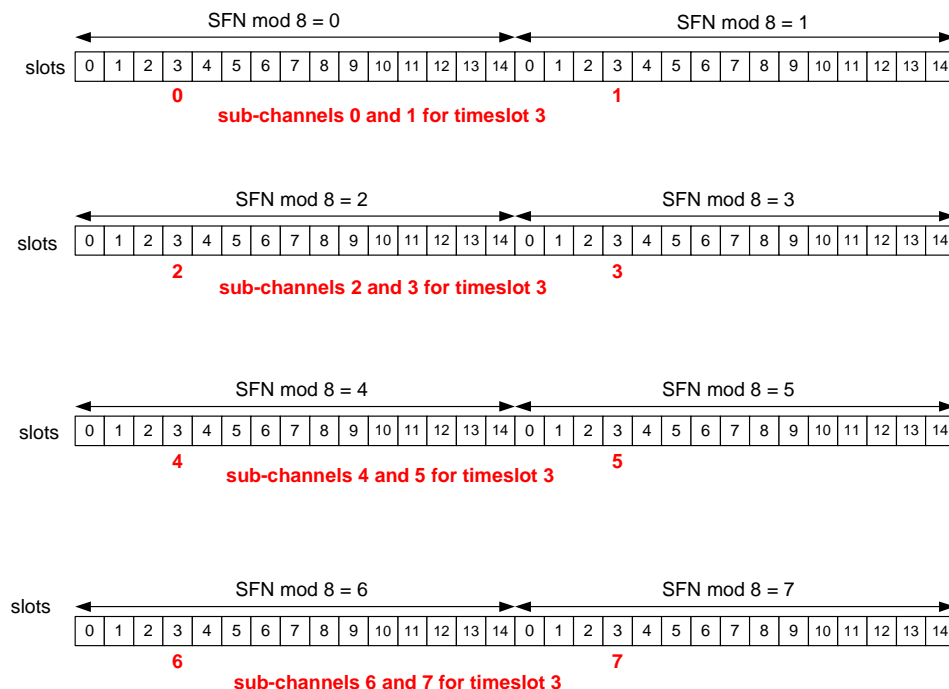


Figure 11.2.3.1 Eight sub-channels for timeslot 3

Based on the persistence value  $P$ , the UE decides whether to send the message on the RACH. If transmission is not allowed, a new persistency check is performed in the next transmission time interval. The persistency check is repeated until transmission is permitted. If transmission is allowed, a subchannel is randomly selected from the set of available subchannels for this ASC. The random subchannel selection shall be such that each of the allowed selections is chosen with equal probability. If an available subchannel is not found, the persistency check and subchannel assignment is repeated for the next subchannel period. If an available subchannel is found the PRACH transmission procedure is initiated by sending of a PHY-Data-REQ primitive.

Successful completion (TX status) of the MAC transmission control procedure shall be indicated to higher layer individually for each logical channel of which data was included in the transport block set of that access attempt. When transparent mode RLC is employed (i.e. for CCCH), transmission status is reported to RRC with CMAC-STATUS-Ind primitive. For logical channels employing acknowledged or unacknowledged mode RLC, transmission status is reported to RLC with MAC-STATUS-Ind primitive.

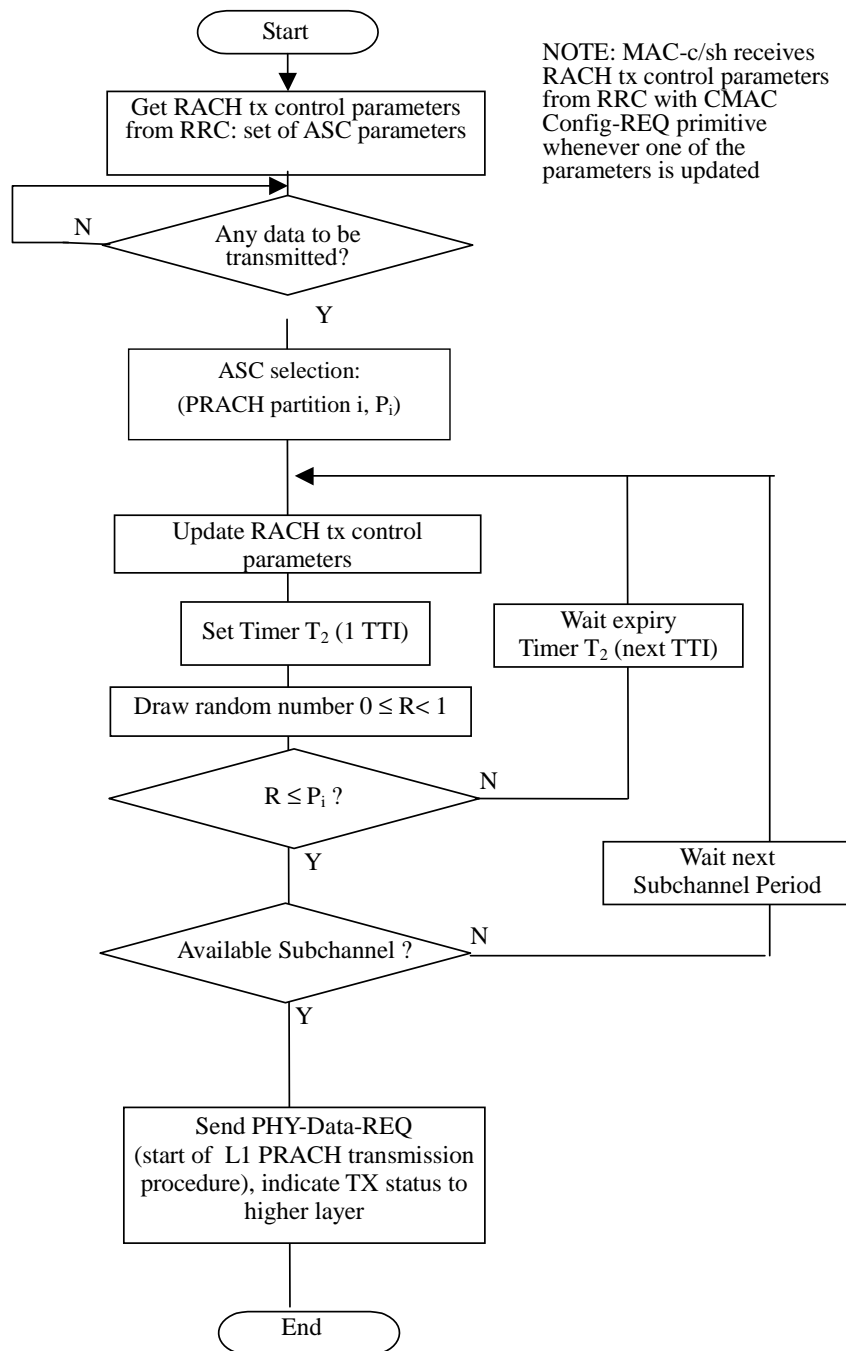


Figure 11.2.3.2: RACH transmission control procedure for TDD (UE side, informative)

11.2.3.1.1 Control of E-RUCCH transmissions

The MAC-e sublayer is in charge of controlling the timing of E-RUCCH transmission.

MAC receives the following E-RUCCH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  a persistence value  $P_i$  (transmission probability).

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a persistence value  $P_i$ . The procedure to be applied for ASC selection is described in subclause 11.2.3.1.1.1.

If this is the first transmission of the E-RUCCH, i.e. timer T-RUCCH (as described in 11.9.1.4a) is not currently running, then the persistence value will be assumed to be 1, otherwise it will be the value associated with the chosen ASC. The persistence value will then be used in the same way as described for RACH transmissions as defined in section 11.2.3.1.

Note that unlike RACH transmissions no partitioning of the E-RUCCH resource based on ASC will be implemented..

#### 11.2.3.1.1.1 Access Service Class selection

For E-RUCCH transmission, the following ASC selection scheme shall be applied:

- select ASC = min (NumASC, MinMLP);

Where NumASC is the highest available ASC number and MinMLP is the highest priority level of the logical channels which have data buffered for transmission.

#### 11.2.3.2 Control of RACH Transmissions for 1.28 Mcps TDD

The RACH transmissions are performed by the UE as shown in figure 11.2.3.3.

NOTE: The figure shall illustrate the operation of the transmission control procedure as specified below. It shall not impose restrictions on implementation.

UE MAC receives the following RACH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  an identification of a PRACH partition and a persistence value  $P_i$  (transmission probability),
- maximum number of synchronisation attempts  $M_{\max}$ .

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a certain PRACH partition and an associated persistence value  $P_i$ .

Based on the persistence value  $P_i$ , MAC decides whether to start the L1 PRACH procedure in the present transmission time interval or not. If transmission is allowed, the PRACH transmission procedure (starting with the SYNC\_UL/FPACH power ramping sequence) is initiated by the sending of a PHY-ACCESS-REQ primitive. MAC then waits for access information from L1 via the PHY-ACCESS-CNF primitive. If transmission is not allowed, a new persistency check is performed in the next transmission time interval. The persistency check is repeated until transmission is permitted.

If a synchronisation burst has been acknowledged on its associated FPACH, PHY will inform MAC by a PHY-ACCESS-CNF primitive indicating "ready for RACH data transmission". Then MAC requests data transmission with a PHY-DATA-REQ primitive, and the PRACH transmission procedure will be completed with transmission on the PRACH resources associated with the FPACH.

Successful completion of the MAC procedure is indicated to higher layer individually for each logical channel of which data was included in the transport block set of that access attempt. When transparent mode RLC is employed (i.e. for CCCH), transmission status is reported to RRC with CMAC-STATUS-Ind primitive. For logical channels employing acknowledged or unacknowledged mode RLC, transmission status is reported to RLC with MAC-STATUS-Ind primitive.

If no synchronisation burst received an acknowledgement on the FPACH within the maximum number of transmissions permitted in a power ramping cycle, PHY will inform MAC by a PHY-ACCESS-CNF primitive indicating "no response received on FPACH". If the maximum number of synchronisation attempts permitted,  $M_{\max}$ , has not been exceeded, then MAC commences a new persistency test sequence in the next transmission time interval and the PHY-ACCESS-REQ procedure is repeated. The timer  $T_2$  ensures that two successive persistency tests are separated by at least one transmission time interval. If the maximum number of synchronisation attempts is exceeded then MAC abandons the RACH procedure. Failure to complete the MAC procedure is indicated to higher layer by the CMAC-STATUS-Ind or MAC-STATUS-Ind primitives.

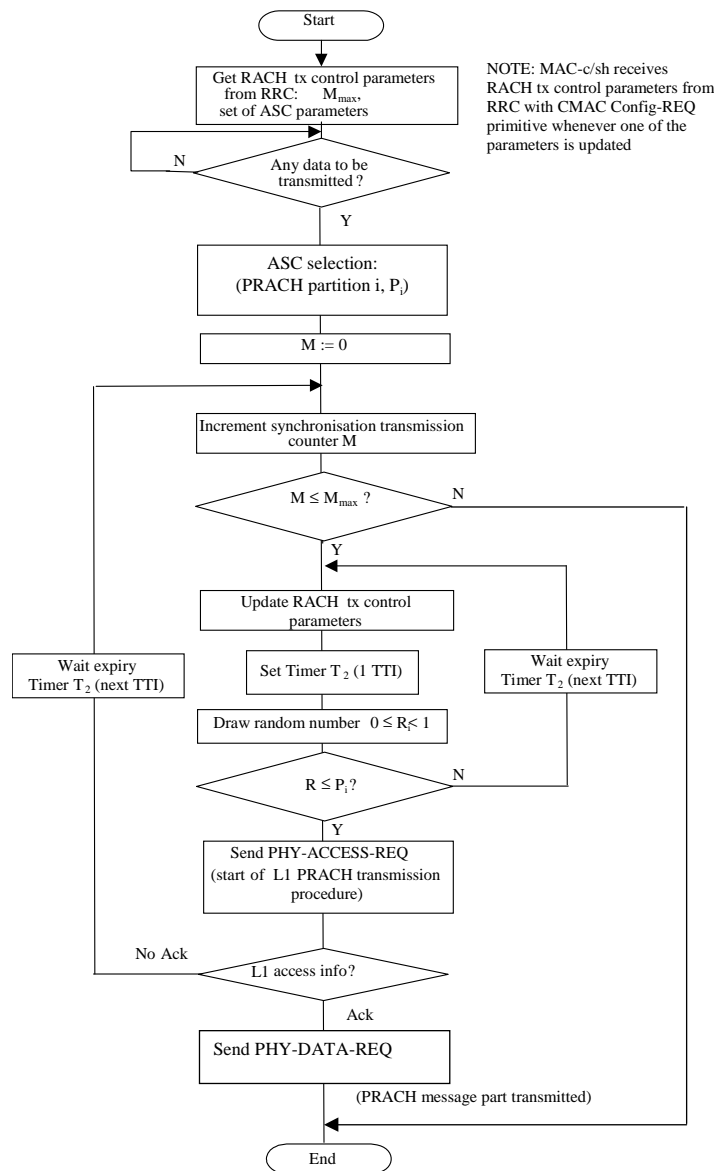


Figure 11.2.3.3: RACH transmission control procedure for 1.28 Mcps TDD (UE side, informative)

11.2.3.2.1 Control of E-RUCCH transmissions

The MAC-e or MAC-i sublayer is in charge of controlling the timing of E-RUCCH transmission.

MAC receives the following E-RUCCH transmission control parameters from RRC with the CMAC-Config-REQ primitive:

- a set of Access Service Class (ASC) parameters, which includes for each ASC,  $i=0, \dots, \text{NumASC}$  a persistence value  $P_i$  (transmission probability).
- maximum number of synchronisation attempts  $M_{max}$ .

When there is data to be transmitted, MAC selects the ASC from the available set of ASCs, which consists of an identifier  $i$  of a persistence value  $P_i$ . The procedure to be applied for ASC selection is described in subclause 11.2.3.2.1.1.

The persistence value will be the value associated with the chosen ASC. The persistence value will then be used in the same way as described for RACH transmissions as defined in section 11.2.3.2.

If one of the following criteria for E-RUCCH transmission are met, failure indication of the E-RUCCH transmission is sent to RRC by the CMAC-STATUS-Ind primitive with E-RUCCH failure:

- The maximum number  $M_{max}$  of synchronisation attempts is reached;
- When the hysteresis timer with the value of  $N_{RUCCH}$  times of T-RUCCH period, which is started when the the E-RUCCH transmission counter is reached to  $N_{RUCCH}$ , is expired.

#### 11.2.3.2.1.1 Access Service Class selection

For E-RUCCH transmission, the following ASC selection scheme shall be applied:

- select  $ASC = \min(NumASC, MinMLP)$ ;

Where NumASC is the highest available ASC number and MinMLP is the highest logical channel priority of the logical channel which has data buffered for transmission.

#### 11.2.3.2.1.2 Void

### 11.3 Void

## 11.4 Transport format combination selection in UE (non E-DCH)

RRC can control the scheduling of uplink data by giving each logical channel a priority between 1 and 8, where 1 is the highest priority and 8 the lowest. TFC selection in the UE shall be done in accordance with the priorities indicated by RRC. Logical channels have absolute priority, i.e. the UE shall maximise the transmission of higher priority data.

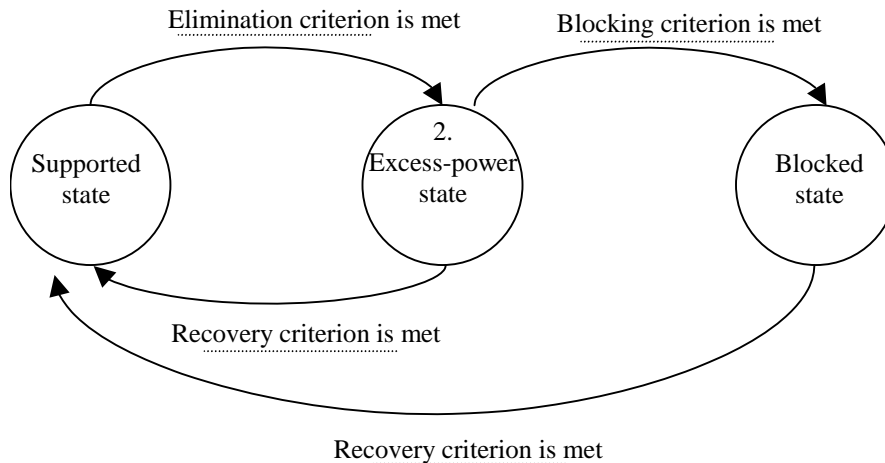
If the uplink TFCS or TFC Subset configured by UTRAN follows the guidelines described in [7] the UE shall perform the TFC selection according to the rules specified below. If these guidelines are not followed then the UE behaviour is not specified.

A given TFC can be in any of the following states:

- Supported state;
- Excess-power state;
- Blocked state.

TDD mode UEs in CELL\_FACH state using the USCH transport channel and UEs in CELL\_DCH state using a DCH shall continuously monitor the state of each TFC based on its required transmit power versus the maximum UE transmit power (see [7]). The state transition criteria and the associated requirements are described in [12, 14]. The UE shall consider that the Blocking criterion is never met for TFCs included in the minimum set of TFCs (see [7]).

The following diagram illustrates the state transitions for the state of a given TFC:



**Figure 11.4.1: State transitions for the state of a given TFC**

FDD Mode UEs in CELL\_FACH state may estimate the channel path loss and set to excess power state all the TFCs requiring more power than the Maximum UE transmitter power (see [7]). All other TFCs shall be set to Supported state.

Every time the set of supported TFCs changes, the available bitrate shall be indicated to upper layers for each logical channel in order to facilitate the adaptation of codec data rates when codecs supporting variable-rate operation are used. The details of the computation of the available bitrate and the interaction with the application layer are not further specified.

Before selecting a TFC, i.e. at every boundary of the shortest TTI, or prior to each transmission on PRACH the set of valid TFCs shall be established. All TFCs in the set of valid TFCs shall:

1. belong to the TFCS.
- 1a. not be restricted by higher layer signalling (e.g. TFC Control, see [7]).
2. not be in the Blocked state.
3. be compatible with the RLC configuration.
4. not require RLC to produce padding PDUs (see [6] for definition).
5. not carry more bits than can be transmitted in a TTI (e.g. when compressed mode by higher layer scheduling is used and the presence of compressed frames reduces the number of bits that can be transmitted in a TTI using the Minimum SF configured).

The UE may remove from the set of valid TFCs, TFCs in Excess-power state in order to maintain the quality of service for sensitive applications (e.g. speech). However, this shall not apply to TFCs included in the minimum set of TFCs (see [7]). Additionally, if compressed frames are present within the longest configured TTI to which the next transmission belongs, the UE may remove TFCs from the set of valid TFCs in order to account for the higher power requirements.

The chosen TFC shall be selected from within the set of valid TFCs and shall satisfy the following criteria in the order in which they are listed below:

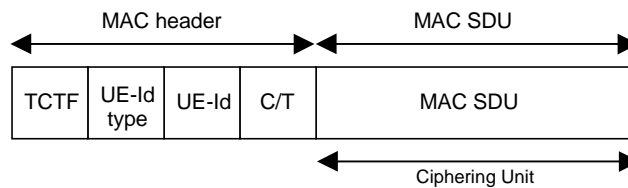
1. No other TFC shall allow the transmission of more highest priority data than the chosen TFC.
2. No other TFC shall allow the transmission of more data from the next lower priority logical channels. Apply this criterion recursively for the remaining priority levels.
3. No other TFC shall have a lower bit rate than the chosen TFC.

In FDD mode the above rules for TFC selection in the UE shall apply to DCH, and the same rules shall apply for TF selection on RACH.

In 3.84 Mcps TDD mode and in 7.68 Mcps TDD mode the above rules for TFC selection in the UE shall apply to DCH and USCH.

## 11.5 Ciphering

The ciphering function is performed in MAC (i.e. only in MAC-d) if a radio bearer is using the transparent RLC mode. The part of the MAC PDU that is ciphered is the MAC SDU and this is shown in Figure 11.5.1 below.



**Figure 11.5.1: Ciphered part unit for a MAC PDU**

In case a TTI contains multiple MAC PDUs for a given Transparent mode RB, the ciphering unit for this RB is the bitstring concatenation of all the MAC SDUs, resulting in the PLAINTEXT BLOCK, as defined in [15]. In case there is only one MAC PDU for a given Transparent mode RB, the ciphering unit is the MAC SDU, resulting in the PLAINTEXT BLOCK. The concatenation order is the same as the order of transmission of the Transport Blocks between MAC and Physical layer.

The KEYSTREAM BLOCK as defined in [10] is applied to the PLAINTEXT BLOCK, and the end result, CIPHERTEXT BLOCK, becomes the ciphered part for the MAC PDU, in case there is only one MAC PDU per RB. In case there is more than one MAC PDU per RB, the CIPHERTEXT BLOCK is split into the corresponding ciphered parts for each MAC PDU. The split order is the same as the order of transmission of the Transport Blocks between MAC and Physical layer.

The ciphering algorithm and key to be used are configured by upper layers [7] and the ciphering method shall be applied as specified in [10].

The parameters that are required by MAC for ciphering are defined in [10] and are input to the ciphering algorithm. The parameters required by MAC which are provided by upper layers [7] are listed below:

- MAC-d HFN (Hyper frame number for radio bearers that are mapped onto transparent mode RLC)
- BEARER defined as the radio bearer identifier in [10]. It will use the value RB identity -1 as in [7])
- CK (Ciphering Key)

If the TTI consists of more than one 10 ms radio frame, the CFN of the first radio frame in the TTI shall be used as input to the ciphering algorithm for all the data in the TTI.

## 11.6 Control of HS-DSCH transmission and reception

If MAC-hs is configured by upper layers [7], the control of HS-DSCH transmission and reception is defined in subclauses 11.6.1 and 11.6.2.

If MAC-ehs version is configured by upper layers [7], the control of HS-DSCH transmission and reception is defined in subclauses 11.6.3 and 11.6.4.

### 11.6.1 Network operation

The following are the functions of the various functional entities at the network in support of the HARQ protocol used on HS-DSCH when MAC-hs is configured by upper layers [7].

#### 11.6.1.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell;

- Services priority queues:
  - The scheduler schedules MAC-hs SDUs based on information from upper layers. One UE may be associated with one or more MAC-d flows. Each MAC-d flow contains HS-DSCH MAC-d PDUs for one or more priority queues.
- Determines the HARQ Entity and the queue to be serviced;
- Sets the TSN for new data blocks being transferred from the selected queue;
  - set the TSN to value 0 for the first MAC-hs PDU transmitted for each Queue ID within an HS-DSCH;
  - increment the TSN with one for each transmitted MAC-hs PDU on each Queue ID within an HS-DSCH.

NOTE: In 1.28 Mcps TDD multi-frequency HS-DSCH cell, the length of TSN can be 6 bits or 9 bits based on the configuration of higher layer.

NOTE: The scheduler may re-use TSNs by toggling the NDI bit in order to resume pre-empted transmissions or to force the UE to flush the soft buffer. In this case the content of the payload may be changed but care should be taken to preserve the higher layer data order.

- Indicates the Queue ID and TSN to the HARQ entity for each MAC-hs PDU to be transmitted;
- Schedules new transmissions and retransmissions:
  - Based on the status reports from HARQ Processes the scheduler determines if either a new transmission or a retransmission should be made. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-hs SDU.
- Determines the redundancy version:
  - The scheduler determines a suitable redundancy version for each transmitted and retransmitted MAC-hs PDU and indicates the redundancy version to lower layer.
    - Determines the TDD HCSN;
  - Increment UE specific HCSN for each HS-SCCH transmission. In 1.28Mcps TDD multi-frequency HS-DSCH cell, UE maintains the respective HCSN for each carrier independently.

#### 11.6.1.2 HARQ entity

- There is one HARQ entity per UE in UTRAN. In 1.28 Mcps TDD multi-frequency HS-DSCH cell, HARQ entity consists of some HARQ sub-entities, each sub-entity is associated with one carrier.
- The HARQ entity sets the Queue ID in transmitted MAC-hs PDUs to the value indicated by the UTRAN scheduler.
- The HARQ entity sets the transmission sequence number (TSN) in transmitted MAC-hs PDUs to the value indicated by the UTRAN scheduler.
- The HARQ entity sets the HARQ process identifier in transmitted MAC-hs PDUs. UTRAN should:
  - determine a suitable HARQ process to service the MAC-hs PDU and set the HARQ process identifier accordingly.

#### 11.6.1.3 HARQ process

- The HARQ process sets the New data indicator in transmitted MAC-hs PDUs. UTRAN should:
  - set the New Data Indicator to the value "0" for the first MAC-hs PDU transmitted by a HARQ process;



- not increment the New Data Indicator for retransmissions of a MAC-hs PDU;
- increment the New Data Indicator with one for each transmitted MAC-hs PDU containing new data.
- The HARQ process processes received status messages. UTRAN should:
  - deliver received status messages to the scheduler.

## 11.6.2 UE operation

The UE operation in support of the HARQ protocol used on HS-DSCH is split among the following four functional units with their associated functions.

### 11.6.2.1 HARQ Entity

There is one HARQ entity at the UE which processes the HARQ process identifiers received on the HS-SCCH transmissions associated with MAC-hs PDUs received on the HS-DSCH.

In 1.28 Mcps TDD multi-frequency HS-DSCH cell, HARQ sub-entity is configured at UE per carrier where HS-DSCH is configured. The associated downlink control channel and uplink control channel pair controlling the HS-DSCH transmission on the certain carrier shall be allocated on the same carrier. The downlink control channel carries the HS-DSCH operation related info and the uplink control channel carries the feedback info from the UE side. In 1.28 Mcps TDD single frequency or multi-frequency HS-DSCH cell, HARQ entity or HARQ sub-entity is configured to handle the HARQ identity associated with the received MAC-hs PDU from every carrier where HS-DSCH is configured at UE side.

A number of parallel HARQ processes are used in the UE to support the HARQ entity. The number of HARQ processes is configured by upper layers:

- Each received MAC-hs PDU shall be allocated to the HARQ process indicated by the HARQ process identifier of the MAC-hs PDU.

### 11.6.2.2 HARQ process

The HARQ process processes the New Data Indicator indicated by lower layers for each received MAC-hs PDU.

The UE may:

- for FDD, if the MAC-hs PDU is received within 5 sub-frames from the reception of the previous MAC-hs PDU intended for this HARQ process; or
- for TDD, if the MAC-hs PDU is received before generation of feedback resulting from reception of a previous MAC-hs PDU for the same H-ARQ process:
  - discard the MAC-hs PDU.

The UE shall:

- if the New Data Indicator has been incremented compared to the value in the previous received transmission in this HARQ process or this is the first received transmission in the HARQ process:
  - replace the data currently in the soft buffer for this HARQ process with the received data.
- if the Transport Block Size index value is equal to 111111 (FDD only):
  - generate a positive acknowledgement (ACK) of the data in this HARQ process;
  - discard the received data;
  - assume that the data has been successfully decoded.
- if the New Data Indicator is identical to the value used in the previous received transmission in the HARQ process:
  - if the Transport Block Size index value is equal to 111111 (FDD only):

- assume that the transport block size is identical to the last valid transport block size signalled for this HARQ process.
- if the data has not yet been successfully decoded:
  - combine the received data with the data currently in the soft buffer for this HARQ process.
- if the transport block size is different from the last valid transport block size signalled for this HARQ process:
  - the UE may replace the data currently in the soft buffer for this HARQ process with the received data.
- if the data in the soft buffer has been successfully decoded and no error was detected:
  - deliver the decoded MAC-hs PDU to the reordering entity;
  - generate a positive acknowledgement (ACK) of the data in this HARQ process.
- else:
  - generate a negative acknowledgement (NAK) of the data in this HARQ process;
- schedule the generated positive or negative acknowledgement for transmission and the time of transmission relative to the reception of data in a HARQ process is configured by upper layer.

The HARQ process processes the Queue ID in the received MAC-hs PDUs. The UE shall:

- arrange the received MAC-hs PDUs in queues based on the Queue ID.

### 11.6.2.3 Reordering entity

#### 11.6.2.3.1 Definitions

In the functions described in this section the following definitions apply:

##### Parameters

- Transmitter window size (TRANSMIT\_WINDOW\_SIZE)  
TRANSMIT\_WINDOW\_SIZE is the size of the transmitter window according to the definition below. This is a parameter in the Node B and the value of the parameter is configured by higher layers.
- Receiver window size (RECEIVE\_WINDOW\_SIZE)  
RECEIVE\_WINDOW\_SIZE is the size of the receiver window according to the definition below. This is a parameter in the UE and the value of the parameter is configured by higher layers.

##### State variables

All state variables are non-negative integers. MAC-hs PDUs are numbered by modulo integer Transmission sequence numbers (TSN) cycling through the field 0 to 63. All arithmetic operations contained in the present document on next\_expected\_TSN, RcvWindow\_UpperEdge, T1\_TSN and TSN\_flush are affected by the 64 modulus. When performing arithmetic comparisons of state variables or Transmission sequence number values a 64 modulus base shall be used. This modulus base is subtracted (within the appropriate field) from all the values involved and then an absolute comparison is performed.  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$  shall be assumed to be the modulus base. For 1.28 Mcps TDD multi-frequency HS-DSCH operation operation mode, TSN\_MAX represents period length of TSN; the arithmetic operations and comparisons of state variables in multi-frequency mode are performed on TSN\_MAX modulus base.

- next\_expected\_TSN:  
The next\_expected\_TSN is the Transmission sequence number (TSN) following the TSN of the last in-sequence MAC-hs PDU received. It shall be updated according to the procedures given in subclauses 11.6.2.3.2, 11.6.2.5 and 11.6.2.6. The initial value of next\_expected\_TSN = 0.
- RcvWindow\_UpperEdge:  
The RcvWindow\_UpperEdge represents the TSN, which is at the upper edge of the receiver window. After the first MAC-hs PDU has been received successfully, it also corresponds to the MAC-hs PDU with the highest

TSN of all received MAC-hs PDUs. The initial RcvWindow\_UpperEdge equals 63. RcvWindow\_UpperEdge is updated based on the reception of new MAC-hs PDU according to the procedure given below.

- T1\_TSN:  
The TSN of the latest MAC-hs PDU that cannot be delivered to the disassembly entity, when the timer T1 is started.
- TSN\_MAX (1.28Mcps TDD multi-frequency HS-DSCH operation mode only):  
TSN\_MAX represents the periodicity of TSN for 1.28Mcps TDD multi-frequency HS-DSCH operation mode, the possible value is 64 or 512.

### Timers

- Re-ordering release timer (T1):  
The Re-ordering release timer T1 controls the stall avoidance in the UE reordering buffer as described below. The value of T1 is configured by upper layers.

### Other definitions

- Receiver window:  
The receiver window defines TSNs of those MAC-hs PDUs that can be received in the receiver without causing an advancement of the receiver window according to the procedure below. The size of the receiver window equals RECEIVE\_WINDOW\_SIZE and spans TSNs going from RcvWindow\_UpperEdge – RECEIVE\_WINDOW\_SIZE + 1 to RcvWindow\_UpperEdge included.

#### 11.6.2.3.2 Reordering functionality

If no timer T1 is active:

- the timer T1 shall be started when a MAC-hs PDU with TSN > next\_expected\_TSN is correctly received.
- T1\_TSN shall be set to the TSN of this MAC-hs PDU.

If a timer T1 is already active:

- no additional timer shall be started, i.e. only one timer T1 may be active at a given time.

The timer T1 shall be stopped if:

- the MAC-hs PDU with TSN = T1\_TSN can be delivered to the disassembly entity before the timer expires.

When the timer T1 expires and T1\_TSN > next\_expected\_TSN:

- all correctly received MAC-hs PDUs with TSN > next\_expected\_TSN up to and including T1\_TSN-1 shall be delivered to the disassembly entity;
- all correctly received MAC-hs PDUs up to the next not received MAC-hs PDU shall be delivered to the disassembly entity.
- next\_expected\_TSN shall be set to the TSN of the next not received MAC-hs PDU.

When the timer T1 is stopped or expires, and there still exist some received MAC-hs PDUs that can not be delivered to higher layer:

- timer T1 is started
- set T1\_TSN to the highest TSN among those of the MAC-hs PDUs that can not be delivered.

### Transmitter operation:

After the transmitter has transmitted a MAC-hs PDU with TSN=SN, any MAC-hs PDU with TSN ≤ SN – TRANSMIT\_WINDOW\_SIZE should not be retransmitted to avoid sequence number ambiguity in the receiver.

### Receiver operation:

When a MAC-hs PDU with TSN = SN is received:

- if SN is within the receiver window:
  - if SN < next\_expected\_TSN, or this MAC-hs PDU has previously been received:
    - the MAC-hs PDU shall be discarded;
  - else:
    - the MAC-hs PDU shall be placed in the reordering buffer at the place indicated by the TSN.
- if SN is outside the receiver window:
  - the received MAC-hs PDU shall be placed above the highest received TSN in the reordering buffer, at the position indicated by SN;
  - RcvWindow\_UpperEdge shall be set to SN thus advancing the receiver window;
  - any MAC-hs PDUs with TSN  $\leq$  RcvWindow\_UpperEdge – RECEIVE\_WINDOW\_SIZE, i.e. outside the receiver window after its position is updated, shall be removed from the reordering buffer and be delivered to the disassembly entity;
  - if next\_expected\_TSN is below the updated receiver window:
    - next\_expected\_TSN shall be set to RcvWindow\_UpperEdge – RECEIVE\_WINDOW\_SIZE + 1;
  - if the MAC-hs PDU with TSN = next\_expected\_TSN is stored in the reordering buffer:
    - all received MAC-hs PDUs with consecutive TSNs from next\_expected\_TSN (included) up to the first not received MAC-hs PDU shall be delivered to the disassembly entity;
    - next\_expected\_TSN shall be advanced to the TSN of this first not received MAC-hs PDU.

In case a UE has insufficient memory to process a received MAC-hs PDU, it shall perform the following set of operations:

- select TSN\_flush such that: next\_expected\_TSN < TSN\_flush  $\leq$  RcvWindow\_UpperEdge + 1;
- deliver all correctly received MAC-hs PDUs with TSN < TSN\_flush to the disassembly entity;
- if the MAC-hs PDU with TSN=TSN\_flush has previously been received:
  - deliver all received MAC-hs PDUs with consecutive TSNs from TSN\_flush (included) up to the first not received MAC-hs PDU to the disassembly entity;
  - advance next\_expected\_TSN to the TSN of this first not received MAC-hs PDU.
- else:
  - set next\_expected\_TSN to TSN\_flush.

#### 11.6.2.4 Disassembly entity

For each MAC-hs PDU that is delivered to the disassembly entity, the UE shall:

- remove any padding bits if present;
- remove the MAC-hs header;
- deliver the MAC-d PDUs in the MAC-hs PDU to MAC-d.

### 11.6.2.5 MAC-hs Reset

If a reset of the MAC-hs entity is requested by upper layers, the UE shall at the activation time indicated by higher layers:

- flush soft buffer for all configured HARQ processes;
- stop all active re-ordering release timer (T1) and set all timer T1 to their initial value;
- start TSN with value 0 for the next transmission on every configured HARQ process;
- initialise the variables RcvWindow\_UpperEdge and next\_expected\_TSN to their initial values;
- disassemble all MAC-hs PDUs in the re-ordering buffer and deliver all MAC-d PDUs to the MAC-d entity;
- flush the re-ordering buffer;
- treat next received Transport Block as new data.

### 11.6.2.6 Reconfiguration of MAC-hs parameters

The parameters for a MAC-hs entity may be reconfigured (modified) by upper layers.

When a parameter is reconfigured by the upper layer, the UE shall:

- start using the reconfigured value of the parameter at the activation time indicated by higher layers.

If the parameter T1 is reconfigured for an already existing re-ordering queue, the UE shall:

- start to use the new value of T1 the next time T1 is started.

If the MAC-d PDU size info (i.e. mapping of MAC-d PDU size index to MAC-d PDU size) is reconfigured for an already existing re-ordering queue, at the activation time indicated by higher layers, the UE shall:

- stop timer T1 if running;
- set next\_expected\_TSN to (highest TSN of received MAC-hs PDU of this re-ordering queue + 1);
- deliver all correctly received MAC-hs PDUs in this re-ordering queue to the disassembly entity and use the old MAC-d PDU size info for these MAC-hs PDUs.

If the parameter RECEIVE\_WINDOW\_SIZE is reconfigured for a re-ordering queue, the UE shall:

- set RECEIVE\_WINDOW\_SIZE to the new value;
- remove any MAC-hs PDUs in this re-ordering queue with  $TSN \leq RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE$  (i.e. outside the receiver window after its size is updated) from the reordering buffer and deliver these MAC-hs PDUs to the disassembly entity;
- if next\_expected\_TSN is below the receiver window after its size is updated:
  - set next\_expected\_TSN to  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$ ;
  - deliver all received MAC-hs PDUs in this re-ordering queue with consecutive TSNs from next\_expected\_TSN (included) up to the first not received MAC-hs PDU to the disassembly entity;
  - advance next\_expected\_TSN to the TSN of this first not received MAC-hs PDU.

If the "Memory Partitioning" (see [7]) for soft buffer is reconfigured, the UE shall:

- flush soft buffer for all configured HARQ processes.

If the "TSN-Length" is reconfigured, the UE shall:

- perform the operation as per subclause 11.6.2.5.

### 11.6.2.7 HARQ procedure for HS-SCCH less operation (FDD only)

When the HS-SCCH less mode of operation is enabled, the UE shall be able to store 13 TTIs in a cyclic soft buffer.

For each received MAC-hs PDU provided by the lower layers the UE shall:

- If the associated HS-SCCH corresponds to an HS-SCCH less retransmission as defined in subclause 4.6A.2.1.2 of [16]:
  - if the data in the soft buffer identified by the TTI  $[5*CFN + \text{subframe number} - 6 - PTR] \bmod 13$  has not been decoded successfully:
    - combine the received data with the data currently in the soft buffer identified by  $[5*CFN + \text{subframe number} - 6 - PTR] \bmod 13$  where PTR is the value of the pointer to the previous transmission as defined in subclause 4.6A.2.1.2.1 of [16].
  - If the data in the soft buffer has been successfully decoded and no error was detected;
    - deliver the decoded MAC-hs PDU to the reordering entity;
    - generate a positive acknowledgement (ACK) of the data corresponding to this TTI.
  - else:
    - place the combined data for the HS-SCCH less TTI in the soft buffer identified by  $[5*CFN + \text{subframe number}] \bmod 13$ , replacing any data previously stored in that buffer.
    - generate a negative acknowledgement (NACK) of the data corresponding to this TTI.
- Else if the associated HS-SCCH corresponds to a HS-SCCH type 1 as defined in subclause 4.6 of [16];
  - process the received MAC-hs PDU provided by the lower layers as per subclause 11.6.2.2.
- Else if HS-SCCH less operation is active according to the definition in [13];
  - If the data has been successfully decoded and no error was detected;
    - deliver the decoded MAC-hs PDU to the reordering entity;
    - generate a positive acknowledgement (ACK) of the data corresponding to this TTI.
  - else
    - place the data for the HS-SCCH less TTI in the soft buffer identified by  $[5*CFN + \text{subframe number}] \bmod 13$ , replacing any data previously stored in that buffer.

## 11.6.3 Network operation

The following are the functions of the various functional entities at the network in support of the HARQ protocol used on HS-DSCH when MAC-hs is configured by upper layers [7].

### 11.6.3.1 Scheduler

The scheduler performs the following functions:

- Schedules all UEs within a cell;
- Services priority queues:
  - The scheduler schedules reordering PDUs (see subsection 9.1.4) based on information from upper layers. One UE operating in CELL\_DCH may be associated with one or more priority queues.
- In FDD and 1.28 Mcps TDD, when transmitting to the UE in CELL\_FACH or CELL\_PCH or URA\_PCH state there can be multiple service priority queues. One service priority queue can be associated to multiple H-RNTIs.
- Determines the HARQ Entity and the queues to be serviced;

- Sets the TSN values for new data blocks being transferred from the selected queue;
  - set the TSN to value 0 for the first reordering PDU transmitted from the selected queue;
  - increment the TSN with one for each subsequent reordering PDU transmitted from the selected queue.
  - increment the TSN with one for each subsequent reordering PDU transmitted from the selected queue per H-RNTI within an HS-DSCH, when transmitting to the UEs in CELL\_FACH, CELL\_PCH or URA\_PCH state.

NOTE: The scheduler may re-use TSNs by toggling the NDI bit in order to resume pre-empted transmissions or to force the UE to flush the soft buffer. In this case the content of the payload may be changed but care should be taken to preserve the higher layer data order.

- Indicates the LCH ID and L field values for each reordering SDU to be transmitted and the TSN field and SI field values for each reordering PDU to be transmitted to the HARQ entity;
- Schedules new transmissions and retransmissions:
  - When transmitting for a UE in CELL\_DCH state the scheduler determines based on the status reports from HARQ Processes if either a new transmission or a retransmission should be made. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-ehs SDU.
  - In FDD when transmitting for a UE in CELL\_FACH state the scheduler determines based on RRM and IE "Transmitted Power Level" received on Iub FP the number of retransmission that should be made after new transmission. A new transmission can however be initiated on a HARQ process at any time. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-hs SDU.
  - In 1.28Mcps TDD, when transmitting CCCH or DCCH with common H-RNTI for a UE in CELL\_FACH state the scheduler determines based on RRM and IE "Transmitted Power Level" received on Iub FP the number of retransmission that should be made after new transmission. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-ehs SDU.
  - In 1.28Mcps TDD, When transmitting or retransmitting DCCH/DTCH with dedicated H-RNTI for a UE in CELL\_FACH state, if In SYNC state is not indicated by physical layer as in [18], then the synchronization Command via HS-SCCH shall be sent to the UE firstly, the transmitting or retransmitting DCCH/DTCH shall not be initiated or resumed until In-SYNC state is detected as in [18]. The scheduler determines based on the status reports from HARQ Processes if either a new transmission or a retransmission should be made. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-ehs SDU.
  - In 1.28Mcps TDD, when transmitting DCCH/DTCH for a UE in CELL\_PCH state, synchronization command via HS-SCCH shall be sent to the UE firstly. The transmitting DCCH/DTCH shall not be initiated until In-SYNC state is detected as in [18]. The scheduler determines based on the status reports from HARQ Processes if either a new transmission or a retransmission should be made. Based on a delay attribute provided by upper layers, the scheduler may decide to discard any 'out-of-date' MAC-ehs SDU.

NOTE: When operating in MIMO mode, the scheduler uses the redundancy version coding to indicate whether a transmission is a new transmission or a retransmission, otherwise, the New Data Indicator field is used.

- Determines the redundancy version:
  - The scheduler determines a suitable redundancy version for each transmitted and retransmitted MAC-ehs PDU and indicates the redundancy version to lower layer.
- Determines the TDD HCSN;
- Increment UE specific HCSN for each HS-SCCH transmission.
- In 1.28 Mcps TDD, the operation of HSCN on HS-SCCH with common H-RNTI and BCCH specific H-RNTI is unspecified.

### 11.6.3.2 HARQ entity

- There is one HARQ entity per HS-DSCH for each UE operating in CELL\_DCH state in UTRAN.
- In FDD and 1.28 Mcps TDD, there is one HARQ entity per H-RNTI in UTRAN used for transmitting data for UE(s) in CELL\_FACH state.
- The HARQ entity sets the logical channel ID (LCH ID) fields in transmitted MAC-ehs PDUs to the values indicated by the UTRAN scheduler.
- The HARQ entity sets the Length (L) fields in transmitted MAC-ehs PDUs to the values indicated by the UTRAN scheduler.
- The HARQ entity sets the Segmentation Indication (SI) fields in transmitted MAC-ehs PDUs to the values indicated by the UTRAN scheduler.
- The HARQ entity sets the transmission sequence number (TSN) fields in transmitted MAC-ehs PDUs to the values indicated by the UTRAN scheduler.
- The HARQ entity sets the HARQ process identifier in transmitted MAC-ehs PDUs. UTRAN should:
  - determine a suitable HARQ process to service the MAC-ehs PDU and set the HARQ process identifier accordingly.

### 11.6.3.3 HARQ process

- If the New Data Indicator field exists, the HARQ process sets the New Data indicator in transmitted MAC-ehs PDUs. UTRAN should:
  - set the New Data Indicator to the value "0" for the first MAC-ehs PDU transmitted by a HARQ process;
  - not increment the New Data Indicator for retransmissions of a MAC-ehs PDU;
  - increment the New Data Indicator with one for each transmitted MAC-ehs PDU containing new data.
- If the New Data Indicator field doesn't exist, UTRAN should:
  - instruct the physical layer to set the appropriate redundancy version coding when indicating the MAC-ehs PDU is either an initial transmission or a retransmission.
- The HARQ process processes received status messages. UTRAN should:
  - deliver received status messages to the scheduler.

## 11.6.4 UE operation

The UE operation in support of the HARQ protocol used on HS-DSCH is split among the following five functional units with their associated functions.

### 11.6.4.1 HARQ Entity

There is one HARQ entity per HS-DSCH at the UE which processes the HARQ process identifiers received on the HS-SCCH transmissions associated with MAC-ehs PDUs received on the HS-DSCH.

A number of parallel HARQ processes are used in the UE to support the HARQ entity. The number of HARQ processes is configured by upper layers:

- Each received MAC-ehs PDU shall be allocated to the HARQ process indicated by the HARQ process identifier of the MAC-ehs PDU.

### 11.6.4.2 HARQ process

The HARQ process processes the New Data Indicator (if any) indicated by lower layers for each received MAC-ehs PDU.



The UE may:

- for FDD, when operating in CELL\_DCH state, or in CELL\_FACH state with a dedicated H-RNTI, if the MAC-ehs PDU is received within 5 sub-frames from the reception of the previous MAC-ehs PDU intended for this HARQ process; or
- for TDD, when operating in CELL\_DCH state, or in CELL\_FACH state with a dedicated H-RNTI (1.28 Mcps TDD only), if the MAC-ehs PDU is received before generation of feedback resulting from reception of a previous MAC-ehs PDU for the same H-ARQ process: or
  - discard the MAC-ehs PDU.

The UE shall:

- if the New Data Indicator (if any) has been incremented compared to the value in the previous received transmission in this HARQ process or in absence of a New Data Indicator field, the physical layer redundancy version coding indicates it is an initial transmission:
  - replace the data currently in the soft buffer for this HARQ process with the received data.
- if the Transport Block Size index value is equal to 111111 (FDD only):
  - generate a positive acknowledgement (ACK) of the data in this HARQ process;
  - discard the received data;
  - assume that the data has been successfully decoded.
- if the New Data Indicator is not present and the physical layer redundancy version coding indicates it is a retransmission and the UE had positively acknowledged the earlier transmission:
  - discard received data and generate a positive acknowledgement (ACK).
- if the New Data Indicator (if any) is identical to the value used in the previous received transmission in the HARQ process or in absence of a New Data Indicator field, the physical layer redundancy version coding indicates it is a retransmission and the UE had negatively acknowledged the earlier transmission:
  - if the Transport Block Size index value is equal to 111111 (FDD only):
    - assume that the transport block size is identical to the last valid transport block size signalled for this HARQ process.
  - if the data has not yet been successfully decoded:
    - combine the received data with the data currently in the soft buffer for this HARQ process.
  - if the transport block size is different from the last valid transport block size signalled for this HARQ process:
    - the UE may replace the data currently in the soft buffer for this HARQ process with the received data.
- if the data in the soft buffer has been successfully decoded and no error was detected:
  - deliver the decoded MAC-ehs PDU to the disassembly entity;
  - when operating in CELL\_DCH state or, if configured by higher layers, in CELL\_FACH state while the UE is using a common E-DCH resource and after collision resolution (FDD only), or operating in CELL\_FACH state with dedicated H-RNTI for 1.28 Mcps TDD, generate a positive acknowledgement (ACK) of the data in this HARQ process.
- else:
  - when operating in CELL\_DCH state or, if configured by higher layers, in CELL\_FACH state while the UE is using a common E-DCH resource and after collision resolution (FDD only), or operating in CELL\_FACH state with dedicated H-RNTI for 1.28 Mcps TDD, generate a negative acknowledgement (NAK) of the data in this HARQ process;

- schedule the generated positive or negative acknowledgement for transmission and the time of transmission relative to the reception of data in a HARQ process is configured by upper layer.

#### 11.6.4.3 Disassembly entity

For each MAC-ehs PDU that is delivered to the disassembly entity, the UE shall:

- remove any padding bits if present;
- remove the MAC-ehs header;
- deliver the reordering PDUs in the MAC-ehs PDU to reordering distribution entity.

#### 11.6.4.4 Reordering queue distribution entity

For each reordering PDU in the MAC-ehs PDU, the UE shall:

- route the reordering PDU to the correct reordering queue based on the received LCH ID. The mapping of the LCH ID to queue is provided by upper layers [7].

#### 11.6.4.5 Reordering entity

##### 11.6.4.5.1 Definitions

In the functions described in this section the following definitions apply:

##### Parameters

- Transmitter window size (TRANSMIT\_WINDOW\_SIZE)  
TRANSMIT\_WINDOW\_SIZE is the size of the transmitter window according to the definition below. This is a parameter in the Node B and the value of the parameter is configured by higher layers.
- Receiver window size (RECEIVE\_WINDOW\_SIZE)  
RECEIVE\_WINDOW\_SIZE is the size of the receiver window according to the definition below. This is a parameter in the UE and the value of the parameter is configured by higher layers.

##### State variables

All state variables are non-negative integers. Reordering PDUs are numbered by modulo integer Transmission sequence numbers (TSN) cycling through the field 0 to 63. All arithmetic operations contained in the present document on next\_expected\_TSN, RcvWindow\_UpperEdge, T1\_TSN and TSN\_flush are affected by the 64 modulus. When performing arithmetic comparisons of state variables or Transmission sequence number values a 64 modulus base shall be used. This modulus base is subtracted (within the appropriate field) from all the values involved and then an absolute comparison is performed.  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$  shall be assumed to be the modulus base.

- next\_expected\_TSN:  
The next\_expected\_TSN is the Transmission sequence number (TSN) following the TSN of the last in-sequence reordering PDU received. It shall be updated according to the procedures given in subclauses 11.6a.2.3.2, 11.6a.2.5 and 11.6a.2.6. For CELL\_DCH, the initial value of next\_expected\_TSN = 0. For states other than CELL\_DCH the initial value of the next\_expected\_TSN =  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$ .
- RcvWindow\_UpperEdge:  
The RcvWindow\_UpperEdge represents the TSN, which is at the upper edge of the receiver window. After the first reordering PDU has been received successfully, it also corresponds to the reordering PDU with the highest TSN of all received reordering PDUs. The initial RcvWindow\_UpperEdge equals 63. RcvWindow\_UpperEdge is updated based on the reception of new reordering PDU according to the procedure given below.
- T1\_TSN:  
The TSN of the latest reordering PDU that cannot be delivered to the reassembly entity, when the timer T1 is started.

## Timers

- Re-ordering release timer (T1):  
The Re-ordering release timer T1 controls the stall avoidance in the UE reordering buffer as described below. The value of T1 is configured by upper layers.
- Reset timer (Treset) (FDD and 1.28 Mcps TDD)  
Treset controls the reset of the MAC-ehs reordering functionality. This timer is not used when the UE is in CELL\_DCH state.

## Other definitions

- Receiver window:  
The receiver window defines TSNs of those reordering PDUs that can be received in the receiver without causing an advancement of the receiver window according to the procedure below. The size of the receiver window equals RECEIVE\_WINDOW\_SIZE and spans TSNs going from RcvWindow\_UpperEdge – RECEIVE\_WINDOW\_SIZE + 1 to RcvWindow\_UpperEdge included.

### 11.6.4.5.2 Reordering functionality

If no timer T1 is active:

- the timer T1 shall be started when a reordering PDU with TSN > next\_expected\_TSN is correctly received.
- T1\_TSN shall be set to the TSN of this reordering PDU.

If a timer T1 is already active:

- no additional timer shall be started, i.e. only one timer T1 may be active at a given time.

The timer T1 shall be stopped if:

- the reordering PDU with TSN = T1\_TSN can be delivered to the reassembly entity before the timer expires.

When the timer T1 expires and T1\_TSN > next\_expected\_TSN:

- all correctly received reordering PDUs with TSN > next\_expected\_TSN up to and including T1\_TSN-1 shall be delivered to the reassembly entity;
- all correctly received reordering PDUs up to the next not received reordering PDU shall be delivered to the reassembly entity.
- next\_expected\_TSN shall be set to the TSN of the next not received reordering PDU.

When the timer T1 is stopped or expires, and there still exist some received reordering PDUs that can not be delivered to higher layer:

- timer T1 is started
- set T1\_TSN to the highest TSN among those of the reordering PDUs that can not be delivered.

For FDD and 1.28 Mcps TDD, if the UE is not in CELL\_DCH state and if the timer Treset is not active:

- the timer Treset shall be started when a reordering PDU is correctly received.

For FDD and 1.28 Mcps TDD, if the UE is in any state other than CELL\_DCH state and if a timer Treset is already active:

- the timer Treset shall be restarted when a reordering PDU is correctly received.
- no additional timer shall be started, i.e. only one timer Treset may be active at a given time.

When the timer Treset expires:

- perform a MAC-ehs reset.

For FDD and 1.28 Mcps TDD, if the UE enters CELL\_DCH state:

- stop all configured Treset timers.

#### **Transmitter operation:**

After the transmitter has transmitted a reordering PDU with  $TSN=SN$ , any reordering PDU with  $TSN \leq SN - TRANSMIT\_WINDOW\_SIZE$  should not be retransmitted to avoid sequence number ambiguity in the receiver.

#### **Receiver operation:**

When a reordering PDU with  $TSN = SN$  is received:

- if SN is within the receiver window:
  - if  $SN < next\_expected\_TSN$ , or this reordering PDU has previously been received:
    - the reordering PDU shall be discarded;
  - else:
    - the reordering PDU shall be placed in the reordering buffer at the place indicated by the TSN.
- if SN is outside the receiver window:
  - the received reordering PDU shall be placed above the highest received TSN in the reordering buffer, at the position indicated by SN;
  - $RcvWindow\_UpperEdge$  shall be set to SN thus advancing the receiver window;
  - any reordering PDU with  $TSN \leq RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE$ , i.e. outside the receiver window after its position is updated, shall be removed from the reordering buffer and be delivered to the reassembly entity;
  - if  $next\_expected\_TSN$  is below the updated receiver window:
    - $next\_expected\_TSN$  shall be set to  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$ ;
  - if the reordering PDU with  $TSN = next\_expected\_TSN$  is stored in the reordering buffer:
    - all received reordering PDUs with consecutive TSNs from  $next\_expected\_TSN$  (included) up to the first not received reordering PDU shall be delivered to the reassembly entity;
    - $next\_expected\_TSN$  shall be advanced to the TSN of this first not received reordering PDU.

In case a UE has insufficient memory to process a received reordering PDU, it shall perform the following set of operations:

- select  $TSN\_flush$  such that:  $next\_expected\_TSN < TSN\_flush \leq RcvWindow\_UpperEdge + 1$ ;
- deliver all correctly received reordering PDUs with  $TSN < TSN\_flush$  to the reassembly entity;
- if the reordering PDU with  $TSN=TSN\_flush$  has previously been received:
  - deliver all received reordering PDUs with consecutive TSNs from  $TSN\_flush$  (included) up to the first not received reordering PDU to the reassembly entity;
  - advance  $next\_expected\_TSN$  to the TSN of this first not received reordering PDU.
- else:
- set  $next\_expected\_TSN$  to  $TSN\_flush$ .

#### **11.6.4.6 Reassembly unit**

The reassembly unit processes the SI field associated with a reordering PDU. The UE shall:

- if SI field is set to "00":

- deliver all MAC-d or MAC-c PDUs corresponding to MAC-ehs SDUs in the reordering PDU to demultiplexing entity;
- discard any previously stored segment of MAC-ehs SDU.
- if SI field is set to "01":
  - if the received and stored segments of a MAC-ehs SDU are consecutive:
    - combine the first reordering SDU with the stored segment of MAC-ehs SDU;
    - deliver the MAC-d or MAC-c PDU corresponding to the combined MAC-ehs SDU to demultiplexing entity.
  - if the received and stored segments of MAC-ehs SDU are not consecutive
    - discard the first received reordering SDU and the stored segment of MAC-ehs SDU.
  - deliver all MAC-d or MAC-c PDUs corresponding to subsequent MAC-ehs SDUs in the reordering queue to demultiplexing entity;
- if SI field is set to "10":
  - deliver all MAC-d or MAC-c PDUs corresponding to all but last reordering SDU in the reordering PDU to the demultiplexing entity;
  - discard any previously stored segment of MAC-ehs SDU and store the last reordering SDU of the received reordering PDU
- if SI field is set to "11":
  - if the received and stored MAC-ehs SDUs are consecutive:
    - if there is only one reordering SDU in the reordering PDU:
      - combine the received reordering SDU with the stored segment of MAC-ehs SDU;
    - if there is more than one reordering SDU in the reordering PDU:
      - combine the first received reordering SDU with the stored segment MAC-ehs SDU;
      - deliver the MAC-d or MAC-c PDU corresponding to the combined MAC-ehs SDU to demultiplexing entity.
      - deliver all MAC-d or MAC-c PDUs corresponding to all but last reordering SDU in the reordering PDU to demultiplexing entity;
      - discard any previously stored segment of MAC-ehs SDU and store the last reordering SDU of the received reordering PDU.
  - if the received and stored segments of the MAC-ehs SDU are not consecutive:
    - discard the first received reordering SDU and the stored segment of MAC-ehs SDU;
    - if there is more than one reordering SDU in the reordering PDU:
      - deliver all MAC-d or MAC-c PDUs corresponding to all but first and last reordering SDUs in the reordering PDU to demultiplexing entity and store the last reordering SDU of the received reordering PDU.

#### 11.6.4.7 Demultiplexing entity

For each MAC-d or MAC-c PDU that is delivered to the demultiplexing entity, the UE shall:

- route MAC-d or MAC-c PDU to the correct logical channel based on the corresponding LCH ID field.

#### 11.6.4.8 MAC-ehs Reset

If a reset of the MAC-ehs entity is requested by upper layers, the UE shall at the activation time indicated by higher layers:

- flush soft buffer for all configured HARQ processes;
- stop all active re-ordering release timer (T1) and set all timer T1 to their initial value;
- stop all active reset timers (Treset) and set all timers Treset to their initial value;
- start TSN with value 0 for the next transmission on every configured HARQ process;
  - initialise the variables RcvWindow\_UpperEdge and next\_expected\_TSN to their initial value;
- deliver all reordering PDUs in the re-ordering buffer to the reassembly entity;
- deliver any successfully reassembled MAC-ehs SDUs to logical channel demultiplexing entity;
- route any MAC-d or MAC-c PDUs delivered to the demultiplexing entity to the correct logical channel;
- flush the re-ordering buffer;
- discard any stored segment in the resegmentation entity;
- treat next received Transport Block as new data.

If a reset of the MAC-ehs entity is required by the expiry of Treset, the UE shall:

- flush soft buffer for all configured HARQ processes;
- for each reordering queue where Treset has expired:
  - stop the active re-ordering release timer (T1) and set the timer T1 to its initial value;
  - start TSN with value 0 for the next transmission on every configured HARQ process;
  - initialise the variable RcvWindow\_UpperEdge to its initial value;
  - initialise the variable next\_expected\_TSN to its initial value;
  - deliver all reordering PDUs in the re-ordering buffer to the reassembly entity;
  - deliver any successfully reassembled MAC-ehs SDUs to logical channel demultiplexing entity;
  - route any MAC-d or MAC-c PDUs delivered to the demultiplexing entity to the correct logical channel;
  - flush the re-ordering buffer;
  - discard any stored segment in the resegmentation entity;
  - treat next received Transport Block as new data.

#### 11.6.4.9 Reconfiguration of MAC-ehs parameters

The parameters for a MAC-ehs entity may be reconfigured (modified) by upper layers.

When a parameter is reconfigured by the upper layer, the UE shall:

- start using the reconfigured value of the parameter at the activation time indicated by higher layers.

If the parameter T1 is reconfigured for an already existing re-ordering queue, the UE shall:

- start to use the new value of T1 the next time T1 is started.

If the parameter RECEIVE\_WINDOW\_SIZE is reconfigured for a re-ordering queue, the UE shall:

- set RECEIVE\_WINDOW\_SIZE to the new value;

- remove any reordering PDUs in this re-ordering queue with  $TSN \leq RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE$  (i.e. outside the receiver window after its size is updated) from the reordering buffer and deliver these reordering PDUs to the reassembly entity;
- if `next_expected_TSN` is below the receiver window after its size is updated:
  - set `next_expected_TSN` to  $RcvWindow\_UpperEdge - RECEIVE\_WINDOW\_SIZE + 1$ ;
  - deliver all received reordering PDUs in this re-ordering queue with consecutive TSNs from `next_expected_TSN` (included) up to the first not received reordering PDU to the reassembly entity;
  - advance `next_expected_TSN` to the TSN of this first not received reordering PDU.

If the "Memory Partitioning" (see [7]) for soft buffer is reconfigured, the UE shall:

- flush soft buffer for all configured HARQ processes.

## 11.7 HS-DSCH Provided Bit Rate measurement

The HS-DSCH Provided Bit Rate measurements is defined as follows:

- for each priority class the MAC-hs/ehs entity measures the total number of MAC-d PDU bits whose transmission over the radio interface has been considered successful by MAC-hs in Node-B during the last measurement period, divided by the duration of the measurement period;
- the values reported by MAC-hs/ehs shall be raw samples;
- the measurement period shall be [100 ms];
- when the cell portions are defined in a cell, the HS-DSCH Provided Bit Rate shall be measured for each cell portion.

## 11.8 Control of E-DCH transmission and reception (FDD)

### 11.8.1 UE operation

#### 11.8.1.1 HARQ Operation

##### 11.8.1.1.1 HARQ entity

There is one HARQ entity at the UE. A number of parallel HARQ processes are used in the UE to support the HARQ entity, allowing transmissions to take place continuously while waiting for the feedback on the successful or unsuccessful reception of previous transmissions.

At a given TTI, the HARQ entity identifies the HARQ process for which a transmission should take place. Also, based on the timing, it routes the receiver feedback (ACK/NACK information), relayed by the physical layer, to the appropriate HARQ process.

The number of HARQ processes is equal to the HARQ round-trip-time (HARQ\_RTT). The HARQ\_RTT is equal to 4 for 10ms TTI and 8 for 2ms TTI. The TTI duration shall be configured by the higher layers. Each process is associated with a number from 0 to HARQ\_RTT-1.

After each TTI, the HARQ entity shall:

- if the buffer of the HARQ process corresponding to the next TTI is empty:
  - notify the E-TFC selection entity that the next TTI is available for a new transmission;
- if the "E-TFC Selection" entity indicates the need for a new transmission:
  - obtain the transmission information (i.e. HARQ profile, whether triggered Scheduling Information is included and whether it is sent alone) from the "E-TFC Selection" entity;

- obtain the MAC-e or MAC-i PDU to transmit from the "Multiplexing and TSN setting" entity;
  - instruct the HARQ process corresponding to this TTI to trigger the transmission of this new payload using the identified HARQ profile parameters.
- else:
- instruct the HARQ process to generate a re-transmission.

#### 11.8.1.1.2 HARQ process

Each HARQ process is associated with a physical buffer (HARQ buffer).

Each HARQ process maintains the state variable CURRENT\_TX\_NB, which indicates the number of transmissions that have taken place for the MAC-e or MAC-i PDU currently in the buffer. When the HARQ process is established, CURRENT\_TX\_NB shall be initialized to 0.

At the time of a new transmission, the HARQ entity provides the HARQ profile to use for all transmissions and re-transmissions of this MAC-e or MAC-i PDU. This HARQ profile includes information on the maximum number of transmissions to perform, and the power offset with which to configure the physical layer.

If the HARQ entity provides a new PDU, the HARQ process shall:

- set CURRENT\_TX\_NB to 0;
- set CURRENT\_RSN to 0;
- store the MAC-e or MAC-i PDU in the associated HARQ buffer;
- generate a transmission as described below.

If the HARQ entity requests a re-transmission, the HARQ process shall:

- generate a transmission as described below.

To generate a transmission, the HARQ process shall, regardless of any overlapping with a compressed mode gap:

- instruct the physical layer to set the RSN field on the E-DPCCH to CURRENT\_RSN;
- instruct the physical layer to generate a transmission with the power offset corresponding to the HARQ profile and the redundancy version corresponding to the RSN value and the transmission timing (i.e. the CFN and in the case of 2ms TTI, sub-frame number as described in [16]);
- if CURRENT\_RSN < 3:
  - increment CURRENT\_RSN by 1;
- increment CURRENT\_TX\_NB by 1;

The HARQ process shall:

- if an ACK is received from the RLS containing the serving cell; or
- if an ACK is received from any RLS and the transmission included higher layer data (i.e. not only included Scheduling Information); or
- if CURRENT\_TX\_NB  $\geq$  maximum number of transmissions indicated in the transmission HARQ profile:
  - flush the HARQ buffer;
  - if the transmission included Scheduling Information which was triggered per subclause 11.8.1.6 and if no ACK for that transmission was received from the RLS containing the serving cell:
    - notify the Scheduling Information Reporting function that the HARQ process failed to deliver the triggered Scheduling Information to the RLS containing the serving cell (see subclause 11.8.1.6.3).



NOTE: In the case where the Scheduling Information is transmitted alone, without any higher layer data the UE will keep re-transmitting the Scheduling Information until an ACK is received from the RLS containing the serving cell or the maximum number of re-transmissions is reached. In the latter case, periodic triggering will be relied upon for reliability.

### 11.8.1.2 Multiplexing and TSN setting entity

There is one Multiplexing and TSN setting entity at the UE. A number of TSN setting processes are used to support independent numbering of transmissions from different logical channels.

#### 11.8.1.2.1 TSN setting process operation

There is one TSN setting process at the UE for each logical channel. When a MAC-es or MAC-is PDU is transmitted, the UE operation in support of the re-ordering functionality consists in generating an explicit sequence number (TSN) for the MAC-es or MAC-is PDU intended for the associated re-ordering queue. In one TTI, there is only one TSN per logical channel: one for the MAC-es or MAC-is PDU that is transmitted.

Each TSN setting process maintains the state variable `CURRENT_TSN`, which indicates the sequence number to be included in the header of the following MAC-es or MAC-is PDU to be generated. When the TSN setting process is established, `CURRENT_TSN` shall be initialized to 0.

When a new payload needs to be generated for the associated re-ordering queue, the TSN setting entity shall:

- set the TSN of the transmission to `CURRENT_TSN`;

After each MAC-es PDU or MAC-is PDU is multiplexed:

- increment `CURRENT_TSN` by 1;
- if `CURRENT_TSN > 63`:
  - set `CURRENT_TSN = 0`.

#### 11.8.1.2a Segmentation entity

There is one segmentation entity per logical channel in the UE.

When the MAC-d PDU size, the untransmitted part of the MAC-d PDU, the MAC-c PDU size (FDD only) or the untransmitted part of the MAC-c PDU (FDD only) exceeds available space in the transport block according to the E-TFC selection, the segmentation entity shall:

- segment the MAC-d PDU, the untransmitted part of the MAC-d PDU, the MAC-c PDU or the untransmitted part of the MAC-c PDU to fit the available space in the transport block according to the E-TFC selection and store the untransmitted part of the MAC-d PDU or MAC-c PDU;
- set the segmentation status (SS) field of the transmission to indicate the segmentation status as described in subclause 9.2.4.3.

#### 11.8.1.3 Serving Grant Update

UEs in `CELL_DCH` state, `CELL_FACH` state (FDD only), configured with an E-DCH transport channel shall maintain a Serving Grant and the list of active HARQ processes based on the absolute and relative grant commands decoded on the configured E-AGCH and E-RGCH(s).

Each Absolute Grant or Relative Grant command is applied at a specific TTI. This association is implicit based on the timing of the E-AGCH and E-RGCH (see [13]). The timing is tight enough that this relationship is un-ambiguous.

The activation/deactivation of one or all processes is only applicable to processes for which transmission of scheduled data is allowed according to RRC signalling

Process activation of an active process does not result in any action taken by the UE.

### 11.8.1.3.1 Baseline Procedure

The Serving Grant Update procedure shall be applied at every TTI boundary and shall take into account the Absolute Grant message, Serving Relative Grant and non-serving Relative Grants that apply to the TTI.

The UE shall:

- 1> set reference\_ETPR2 to reference\_ETPR as defined in subclause 3.1.2;
- 1> set reference\_ETPR to the E-DPDCH to DPCCH power ratio as defined in subclause 3.1.2;
- 1> if an Absolute Grant was received for this TTI:
  - 2> if the UE is in CELL\_FACH state:
    - 3> if the Absolute Grant value is set to "INACTIVE":
      - 4> deactivate all HARQ processes (and act as described section 11.2.2A).
    - 2> if the Identity type is "Primary", and the Absolute Grant value is set to "INACTIVE":
      - 3> if Absolute Grant Scope indicates "Per HARQ process" and a 2ms TTI is configured:
        - 4> de-activate the process given by the value of CURRENT\_HARQ\_PROCESS.
      - 3> if Absolute Grant Scope indicates "All HARQ processes" and a secondary E-RNTI was configured by higher layers:
        - 4> activate all HARQ processes;
        - 4> set Serving\_Grant = Stored\_Secondary\_Grant;
        - 4> set Primary\_Grant\_Available to "False".
      - 3> if Absolute Grant Scope indicates "All HARQ processes", a 2ms TTI is configured and a secondary E-RNTI was not configured by higher layers:
        - 4> deactivate all HARQ processes (if a process was inactive it remains inactive, if a process was active it becomes inactive).
    - 2> else if the Absolute Grant Value is different from "INACTIVE":
      - 3> if the Identity Type is "Secondary":
        - 4> set Stored\_Secondary\_Grant = Absolute Grant Value.
      - 3> if the Identity Type is "Primary" or Primary\_Grant\_Available is set to "False":
        - 4> set Serving\_Grant = Absolute Grant Value.
        - 4> if the Identity Type is "Primary":
          - 5> set Primary\_Grant\_Available to "True";
          - 5> if Absolute Grant Scope indicates "Per HARQ process":
            - 6> activate the process given by the value of CURRENT\_HARQ\_PROCESS.
          - 5> if Absolute Grant Scope indicates "All HARQ processes":
            - 6> activate all HARQ processes.
          - 5> if AG\_Timer is not active, it shall be started, otherwise it shall be restarted.
    - 1> else (no Absolute Grant received):
      - 2> if the HARQ process given by the value of CURRENT\_HARQ\_PROCESS is active; and

- 2> if Primary\_Grant\_Available is equal to "True"; and
- 2> if Serving\_Grant <> "Zero\_Grant" ; and
- 2> if AG\_Timer has expired; and
- 2> if there was a scheduled transmission (see NOTE) in the previous TTI of the HARQ process given by the value of CURRENT\_HARQ\_PROCESS:
  - 3> if the Serving Relative Grant indicates "UP":
    - 4> determine the Serving\_Grant in accordance with subclause 9.2.5.2.1.
  - 3> else, if the Serving Relative Grant indicates "DOWN":
    - 4> determine the Serving\_Grant in accordance with subclause 9.2.5.2.1.
  - 3> else:
    - 4> the Serving\_Grant is unchanged (i.e. kept from previous TTI).
- 1> if any Non-Serving Relative Grants indicate "DOWN" for this TTI and Serving\_Grant <> "Zero\_Grant":
  - 2> Serving\_Grant = MIN(Serving\_Grant, Maximum\_Serving\_Grant, Serving\_Grant determined in accordance with subclause 9.2.5.2.1);
  - 2> Maximum\_Serving\_Grant = Serving\_Grant.
  - 2> if Non\_Serving\_RG\_Timer is not active it shall be started, otherwise it shall be restarted;
- 1> else if no Non-Serving Relative Grants indicate "DOWN" for this TTI:
  - 2> if Non\_Serving\_RG\_Timer has not expired:
    - 3> Serving\_Grant = MIN(Maximum\_Serving\_Grant, Serving\_Grant).
- 1> if Non\_Serving\_RG\_Timer expires:
  - 2> set the Maximum\_Serving\_Grant to the highest possible value (i.e. index 37 in table 9.2.5.2.1.1 or 9.2.5.2.1.2 as configured by higher layers).

NOTE 1: MIN("Zero\_Grant", any numerical value) = "Zero\_Grant".

NOTE 2: Scheduling Information sent alone is not considered as a scheduled transmission.

#### 11.8.1.3.2 Handling at start of E-DCH transmission

When E-DCH transmission is started (i.e. the RRC variable E\_DCH\_TRANSMISSION is changed from "false" to "true"), the UE shall:

- activate all HARQ processes;
- if the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:
  - update the state variables and timers according to subclause 11.8.1.3.5.
- else:
  - initialise the state variable Serving\_Grant to Zero\_Grant;
  - initialise the state variable Primary\_Grant\_Available to "False";
  - initialise the state variable Stored\_Secondary\_Grant to "Zero\_Grant".
- initialise the state variables reference\_ETPR and reference\_ETPR2 to "Minimum\_Grant";
- initialise the state variable Maximum\_Serving\_Grant to the highest possible value (i.e. index 37 in table 9.2.5.2.1.1 or 9.2.5.2.1.2 as configured by higher layers).

### 11.8.1.3.3 Handling at serving cell change

At E-DCH serving cell change, the UTRAN may configure the UE with the grant value to use in the new cell and shall indicate whether the UE should monitor Absolute Grant Messages with the secondary E-RNTI.

The UE shall:

- activate all HARQ processes;
- if the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:
  - update the state variables and timers according to subclause 11.8.1.3.5.
- else:
  - continue to use the current values of state variables `Serving_Grant` and `Primary_Grant_Available`;
  - initialise the state variable `Stored_Secondary_Grant` to "Zero\_Grant".

### 11.8.1.3.4 Handling at TTI change

At E-DCH TTI change, the UE shall:

- activate all HARQ processes;
- initialise the state variables `reference_ETPR` and `reference_ETPR2` to "Minimum\_Grant";
- reset `Non_Serving_RG_Timer` and `AG_Timer`;
- set the state variable `Maximum_Serving_Grant` to the highest possible value (i.e. index 37 in table 9.2.5.2.1.1 or 9.2.5.2.1.2 as configured by higher layers).
- if the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:
  - update the state variables and timers according to subclause 11.8.1.3.5.
- else:
  - continue to use the current values of state variables `Serving_Grant` and `Primary_Grant_Available`;
  - initialise the state variable `Stored_Secondary_Grant` to "Zero\_Grant".

### 11.8.1.3.5 Higher Layer Signalling

When the IE's "Serving Grant value" and "Primary/Secondary Grant Selector" are provided by higher layers:

- set the state variable `Serving_Grant` to the value of the IE's "Serving Grant value" provided by higher layers;
- if the IE's "Primary/Secondary Grant Selector" is provided by higher layers as "Primary":
  - if `AG_Timer` is not active, it shall be started, otherwise it shall be restarted;
  - set the state variable `Primary_Grant_Available` to "True";
  - set the state variable `Stored_Secondary_Grant` to "Zero\_Grant".
- if the IE's "Primary/Secondary Grant Selector" is provided by higher layers as "Secondary":
  - set the state variable `Primary_Grant_Available` to "False";
  - set the state variable `Stored_Secondary_Grant` to the value of the IE's "Serving Grant value" provided by higher layers.

#### 11.8.1.3.6 Handling in UE DTX Cycle 2.

In FDD, in case the DTX feature is configured by higher layers, and there has not been any E-DCH transmission for the last "Inactivity Threshold for UE DTX cycle 2" E-DCH TTIs:

- If Default-SG-in-DTX-Cycle-2 has been signalled by higher layers:
  - set the state variable `Serving_Grant` to the value of `Default-SG-in-DTX-Cycle-2`.

#### 11.8.1.4 E-TFC Selection

In FDD mode, the rules for E-TFC selection provided below shall apply to UEs in `CELL_DCH` state, `CELL_FACH` state and Idle Mode with an E-DCH transport channel configured. These UEs shall apply the E-TFC selection procedure when invoked by the HARQ entity (see subclause 11.8.1.1.1). In the case where a 2ms TTI is configured, E-TFC selection shall not be performed for TTIs that overlap with an uplink compressed mode gap. The E-TFC restriction procedure described in [12] shall always be applied before the E-TFC selection process below. E-TFCs which (according to calculations in [16]) require channelisation codes which are not allowed by the value given by the Maximum channelisation codes for E-DPDCH or are not supported by the UE capability shall be considered as blocked. Furthermore, for UEs that are also configured with a DCH transport channel on uplink, the TFC selection procedure shall be applied before either of these.

For each MAC-d flow, RRC configures MAC with a HARQ profile and a multiplexing list. Additionally, RRC configures MAC with a power offset for "Control-only" transmissions. This power offset and a maximum number of HARQ transmissions of 8 will be used to define a HARQ profile for "Control-only" transmissions which will be used, in case the Scheduling Information needs to be transmitted without any higher-layer data. The HARQ profile includes the power offset and maximum number of HARQ transmissions to use for this MAC-d flow. The multiplexing list identifies for each MAC-d flow(s), the other MAC-d flows from which data can be multiplexed in a transmission that uses the power offset included in its HARQ profile.

RRC can control the scheduling of uplink data by giving each logical channel a priority between 1 and 8, where 1 is the highest priority and 8 the lowest. E-TFC selection in the UE shall be done in accordance with the priorities indicated by RRC. Logical channels have absolute priority, i.e. the UE shall maximise the transmission of higher priority data.

RRC can allocate non-scheduled transmission grants to individual MAC-d flows in order to reduce the transmission delays. When a 2ms TTI is configured each non-scheduled grant is applicable to the specific set of HARQ processes indicated by RRC. The applicability of scheduled grants can be also restricted to a specific set of HARQ processes when a 2ms TTI is configured. HARQ process restriction and reservation is under the control of the serving cell Node B and indicated to the UE by RRC.

For each configured MAC-d flow, a given E-TFC can be in any of the following states:

- Supported state;
- Blocked state.

At each TTI boundary, UEs in `CELL_DCH` state, `CELL_FACH` state and Idle mode with an E-DCH transport channel configured shall determine the state of each E-TFC for every MAC-d flow configured based on its required transmit power versus the maximum UE transmit power (see [7] and [12]). The UE shall consider that E-TFCs included in the minimum set of E-TFCs are always in supported state (see [7]).

At every TTI boundary for which a new transmission is requested by the HARQ entity (see subclause 11.8.1.1.1), the UE shall perform the operations described below. UEs configured both with DCH and E-DCH transport channels shall perform TFC selection before performing E-TFC selection.

The Serving Grant Update function provides the E-TFC selection function with the maximum E-DPDCH to DPCCCH power ratio that the UE is allowed to allocate for the upcoming transmission for scheduled data (held in the Serving Grant state variable – see subclause 11.8.1.3). This power ratio shall be used to determine a maximum number of bits of scheduled data with a 1 bit granularity for the upcoming transmission, calculated from number of bits corresponding to the reference E-TFCs ( $E\text{-TFC}_{\text{ref},m}$ ), and that the highest value is lower or equal to:

If E-DPDCH power extrapolation formula is configured:

$$\left\lceil K_{e,ref,m} \cdot \frac{\text{Serving\_Grant}}{L_{e,ref,m} \cdot A_{ed,ref,m}^2 \cdot 10^{\Delta_{harq}/10}} \right\rceil$$

This maximum number of bits shall be lower than  $K_{e,ref,n}$  bits, where  $K_{e,ref,n}$  corresponds to any higher  $n^{\text{th}}$  reference E-TFC (E-TFC<sub>ref,n</sub>) and shall be higher or equal to  $K_{e,ref,m}$  of E-TFC<sub>ref,m</sub> except if  $m=1$ .

Else if E-DPDCH power interpolation formula is configured:

$$\left\lceil K_{e,ref,m} + \frac{\left( \frac{\text{Serving\_Grant}}{10^{\Delta_{harq}/10}} - L_{e,ref,m} \cdot A_{ed,ref,m}^2 \right) (K_{e,ref,m+1} - K_{e,ref,m})}{L_{e,ref,m+1} \cdot A_{ed,ref,m+1}^2 - L_{e,ref,m} \cdot A_{ed,ref,m}^2} \right\rceil$$

This maximum number of bits shall be lower than  $K_{e,ref,m+1}$  bits except if  $K_{e,ref,m+1}$  corresponds to the number of bits of the highest reference E-TFC (E-TFC<sub>ref,M</sub>) and shall be higher or equal to  $K_{e,ref,m}$  of E-TFC<sub>ref,m</sub> except if  $m=1$ .

$K_{e,ref,m}$  and  $L_{e,ref,m}$  above are given in [13].  $A_{ed,ref,m}$  is the signalled reference amplitude ratio which corresponds to E-TFC<sub>ref,m</sub> [22].

The HARQ process ID for the upcoming transmission is determined using the following formulae:

- For 2ms TTI:  $\text{CURRENT\_HARQ\_PROCESS\_ID} = [5 * \text{CFN} + \text{subframe number}] \bmod \text{HARQ\_RTT}$
- For 10ms TTI:  $\text{CURRENT\_HARQ\_PROCESS\_ID} = [\text{CFN}] \bmod \text{HARQ\_RTT}$

Based on this current HARQ process ID and the RRC configuration, the UE shall determine whether to take the scheduled and non-scheduled grants into account in the upcoming transmission. If they are not supposed to be taken into account, then the corresponding grant shall be assumed to not exist. If the variable Serving\_Grant has the value "Zero\_Grant" after the Serving Grant Update, then the Serving Grant shall not be taken into account in the upcoming transmission.

When Scheduling Information is triggered per subclause 11.8.1.6, the E-TFC selection and data-allocation process shall assume that a non-scheduled grant is available for its transmission and that Scheduling Information has a priority higher than any other logical channel. Furthermore the HARQ process used for the upcoming transmission shall be assumed to be active and not L3 restricted for the transmission of the Scheduling Information, i.e. transmission of Scheduling Information can take place on this process.

The transmission format and data allocation shall follow the requirements below:

- Only E-TFCs from the configured E-TFCS shall be considered for the transmission;
- For all logical channels, if the logical channel belongs to a non-scheduled MAC-d flow, its data shall be considered as available up to the corresponding non-scheduled grant, if the logical channel does not belong to a non-scheduled MAC-d flow, its data shall be considered as available up to the Serving Grant;
- The power offset for the transmission is the one from the HARQ profile of the MAC-d flow that allows highest-priority data to be transmitted. If more than one MAC-d flow allows data of the same highest priority to be transmitted, it is left to implementation to select which MAC-d flow to prefer);
- In case the variable Serving\_Grant has the value "Zero\_Grant" after the Serving Grant Update function and there is no data available for MAC-d flows for which non-scheduled grants were configured and the transmission of Scheduling Information has been triggered, the 'Control-only' HARQ profile configured by the higher layers shall be used.

- The Nominal Power Offset shall be set to the power offset included in the transmission HARQ profile;
- The UE shall not use the following E-TFCIs;
  - If the UE is configured with E-TFCI table 0 (see [7]) and 2ms TTI, it shall not use E-TFCI 120 in the mapping defined in Annex B.1
  - If the UE is configured with E-TFCI table 1 (see [7]) and 2ms TTI, it shall not use E-TFCI 115 in the mapping defined in Annex B.2
  - If the UE is configured with E-TFCI table 2 (see [7]) and 2ms TTI, it shall not use E-TFCI 121 in the mapping defined in Annex B.2a
  - If the UE is configured with E-TFCI table 3 (see [7]) and 2ms TTI, it shall not use E-TFCIs 101 and 102 in the mapping defined in Annex B.2b
- The data allocation shall maximize the transmission of higher priority data. When scheduled and non-scheduled grants are taken into account for the upcoming transmission:
  - Data of a given priority belonging to a scheduled MAC-d flow shall have precedence over any lower priority data, whether they belong to a scheduled or a non-scheduled MAC-d flow;
  - Data of a given priority belonging to a non-scheduled MAC-d flow shall have precedence over any lower priority data, whether they belong to a scheduled or a non-scheduled MAC-d flow;
- The amount of data and corresponding MAC-e/es or MAC-i/is headers from MAC-d flows for which non-scheduled grants were configured shall not exceed the value of the non-scheduled grant.
- If a 10ms TTI is configured and the TTI for the upcoming transmission overlaps with a compressed mode gap, the Serving\_Grant provided by the Serving Grant Update function shall be scaled back as follows:

$$SG' = SG * \left(\frac{N_c}{15}\right)$$

where SG" represents the modified serving grant considered by the E-TFC selection algorithm and N<sub>c</sub> represents the number of non DTX slots in the compressed TTI;

- If the transmission contains any scheduled data, the size of the selected MAC-e or MAC-i PDU shall not exceed the total of:
  - all non-scheduled grants which are applicable for transmission in this TTI;
  - the maximum number of scheduled bits based on the Serving Grant (after adjustment for compressed frames) and the power offset from the selected HARQ profile;
  - the size of the triggered scheduling information (if any).
- In the case a 2ms TTI is configured and the HARQ process is inactive, the UE shall not include in the transmission any data from MAC-d flows for which no non-scheduled grants were configured;
- The Scheduling Information is always sent when triggered (see subclause 11.8.1.6);
- Only E-TFCs in supported state shall be considered;
- Once all other requirements have been fulfilled, the E-TFC resulting in the smallest amount of padding for the selected MAC-es or MAC-is PDUs and corresponding MAC-e/es or MAC-i/is headers, shall be selected including the case when the Scheduling Information needs to be transmitted.

While respecting all the above listed requirements, for each logical channel using RLC-UM, at every TTI, the UE may select the RLC PDU size so as to maximise the amount of data of this logical channel that can be transmitted.

Once an appropriate E-TFC and data allocation are found according to the rules above, the "Multiplexing and TSN Setting' entity shall generate the corresponding MAC-e or MAC-i PDU.

The E-TFC selection function shall provide this MAC-e or MAC-i PDU and transmission HARQ profile to the HARQ entity. The maximum number of HARQ transmissions and the power offset in this profile, shall be set respectively to

the maximum of the Max Number of HARQ Transmissions of the HARQ profiles from all the MAC-d flows from which data is multiplexed into the transmission and to the Nominal Power Offset. The HARQ entity shall also be informed of whether the transmission includes Scheduling Information and whether this information is sent by itself or with higher-layer data. The E-TFC selection function shall provide the E-TFCI for the selected E-TFC to the HARQ entity.

In FDD, in case the DTX feature is configured by higher layers and no E-DCH transmission is performed in this TTI:

- if *MAC Inactivity Threshold* > 1 and no E-DCH transmission has been performed for *MAC Inactivity Threshold - 1* previous TTIs or,
- if *MAC Inactivity Threshold* = 1:
  - E-TFC selection shall only be performed for the TTIs where the following conditions are fulfilled:
    - For 2ms TTI:  $[5 \cdot \text{CFN} + \text{subframe number} - \text{UE DTX DRX Offset}] \bmod \text{MAC DTX Cycle} = 0$ ;
    - For 10ms TTI:  $[5 \cdot \text{CFN} - \text{UE DTX DRX Offset}] \bmod \text{MAC DTX Cycle} = 0$ .

In 2ms TTI case, if the TTI that fulfilled  $[5 \cdot \text{CFN} + \text{subframe number} - \text{UE DTX DRX Offset}] \bmod \text{MAC DTX Cycle} = 0$  overlapped with an uplink compressed mode transmission gap, the E-TFC selection shall be performed for the first TTI not overlapping with an uplink compressed mode transmission gap.

### 11.8.1.5 Happy Bit Setting

The Happy Bit is included on the E-DPCCH for every E-DCH transmission. E-DCH transmissions shall not be triggered specifically to allow the transmission of the happy bit.

RRC configures MAC with the duration *Happy\_Bit\_Delay\_Condition*, over which to evaluate the current grant relative to the TEBS after application of the E-TFC selection procedure described in subclause 11.8.1.4.

For every E-DCH transmission, the Happy Bit shall be set to "unhappy" if the three following criteria are met:

- 1) UE is transmitting as much scheduled data as allowed by the current *Serving\_Grant* in E-TFC selection; and
- 2) UE has enough power available to transmit at higher data rate; and
- 3) Based on the same power offset as the one selected in E-TFC selection to transmit data in the same TTI as the Happy Bit, TEBS would require more than *Happy\_Bit\_Delay\_Condition* ms to be transmitted with the current *Serving\_Grant* × the ratio of active processes to the total number of processes.

The first criteria is always true for a deactivated process and the ratio of the third criteria is always 1 for 10ms TTI..

Otherwise, the Happy Bit shall be set to "happy".

In order to assess if it has enough power available to transmit at higher data rate the UE shall:

- 1) If MAC-i/is is configured, identify the E-TFC that has a transport block size at least 32 bits larger than the transport block size of the E-TFC selected for transmission in the same TTI as the Happy Bit. Otherwise, identify the E-TFC that has a transport block size at least *x* bits larger than the transport block size of the E-TFC selected for transmission in the same TTI as the Happy Bit, where *x* is the smallest RLC PDU size configured among all the logical channels that do not belong to non-scheduled MAC-d flows and which have data in the buffer; and
- 2) Based on the same power offset as the one selected in E-TFC selection to transmit data in the same TTI as the Happy Bit, check that the identified E-TFC is supported i.e. not blocked.

### 11.8.1.6 Scheduling Information reporting

Scheduling information reports will be triggered differently depending on the value of the variable *Serving\_Grant* after the *Serving Grant Update* function. The triggering of a report shall be indicated to the E-TFC selection function at the first new transmission opportunity (this process may be delayed in case the HARQ processes are occupied with re-transmissions).



Even if multiple events are triggered by the time a new transmission can take place, only a single scheduling information header will be included in the payload.

In CELL\_DCH state, the Scheduling Information shall not be transmitted if the TEBS is zero, even if it was triggered by one of the configured triggering mechanisms.

For FDD and for CCCH transmission in CELL\_FACH state and Idle mode, the transmission of Scheduling Information shall only be triggered when TEBS becomes zero and the MAC-i PDU containing the last data is being transmitted. The SI is transmitted with the MAC-i PDU carrying the last data, given the serving grant is sufficient to carry the SI with the last remaining data. Otherwise, the empty buffer status report is transmitted separately with the next MAC-i PDU.

For FDD and for DTCH/DCCH transmission in CELL\_FACH state, the transmission of Scheduling Information shall be triggered once, if the TEBS remains zero and no higher layer data remains in MAC to be transmitted for a period given by the E-DCH transmission continuation back off period unequal "infinity". For FDD and for DTCH/DCCH transmission in CELL\_FACH state with E-DCH transmission continuation back off period set to "infinity" or "zero", the transmission of Scheduling Information shall be triggered each time when the TEBS becomes zero and no higher layer data remains in MAC to be transmitted after the transmission of the MAC-i PDU containing the scheduling information with the empty buffer status report.

If the Scheduling Information needs to be included in the MAC-e or MAC-i PDU according to subclause 9.2.4.2, it shall be transmitted regardless of TEBS status.

The transmission of Scheduling Information can take place on every HARQ process, even on those processes for which transmission is restricted according to RRC or deactivated by absolute grants, i.e. processes on which scheduled and/or non-scheduled transmission can not take place.

The description of the behaviour in the two cases is provided below.

#### 11.8.1.6.1 Report Triggering when SG = 'Zero\_Grant' or all processes are deactivated

If the Serving\_Grant has the value "Zero\_Grant" or all processes are deactivated, and the TEBS becomes larger than zero, the transmission of Scheduling Information shall be triggered.

If data with higher priority than the data already in the transmission buffer arrives, the transmission of a Scheduling Information shall be triggered.

RRC can also configure MAC with periodic Scheduling Information triggering. The periodic trigger timer T\_SING (Timer Scheduling Information – "Zero\_Grant") shall be started once the Serving\_Grant variable becomes "Zero\_Grant" or all processes are deactivated and TEBS is larger than zero.

When T\_SING expires, the transmission of a Scheduling Information shall be triggered.

T\_SING shall be restarted when the transmission of a Scheduling Information is triggered.

T\_SING shall be stopped and reset once the Serving\_Grant variable in the Serving Grant Update function takes a value other than "Zero\_Grant" and at least one process is activated.

#### 11.8.1.6.2 Report Triggering when SG <> 'Zero\_Grant' and at least one process is activated

If SG becomes too small to allow transmission of a single PDU from any scheduled MAC-d flow or if the SG is too small to allow transmission of a single PDU from any scheduled MAC-d flow and TEBS becomes larger than zero, the transmission of Scheduling Information shall be triggered.

If an E-DCH serving cell change occurs and if the new E-DCH serving cell was not part of the previous Serving E-DCH RLS, the transmission of a Scheduling Information shall be triggered.

RRC can configure MAC with periodic triggering also for the case when the variable Serving\_Grant <> "Zero\_Grant" and at least one process is activated. The periodic trigger timer T\_SIG (Timer Scheduling Information – different from "Zero\_Grant") can be configured to a different value than T\_SING.

T\_SIG shall be started once the Serving\_Grant variable becomes <> "Zero\_Grant" and at least one process is activated.

When T\_SIG expires, the transmission of a new Scheduling Information shall be triggered.

T\_SIG shall be stopped and reset once the Serving\_Grant variable in the Serving Grant Update function becomes equal to "Zero\_Grant" or all processes are deactivated.

T\_SIG shall be restarted when the transmission of a Scheduling Information is triggered.

Once the Serving\_Grant variable in the Serving Grant Update function becomes equal to "Zero\_Grant" or all processes are deactivated and TEBS is larger than zero, the transmission of a Scheduling Information shall be triggered.

#### 11.8.1.6.3 HARQ delivery failure for triggered Scheduling Information

If the HARQ process fails to deliver a MAC-e or MAC-i PDU containing a triggered Scheduling Information to the RLS containing the serving cell:

- if the Scheduling Information was transmitted without any higher layer data multiplexed in the same MAC-e or MAC-i PDU:
  - no further action is required (rely on periodic triggering).
- else (Scheduling Information was transmitted together with higher layer data multiplexed in the same MAC-e or MAC-i PDU):
  - the transmission of a new Scheduling Information shall be triggered.

#### 11.8.1.7 MAC-es/e Reset

If a reset of the MAC-es/e or MAC-is/i entity is requested by upper layers, the UE shall at the activation time indicated by higher layers:

- flush all HARQ processes;
- set CURRENT\_TSN to 0 for all the logical channels mapped to E-DCH;
- if MAC-i/is is configured by upper layers:
  - discard all segments stored in segmentation entities.

NOTE: In this case, the HARQ entity will not notify the Scheduling Information Reporting function if a flushed MAC-e or MAC-i PDU contained a triggered Scheduling Information (rely on periodic triggering).

#### 11.8.1.8 Monitoring of Absolute and Relative Grant Channels

When the DRX feature is enabled by higher layers, and in addition to the conditions defined in subclause 6C.3 of [13] the downlink monitoring of E-AGCH and E-RGCH sets is required in the following conditions:

- At least one MAC-d flow is configured with a scheduled transmission and TEBS > 0 or;
- a scheduled E-DCH transmission has been performed in any of the *Inactivity Threshold for UE Grant Monitoring* previous TTIs or;
- the start of E-AGCH and E-RGCH commands overlap with an E-HICH corresponding to a scheduled E-DCH transmission.

#### 11.8.1.9 Release of common E-DCH resources (FDD only)

If the UE is sending CCCH data in CELL\_FACH state or Idle mode, the UE shall release the common E-DCH resource under following conditions:

- no MAC-i PDU is pending for transmission; or
- the maximum E-DCH resource allocation for CCCH is reached, or;
- a L1 synchronisation failure is reported.

If the UE is sending DTCH or DCCH data, the UE shall release the common E-DCH resource under following conditions:

- a L1 synchronization failure occurs; or

- the maximum period for collision resolution is reached and no E-AGCH with the UE's E-RNTI (through an E-RNTI specific CRC attachment) has been reached; or
- an E-AGCH is received with a common E-DCH resource release command (INACTIVE) (explicit common E-DCH resource release) or;
- "E-DCH transmission continuation back off" is not set to "infinity", the empty buffer status (TEBS = 0 byte) has been reported and no MAC-i PDU is left in a HARQ process for (re-)transmission.

## 11.8.2 Node B operation

### 11.8.2.1 HARQ Operation

#### 11.8.2.1.1 HARQ entity

There is one HARQ entity per UE in each Node-B in its E-DCH active set. The HARQ entity routes the payload and the associated RSN value to the appropriate HARQ process based on the transmission timing. Based on the outcome of the decoding, the HARQ entity transmits an ACK or a NACK in return.

#### 11.8.2.1.2 HARQ process

The HARQ process uses the RSN and the transmission timing (CFN, sub-frame) to establish the transmission number. Based on this it identifies the transmission redundancy version and attempts to decode the transmission. The outcome of the decoding is reported to the HARQ entity, so that it may be fed back to the UE.

### 11.8.2.2 De-multiplexing

There is one de-multiplexing entity per UE in the Node B. If the MAC-e/es is configured by upper layers, the SRNC configures the Node B with the mapping between the active DDI values and the corresponding MAC-d flow and PDU size. If the MAC-i/is is configured by upper layers, the SRNC configured the Node B with the mapping between the LCH-ID and the corresponding MAC-d flow. Also, it provides it with the mapping between MAC-d flow IDs and the corresponding Iub bearer.

If MAC-e/es is configured by upper layers, the de-multiplexing entity uses the MAC-e header information (DDI, N) to determine the size of each MAC-es PDU and based on this it segments the MAC-e payload into MAC-es PDUs. If MAC-i/is is configured by upper layers, the de-multiplexing entity uses the MAC-i header information (L) to determine the size of each MAC-is SDU and based on this it segments the MAC-i payload into MAC-is PDUs. These are then routed onto the Iub bearer indicated by the DDI value.

With each MAC-es PDU, the Node B will send to the SRNC:

- the associated DDI and N values;
- the CFN and sub-frame number when the payload including the MAC-es PDU was decoded correctly;
- the total number of transmissions that were needed for the MAC-e PDU to be decoded correctly.

With each MAC-is PDU, the Node B will send to the SRNC:

- the associated LCH-ID and L values for each MAC-is SDU;
- the CFN and sub-frame number when the payload including the MAC-is PDU was decoded correctly;
- the total number of transmissions that were needed for the MAC-i PDU to be decoded correctly.

### 11.8.2.3 Scheduler

There is one E-DCH Node B scheduler per Node B. The Node B scheduler is responsible for the following functions:

- Allocating uplink resources to UEs for which it acts as the serving Node B;

- Monitoring other-cell interference and accordingly sending relative grants to UEs for which it does not act as the serving Node B;
- Reporting to the SRNC on the lack of processing resources;

#### 11.8.2.4 E-DCH Provided Bit Rate measurement

The E-DCH Provided Bit Rate measurement is defined as follows:

- for each priority class the MAC-e or MAC-i function in the Node B measures the total number of MAC-d PDU bits whose transmission over the radio interface has been considered successful by MAC-e or MAC-i in Node-B during the last measurement period, divided by the duration of the measurement period;
- the number of MAC-d PDU bits from UEs in softer handover shall be considered after soft combining;
- the Node-B shall allocate the bit rate received over an RLS equally divided among all cells in the RLS regardless of whether the RLS contains the E-DCH serving cell or not;
- the values reported shall be raw samples;
- the measurement period shall be 100 ms.

#### 11.8.2.5 Determination of UE-ID (FDD only) and collision resolution

For UEs in CELL\_FACH state or Idle mode, the Node B determines whether the UE id (E-RNTI) is included.

If the Node B receives a MAC-i PDU with an E-RNTI included in the MAC-i header, then the Node B is aware of the user using a common E-DCH resource. By sending a received E-RNTI on the E-AGCH, the Node B grants the common E-DCH resource explicitly to the UE with this UE id, resolving any potential collision. A UE adds its E-RNTI in all MAC-i PDUs at its side until the UE receives an E-AGCH with its E-RNTI (through an E-RNTI-specific CRC attachment). When the UE's E-RNTI is present, it identifies DCCH and/or DTCH data transmission from this UE.

If no E-RNTI is included in any MAC-i header, then only CCCH data can be transmitted. No collision resolution is performed.

### 11.8.3 RNC operation

#### 11.8.3.1 Re-ordering entity for DTCH/DCCH transmission

The re-ordering entity is part of the MAC-es or MAC-is sublayer in the SRNC. There is one re-ordering entity per UE. Each re-ordering entity will support one re-ordering process per logical channel. If MAC-es is configured by upper layers, the DDI value is used to determine the logical channel for which each MAC-es PDU is meant. If MAC-is is configured by upper layers, the LCH-ID value is used to determine the logical channel for which each MAC-is SDU is meant. Based on this information, the MAC-es or MAC-is PDUs are routed to the proper re-ordering process. The re-ordering process may use the explicit TSN indication as well as the timing information provided by the Node B in order to eliminate duplicates and deliver the packets in order to RLC. The details of the re-ordering mechanism are left up to the implementation.

#### 11.8.3.2 Re-ordering and CRC entity for CCCH transmission

The re-ordering entity is part of MAC-is sublayer in the CRNC. There is one re-ordering entity per common E-DCH resource. Each re-ordering entity will support one re-ordering process. If MAC-is is configured by upper layers, the LCH-ID value is used to determine the logical channel for which each MAC-is SDU is meant. Based on this information, the received TSN and Node-B tagging i.e. (CFN, subframe number), the MAC-is PDUs are routed to the proper re-ordering process. The re-ordering process may use the explicit TSN indication as well as the timing information provided by the Node B in order to eliminate duplicates. When the MAC-c PDU is received correctly then after reassembly the CRC field is removed and the resulting data is delivered to the MAC-c. However, if a MAC-c PDU has been received with an incorrect CRC, the MAC-c PDU is discarded. The details of the re-ordering mechanism are left up to the implementation.

Note: A CRC sequence is added to a MAC-c PDU only, if the MAC-c PDU is not sent completely in one MAC-i PDU.

## 11.9 Control of E-DCH transmission and reception (TDD)

### 11.9.1 UE operation

#### 11.9.1.1 HARQ Operation

The TDD HARQ protocol is a stop and wait protocol based on synchronous downlink ACK/NACKs with asynchronous retransmissions in the uplink. If NACK is received then the UE may only retransmit the previously transmitted MAC-e or MAC-i PDU if suitable physical resources are available, otherwise it must wait until it receives an appropriate Absolute Grant (or in the case of non-scheduled transmission, the UE must wait until resource is next designated as available for non-scheduled transmission/retransmission). There are a maximum of 8 HARQ processes (instances of the HARQ entity). For 1.28 Mcps TDD, there are a maximum of 4 HARQ processes employed for the UEs in CELL-FACH state and idle mode as non-scheduled transmission is not allowed. Operation of the HARQ protocol is as follows:

- If an Absolute Grant is received in Frame (i) then the UE transmits a data block (MAC-e or MAC-i PDU) in Frame (i+T1)
- For a MAC-e or MAC-i PDU transmitted in Frame (i+T1) the UE receives an ACK/NACK in Frame (i+T1+T2)
- If NACK is received in Frame (i+T1+T2) then the UE cannot retransmit the MAC-e or MAC-i PDU previously transmitted in Frame (i+T1) (now stored for potential retransmission) until suitable physical resources are available (e.g. until Absolute Grant received)
- The interval T3 between reception of NACK and the availability of suitable resources via reception of a Grant for a subsequent retransmission is variable and depends on Node B scheduling decisions
- If an ACK is received in Frame (i+T1+T2) then the MAC-e or MAC-i PDU previously transmitted in Frame (i+T1) (stored for potential retransmission) is discarded and the HARQ process identity associated with the previously transmitted data block can now be reassigned.

NOTE: For 1.28 Mcps TDD, "subframe" should be used to describe the above timing relation. T1 and T2 may be derived from the physical layer timings given in [21].

Operation of the TDD HARQ protocol is illustrated by Figure 11.9.1.1.

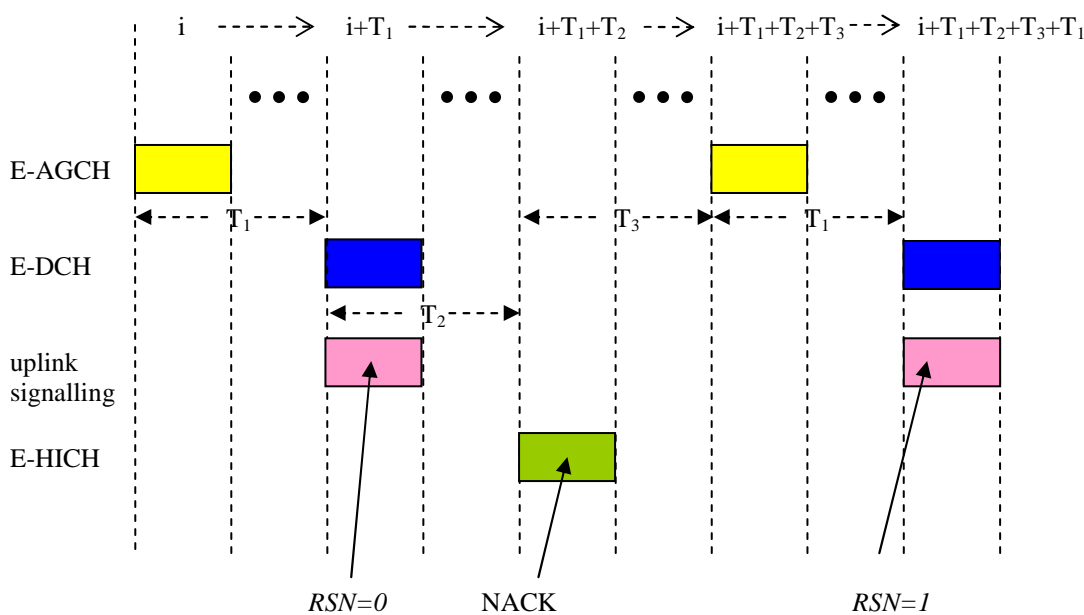


Figure 11.9.1.1: TDD E-DCH HARQ Operation

#### 11.9.1.1.1 HARQ entity

There is one HARQ entity in the UE. A number of parallel HARQ processes (identified by a HARQ process identifier) are used in the UE to support the HARQ entity, allowing transmissions to take place continuously while the UE is granted resources. The HARQ entity identifies the HARQ process for which transmission should take place if resources are available. Also, based on timing with respect to a previously-transmitted MAC-e or MAC-i PDU it routes the receiver feedback (ACK/NACK information), relayed by the physical layer, to the appropriate HARQ process.

The minimum number of HARQ processes is a function of T1 and T2 (see subclause 11.9.1.1). The maximum number of HARQ process identifiers is 8. Each process is associated with a HARQ process identifier numbered from 0 to 7.

The HARQ entity is responsible for determining which HARQ process will use the assigned resources in a given TTI (for both scheduled and non-scheduled resource types). It is further responsible for determining for each HARQ process whether new data or existing data should be transmitted from the HARQ process buffer, including the case in which new data is transmitted before successful delivery of the existing data.

For transmission in a given TTI, the HARQ entity shall only consider those HARQ processes associated with the resource grant type (scheduled / non-scheduled). HARQ processes 0 to 3 are associated with scheduled transmission whilst HARQ processes 4 to 7 are associated with non-scheduled transmission. In the following, the set of HARQ processes associated with the resource grant type is denoted the "associated set".

The following rules control the operation of the HARQ entity:

- If retransmissions are pending for any of the HARQ processes of the associated set:
  - the HARQ entity shall determine for each HARQ process of the associated set whether the current resource grant is sufficient to allow retransmission of the data. The grant is deemed to be sufficient if the corresponding transport block size is supportable within the allocated resources as determined by the E-TFC selection entity (see subclause 11.9.1.4);
  - if the grant is sufficient for retransmission by at least one of the HARQ processes of the associated set, select the HARQ process containing the oldest MAC-e or MAC-i PDU for retransmission and notify the E-TFC selection entity that the TTI shall be used for retransmission;
  - if the grant is not sufficient for retransmission by any of the HARQ processes of the associated set, the HARQ entity shall select an available HARQ process from the associated set for transmission of new data. In the case that none of the HARQ processes in the associated set are available (all contain data for retransmission) the HARQ entity shall discard the data from the HARQ process in the associated set containing the oldest MAC-e or MAC-i PDU and shall select that HARQ process for transmission of new data. In either case, the HARQ entity shall notify the E-TFC selection entity that the TTI shall be used for a new transmission.
- else:
  - the HARQ entity shall select an available HARQ process from the associated set for transmission of new data and shall notify the E-TFC selection entity that the TTI shall be used for a new transmission of scheduled data.

#### 11.9.1.1.2 HARQ process

Each HARQ process is associated with a physical buffer (HARQ buffer).

Each HARQ process maintains the state variable CURRENT\_TX\_NB, which indicates the number of transmissions that have taken place for the MAC-e or MAC-i PDU currently in the buffer. For 1.28 Mcps TDD, each HARQ process also maintains the timer RTX\_TIMER used to determine whether a pending retransmission should be discarded. When the HARQ process is established, CURRENT\_TX\_NB shall be initialized to 0.

At the time of a new transmission, the HARQ entity provides the HARQ profile to use for all transmissions and re-transmissions of this MAC-e or MAC-i PDU. This HARQ profile includes information on the maximum number of transmissions to perform, and the power offset with which to configure the physical layer. For 1.28 Mcps TDD, the HARQ profile also includes a retransmission timer attribute.

If the HARQ entity provides a new PDU, the HARQ process shall:

- set CURRENT\_TX\_NB to 0;
- set CURRENT\_RSN to 0;
- store the MAC-e or MAC-i PDU in the associated HARQ buffer;
- for 1.28 Mcps TDD, if RTX\_TIMER is active, it shall be stopped;
- generate a transmission as described below.

If the HARQ entity requests a re-transmission, the HARQ process shall:

- generate a transmission as described below.
- for 1.28 Mcps TDD, start RTX\_TIMER for this MAC-e or MAC-i PDU if NACK is received for the initial transmission.

To generate a transmission, the HARQ process shall:

- instruct the physical layer to set the RSN field on the E-UCCH to CURRENT\_RSN;
- instruct the physical layer to generate a transmission with the power offset corresponding to the HARQ profile and the redundancy version corresponding to the RSN value
- if CURRENT\_RSN < 3
  - increment CURRENT\_RSN by 1;
- else
  - decrement CURRENT\_RSN by 1;
- increment CURRENT\_TX\_NB by 1;
- if CURRENT\_TX\_NB  $\geq$  maximum number of transmissions indicated in the transmission HARQ profile:
  - flush the HARQ buffer;
  - set CURRENT\_TX\_NB to 0;
  - set CURRENT\_RSN to 0.
  - for 1.28 Mcps TDD, if RTX\_TIMER is active, it shall be stopped
- for 1.28 Mcps TDD, if RTX\_TIMER expires which value indicated in the transmission HARQ profile:
  - flush the HARQ buffer;
  - set CURRENT\_TX\_NB to 0;
  - set CURRENT\_RSN to 0.

If an ACK is received, the HARQ process shall:

- flush the HARQ buffer;
- set CURRENT\_TX\_NB to 0;
- set CURRENT\_RSN to 0.
- for 1.28 Mcps TDD, if RTX\_TIMER is active, it shall be stopped.

For 1.28 Mcps TDD, in case of CCCH transmission with common E-RNTI, all MAC-i PDUs that were negatively acknowledged finally and all MAC-is segmentations (if any) that have not been transmitted shall be flushed at the end of the Available Scheduling Window for this selected common E-RNTI. The calculation of Available Scheduling Window is defined in subclause 11.9.1.5b.

When CCCH transmission finishes, a CMAC-STATUS-Ind shall be sent from MAC to inform the RRC about the end of the Enhanced Uplink for CELL\_FACH state and Idle mode.

### 11.9.1.2 Multiplexing and TSN setting entity

As subclause 11.8.1.2.

#### 11.9.1.2a Segmentation entity

There is one segmentation entity per logical channel in the UE.

When the MAC-d PDU size, the untransmitted part of the MAC-d PDU, the MAC-c PDU size (1.28 Mcps TDD only) or the untransmitted part of the MAC-c PDU (1.28 Mcps TDD only) exceeds available space in the transport block according to the E-TFC selection, the segmentation entity shall:

- segment the MAC-d PDU, the untransmitted part of the MAC-d PDU, the MAC-c PDU or the untransmitted part of the MAC-c PDU to fit the available space in the transport block according to the E-TFC selection and store the untransmitted part of the MAC-d PDU or MAC-c PDU;
- set the segmentation status (SS) field of the transmission to indicate the segmentation status as described in subclause 9.2.4.3.

### 11.9.1.3 Receiving a Grant

The UE determines whether each TTI is available for scheduled or non-scheduled transmissions.

The parameters applicable to a transmission are timeslots, code and maximum power. In the case of non-scheduled transmission, these parameters are set by RRC and retransmissions and/or new transmissions may occur in frames at intervals set by RRC. For scheduled transmission, the parameters are received via the E-AGCH.

UEs in CELL\_FACH state and idle mode (1.28 Mcps TDD only) shall only use the scheduled transmission.

For given grant, the HARQ entity determines which HARQ process to use in the TTI (see subclause 11.9.1.1.1).

For 1.28 Mcps TDD in CELL\_FACH state and idle mode the UE with common E-RNTI shall only monitor the selected common E-RNTI on the pre-configured E-AGCH(s) for the scheduled grants within the Available Scheduling Window assigned for this selected common E-RNTI. At the end of the Available Scheduling Window this selected common E-RNTI shall be released.

### 11.9.1.4 E-TFC Selection

In TDD, rules for E-TFC selection shall be applied as provided below.

UEs shall apply E-TFC selection when invoked by the HARQ entity (see subclause 11.9.1.1.1).

For CELL-DCH state in TDD, for each MAC-d flow, RRC configures MAC-e with a HARQ profile and multiplexing list. Additionally, RRC configures MAC with a power offset in case the Scheduling Information needs to be transmitted without any higher-layer data. For 1.28 Mcps TDD, RRC also configures MAC with a retransmission timer and the maximum number of HARQ transmissions in case the Scheduling Information needs to be transmitted without any higher-layer data. The HARQ profile includes the power offset and maximum number of HARQ transmissions to use for this MAC-d flow. For 1.28 Mcps TDD, the HARQ profile also includes a retransmission timer attribute. The multiplexing list identifies for each MAC-d flow(s), the other MAC-d flows for which data can be multiplexed in a transmission that uses the power offset included in its HARQ profile.

For 1.28 Mcps TDD in CELL\_FACH state and idle mode, for common mac flows, RRC configures MAC with a HARQ profile and multiplexing list. The HARQ profile includes the power offset/maximum number of HARQ transmissions to use for this common mac flows and a retransmission timer attribute.

RRC can control the scheduling of uplink data by giving each logical channel a priority between 1 and 8, where 1 is the highest priority and 8 the lowest. E-TFC selection in the UE shall be done in accordance with the priorities indicated by RRC. Logical channels have absolute priority, i.e. the UE shall maximise the transmission of higher priority data.



For 1.28 Mcps TDD in CELL\_FACH state and idle mode, CCCH shall not be multiplexed with any other logical channel, and the CCCH data shall have higher priority than that of any other logical channel.

RRC can allocate non-scheduled transmission grants to individual MAC-d flows in order to reduce the transmission delays.

The UE shall determine whether to take scheduled or non-scheduled grants into account in the upcoming transmission. If neither are supposed to be taken into account (i.e. the TTI is not available for non-scheduled transmission and no Grant for scheduled transmission has been received) then no grant shall be assumed to exist. If a grant exists then the transmission format and data allocation shall follow the requirements below.

For each configured MAC-d flow or common flow (1.28 Mcps TDD only), a given E-TFC can be in any of the following states:

- Supported state;
- Blocked state.

The E-TFC states are derived according to the following:

- If the transmission is a retransmission then only the E-TFC with the same block size as the original transmission may be in the supported state.
- For 1.28Mcps TDD, only E-TFCs from the E-TFCS (the table of TB sizes) which are consistent with the UE's E-DCH capability category shall be considered for the transmission;
- Only E-TFCs from the E-TFCS (the table of TB sizes) which can be supported by (exactly) the number of slots assigned by the grant shall be considered for the transmission;
- Only E-TFCs which result (for the granted timeslot and code physical resources) in a coderate lying between the maximum and minimum (inclusive) allowable coderates set by RRC [7] shall be considered for the transmission {note: the definition of the term 'coderate' as used here is the same as that provided by [18]}. This shall be evaluated for both QPSK and 16-QAM modulation;
- $P_{\text{HARQ}}$ , the HARQ profile power offset is selected (for 3.84/7.68Mcps TDD the HARQ profile for the transmission shall be selected among the HARQ profiles of MAC-d flows on which the highest priority logical channels with available data are mapped, for 1.28Mcps TDD the HARQ power offset shall be set to the maximum of HARQ power offset of all the MAC-d flows or common flows mapped to the same type of resource (scheduled or non-scheduled resource); Scheduling Information power offset shall be used when Scheduling Information is transmitted without any higher-layer data.)
- Only E-TFCs whose calculated transmission power requirement  $P_{\text{E-PUCH}}$  (see [18]) is less than or equal to both the available and the granted power shall be considered for the transmission (note: this requirement does not apply in the case of a retransmission on non-scheduled resources). For TDD, the smallest E-TFC is considered always in the supported state. The granted power is defined as the calculated E-PUCH transmission power of [18] with  $\beta_e = (\text{Absolute Grant Value} + \alpha_e)$ . The available power is the maximum UE transmission power.

From those E-TFCs in the supported state the UE determines the largest block size that it is permitted to transmit within the given constraints.

The UE shall select the modulation type associated with the determined E-TFC (note: if an E-TFC is supported by both QPSK and 16-QAM then 16-QAM modulation shall be used if its power requirement ( $P_{\text{E-PUCH}}$ ) is lower than the power requirement for QPSK, otherwise QPSK modulation shall be used).

Data allocation shall then be performed in accordance with the following:

- For all logical channels, if the logical channel belongs to a non-scheduled MAC-d flow, its data shall be considered as available up to the largest block size determined for the corresponding non-scheduled grant. If the logical channel does not belong to a non-scheduled MAC-d flow, its data shall be considered as available up to the largest block size determined for the Serving Grant;
- The data allocation shall maximise the transmission of higher priority data;
- The UE shall select the E-TFC, SF and modulation which minimises the power used (3.84/7.68 Mcps TDD only);

- The UE shall select the E-TFC and modulation which minimises the power used (1.28 Mcps TDD only);

While respecting all the above listed requirements, for each logical channel using RLC-UM or RLC-AM when new data to be transmitted, at every TTI, the UE may select the RLC PDU size so as to maximise the amount of data of this logical channel that can be transmitted.

Once an appropriate E-TFC and data allocation are found according to the rules above, the "Multiplexing and TSN Setting" entity shall generate the corresponding MAC-e or MAC-i PDU.

In 1.28Mcps TDD, when Scheduling Information is triggered by timer per subclause 11.9.1.5, the E-TFC selection and data-allocation process shall assume that Scheduling Information has a priority higher than any other logical channel.

The E-TFC selection function shall provide this MAC-e or MAC-i PDU and transmission HARQ profile to the HARQ entity. The selected E-TFC is also provided. For 3.84Mcps TDD and 7.68Mcps TDD the maximum number of HARQ transmissions and the power offset in this profile shall be set respectively to the maximum of both the Max Number of HARQ Transmissions and of the power offset of the HARQ profiles from all the MAC-d flows from which data is multiplexed into the transmission. For 1.28 Mcps TDD, the maximum number of HARQ transmissions shall be set to the maximum of the Max Number of HARQ Transmissions of the HARQ profiles from all the MAC-d flows from which data is multiplexed into the transmission, the HARQ power offset shall be set to the maximum of HARQ power offset of all the MAC-d flows mapped to the same type of resource (scheduled or non-scheduled resource), and the retransmission timer shall be set to the maximum of the retransmission timer value of the HARQ profiles that are permitted to be multiplexed into the transmission. For 1.28Mcps TDD, when the Scheduling Information needs to be transmitted without any higher-layer data, the specific HARQ profile should be applied. Each HARQ process which is associated with a buffer holding a MAC-e or MAC-i PDU for potential retransmission shall maintain the HARQ profile and the number of re-transmissions that have occurred. For 1.28 Mcps TDD, the HARQ process shall also maintain the value of RTX\_TIMER.

Further information on E-TFC selection is provided in Annex CA.

#### 11.9.1.4a Scheduling Information reporting (3.84/7.68 Mcps TDD only)

The UE shall implement a scheduling information delay time mechanism. The period T-SCHED governing the periodicity of sending scheduling information and the period T-RUCCH governing E-RUCCH retransmissions is set by RRC. The delay timer shall be reset whenever Scheduling Information is included in the MAC-e PDU.

If a UE has no Grant and the TEBS becomes larger than zero, the transmission of Scheduling Information shall be sent via E-RUCCH.

When the UE sends scheduling information via E-RUCCH it will start a timer  $T_R$  which will be stopped and reset if the UE receives a subsequent grant. However if this timer reaches T-RUCCH (the value T-RUCCH is set via RRC) the UE will resend the Scheduling information via E-RUCCH.

If the UE has a Grant then Scheduling Information may be included in the MAC-e PDU according to subclause 9.2.4.2. If the UE has a Grant and scheduling information delay timer  $\geq$  T-SCHED then the UE shall include Scheduling Information in the next MAC-e PDU sent and the scheduling information delay timer shall be restarted. If the UE does not receive any Grant before the scheduling information delay timer  $>$  T-SCHED + T-RUCCH / 2 then the UE shall send scheduling information via the E-RUCCH and shall stop and reset the scheduling information delay timer.

#### 11.9.1.5 Scheduling Information reporting (1.28 Mcps TDD only)

A "Grant Request" type Scheduling Information can be triggered if any of the following events occur:

- The TEBS becomes larger than zero;
- An E-DCH serving cell change occurs and the TEBS is larger than zero;

An optional Extended Estimation Window (defined by RRC in TTIs) may be used to prevent the UE from triggering unnecessary E-RUCCH transmission in case the UE potentially has an available Grant a short time in the future. The UE may perform a persistent check through the Extended Estimation Window to evaluate whether there is a Grant available for new data transmission when the UE can not take the decision just according to the related HARQ information, e.g, HARQ timing, HARQ retransmission numbers and so on.

If a UE has no Grant (including scheduled grant or non-scheduled grant) available for a new MAC-e or MAC-i PDU transmission in current TTI or in the Extended Estimation Window (if configured by RRC), as the "Grant Request" type Scheduling Information is triggered, the transmission of Scheduling Information shall be triggered via E-RUCCH.

Else if the UE has a Grant (including scheduled grant or non-scheduled grant) available for a new MAC-e or MAC-i PDU transmission in current TTI or in Extended Estimation Window (if configured by RRC), as the "Grant Request" type Scheduling Information is triggered, the scheduling information should be included in a MAC-e or MAC-i PDU via the Grant. If the HARQ process fails to deliver the MAC-e or MAC-i PDU containing the triggered the "Grant Request" type Scheduling Information, another "Grant Request" type Scheduling Information shall be triggered.

When assembling a MAC-e or MAC-i PDU, if the scheduling information needs to be included in the MAC-e or MAC-i PDU according to subclause 9.2.4.2 and it shall be transmitted regardless of TEBS status.

Additional periodic timer T-SI is used to avoid long pause duration of scheduling information reporting (defined by RRC). Once the grant is designated, T-SI shall be started. When the scheduling information is included in MAC-e or MAC-i PDU and sent, the timer shall be restarted immediately. When the timer expires, if there is a grant to send a new MAC-e or MAC-i PDU, it should include scheduling information, otherwise the UE shall wait for a grant to send scheduling information in a new MAC-e or MAC-i PDU.

Additionally if data with higher priority than the data already in the transmission buffer arrives, the Scheduling Information shall be triggered and included in next available MAC-e or MAC-i PDU, i.e. higher priority data arrival event shall not trigger a E-RUCCH procedure.

RRC can configure MAC with a delay timer to be used when the UE transits from having a Grant to not having a Grant and the TEBS is still larger than zero. The delay timer T\_WAIT shall be started once the Grant expires and shall be stopped and reset when a Grant is received. When T\_WAIT expires, the transmission of a Scheduling Information shall be triggered via E-RUCCH (T\_WAIT shall be stopped and reset).

Even if multiple events are triggered by the time a new Scheduling Information reporting can take place, only single scheduling information with newly updated content shall be sent via E-RUCCH or included in a MAC-e or MAC-i PDU.

### 11.9.1.5a Cell Reselection Indication in CELL\_FACH state (1.28 Mcps TDD only)

UE in CELL\_FACH state with E-DCH transmission and HS-DSCH reception may send Cell Reselection Indication to the Node B scheduler of the serving cell in order to notify the scheduler that the UE is to leave from this cell.

When the Cell Reselection criteria are met as in [5] and if any of the condition is fulfilled, the Cell Reselection Indication procedure shall be triggered and performed as below:

- when the UE has sent the scheduling information with TEBS > 0 byte to Node B scheduler, i.e. Node B may think the UE has data pending for transmission:
  - The Cell Reselection Indication is presented by the scheduling information with TEBS = 0;
  - if the UE has a grant in next TTI or within Extended Estimation Window:
    - include the Cell Reselection Indication in next MAC-i PDU;
  - else
    - initiate E-RUCCH procedure to transmit the Cell reselection Indication, regarding Max = 1. Upon reception of PHY-ACCESS-CNF primitive, MAC sends the indication to RRC;
- when the UE is during synchronization procedure;
  - The Cell Reselection Indication is presented by the scheduling information with TEBS = 0;
  - initiate E-RUCCH procedure to transmit the Cell reselection Indication, regarding Max = 1, Upon reception of PHY-ACCESS-CNF primitive, MAC send the indication to RRC;
- when the UE is during the downlink data receiving procedure;
  - The Cell Reselection Indication is carried in associated HS-SICH by setting RTBS field to 0.

Once the Cell Reselection Indication procedure was accomplished or terminated, then MAC informs RRC the termination of Cell Reselection Indication procedure with CMAC-STATUS-Ind primitive.

### 11.9.1.5b Common E-RNTI selection in CELL\_FACH state and idle mode (1.28 Mcps TDD only)

RRC may configure MAC a common E-RNTIs list associated to each E-RUCCH on which common E-RNTI may be used with the CMAC-CONFIG-Req primitive, each common E-RNTIs list related for an E-RUCCH is divided into K groups and there is N E-RNTIs in each group as configured by RRC. The K groups are numbered in (0..k) as indicated by RRC.

Common E-RNTI selection procedure is invoked in case of sending E-RUCCH with common E-RNTI for CCCH transmission, when performing common E-RNTI selection, the SFN or the SFN" on which the E-RUCCH shall be sent and the TTI length of E-RUCCH shall be provided. Common E-RNTI Selection procedure is performed as below:

$k = \text{SFN}_{\text{E-RUCCH}} \bmod K$ , for TTI of E-RUCCH = 10ms;

or  $k = \text{SFN}''_{\text{E-RUCCH}} \bmod K$ , for TTI of E-RUCCH = 5ms;

Where k is the "Index of selected Common E-RNTI group" and K is the total number of E-RNTI groups related to this E-RUCCH;  $\text{SFN}_{\text{E-RUCCH}}$  or  $\text{SFN}''_{\text{E-RUCCH}}$  is the frame or sub-frame on which the E-RUCCH shall be sent which is indicated by physical layer as the response of physical random access procedure.

Upon the common E-RNTI group was determined as above, the UE shall randomly select a common E-RNTI within the group.

The Available Scheduling Window of each CCCH transmission is equal to the length of K E-RUCCH TTIs, which means that the CCCH only can be scheduled within the consecutive K frames (in case of 10ms E-RUCCH) or sub-frames (in case of 5ms E-RUCCH) upon receiving the E-RUCCH by the Node B scheduler. The start point of the Available Scheduling Window associated with a common E-RNTI corresponds to the frame on which the common E-RNTI is correctly received on E-RUCCH.

### 11.9.1.6 MAC-es/e Reset (1.28 Mcps TDD only)

If a reset of MAC-es/e or MAC-is/i entity is requested by upper layers, the UE shall at the activation time indicated by higher layer:

- flush all HARQ processes;
- set CURRENT\_TSN to 0 for all the logical channels mapped to E-DCH;
- stop all active timers (the timers include Retransmission timer, T\_SI, T\_WAIT, T\_RUCCH);
- set CURRENT\_RUCCH to 0;
- if MAC-i/is is configured by upper layers:
  - discard all segments stored in segmentation entities.

## 11.9.2 Node B operation

### 11.9.2.1 HARQ Operation

#### 11.9.2.1.1 HARQ entity

There is one HARQ entity per UE in the Node-B. The HARQ entity routes the payload and the associated RSN value to the indicated HARQ process (the HARQ process identifier is signalled to the Node B via the E-UCCH). Based on the outcome of the decoding, the HARQ entity transmits an ACK or a NACK in return.

### 11.9.2.1.2 HARQ process

The HARQ process uses the RSN to identify the redundancy version, The Node B uses the identified redundancy version to attempt to decode the transmission. The outcome of the decoding is reported to the HARQ entity, so that it may be fed back to the UE as ACK or NACK.

### 11.9.2.2 De-multiplexing

There is one de-multiplexing entity per UE in the Node B. If the MAC-e/es is configured by upper layers, the SRNC configures the Node B with the mapping between the active DDI values and the corresponding MAC-d flow and PDU size. If the MAC-i/is is configured by upper layers, the SRNC configured the Node B with the mapping between the LCH-ID and the corresponding MAC-d flow. Also, it provides it with the mapping between MAC-d flow IDs and the corresponding Iub bearer.

If MAC-e/es is configured by upper layers, the de-multiplexing entity uses the MAC-e header information (DDI, N) to determine the size of each MAC-es PDU and based on this it segments the MAC-e payload into MAC-es PDUs. If MAC-i/is is configured by upper layers, the de-multiplexing entity uses the MAC-i header information (L) to determine the size of each MAC-is SDU and based on this it segments the MAC-i payload into MAC-is PDUs. These are then routed onto the Iub bearer indicated by the DDI value.

With each MAC-es PDU, the Node B will send to the SRNC:

- the associated DDI and N values;
- the CFN when the payload including the MAC-es PDU was decoded correctly (3.84/7.68 Mcps only);
- the CFN and sub-frame number when the payload including the MAC-es PDU was decoded correctly (1.28 Mcps TDD only);
- the total number of transmissions that were needed for the MAC-e PDU to be decoded correctly.

With each MAC-is PDU, the Node B will send to the SRNC:

- the associated LCH-ID and L values for each MAC-is SDU;
- the CFN when the payload including the MAC-is PDU was decoded correctly (3.84/7.68 Mcps only);
- the CFN and sub-frame number when the payload including the MAC-is PDU was decoded correctly (1.28 Mcps TDD only);
- the total number of transmissions that were needed for the MAC-i PDU to be decoded correctly.

### 11.9.2.3 Scheduler

There is one E-DCH Node B scheduler per Node B. The Node B scheduler is responsible for the following functions:

- Allocating uplink resources to UEs and signalling these to UEs via Absolute Grants;
- Reporting uplink interference measurements to the SRNC
- Reporting to the SRNC on the lack of processing resources
- Determining the TDD ECSN (the UE specific ECSN is incremented for each E-AGCH transmission)
- Determining which E-HICH will be used for the incoming transmission and the value of the associated E-HICH Indicator (1.28 Mcps TDD only)
- Determining how many E-UCCHs should be carried on the incoming E-PUCHs and the value of the associated E-UCCH Number Indicator (1.28 Mcps TDD only).

### 11.9.2.4 E-DCH Provided Bit Rate measurement

The E-DCH Provided Bit Rate measurement is defined as follows:

- for each priority class the MAC-e or MAC-i function in the Node B measures the total number of MAC-d PDU bits whose transmission over the radio interface has been considered successful by MAC-e or MAC-i in Node-B during the last measurement period, divided by the duration of the measurement period;
- the measurement period shall be [100 ms].

### 11.9.3 RNC operation

#### 11.9.3.1 Re-ordering entity for DTCH/DCCH transmission

The re-ordering entity is part of the MAC-es or MAC-is sublayer in the SRNC. There is one re-ordering entity per UE. Each re-ordering entity will support one re-ordering process per logical channel. If MAC-es is configured by upper layers, the DDI value is used to determine the logical channel for which each MAC-es PDU is meant. If MAC-is is configured by upper layers, the LCH-ID value is used to determine the logical channel for which each MAC-is SDU is meant. Based on this information, the MAC-es or MAC-is PDUs are routed to the proper re-ordering process. The re-ordering process may use the explicit TSN indication as well as the timing information provided by the Node B in order to eliminate duplicates and deliver the packets in order to RLC. The details of the re-ordering mechanism are left up to the implementation.

#### 11.9.3.2 Re-ordering entity for CCCH transmissio (1.28 Mcps TDD only)

The re-ordering entity is part of MAC-is sublayer in the CRNC. There is one re-ordering entity per UE. Each re-ordering entity will support one re-ordering process. If MAC-is is configured by upper layers, the LCH-ID value is used to determine the logical channel for which each MAC-is SDU is meant. Based on this information, the received TSN and Node-B tagging i.e. (CFN, subframe number), the MAC-is PDUs are routed to the proper re-ordering process. The re-ordering process may use the explicit TSN indication as well as the timing information provided by the Node B in order to eliminate duplicates. When the MAC-c PDU is received correctly then after reassembly the resulting data is delivered to the MAC-c. The details of the re-ordering mechanism are left up to the implementation.

## Annex A (normative): HS-DSCH Transport Block Size Table for FDD

The following table provides the mapping between  $k_t$  (as per the definition in subclause 9.2.3.1) and the HS-DSCH Transport Block Size ( $L(k_t)$ ) corresponding to table 9.2.3.1:

| Index | TB Size | Index | TB Size | Index | TB Size |
|-------|---------|-------|---------|-------|---------|
| 1     | 137     | 86    | 1380    | 171   | 6324    |
| 2     | 149     | 87    | 1405    | 172   | 6438    |
| 3     | 161     | 88    | 1430    | 173   | 6554    |
| 4     | 173     | 89    | 1456    | 174   | 6673    |
| 5     | 185     | 90    | 1483    | 175   | 6793    |
| 6     | 197     | 91    | 1509    | 176   | 6916    |
| 7     | 209     | 92    | 1537    | 177   | 7041    |
| 8     | 221     | 93    | 1564    | 178   | 7168    |
| 9     | 233     | 94    | 1593    | 179   | 7298    |
| 10    | 245     | 95    | 1621    | 180   | 7430    |
| 11    | 257     | 96    | 1651    | 181   | 7564    |
| 12    | 269     | 97    | 1681    | 182   | 7700    |
| 13    | 281     | 98    | 1711    | 183   | 7840    |
| 14    | 293     | 99    | 1742    | 184   | 7981    |
| 15    | 305     | 100   | 1773    | 185   | 8125    |
| 16    | 317     | 101   | 1805    | 186   | 8272    |
| 17    | 329     | 102   | 1838    | 187   | 8422    |
| 18    | 341     | 103   | 1871    | 188   | 8574    |
| 19    | 353     | 104   | 1905    | 189   | 8729    |
| 20    | 365     | 105   | 1939    | 190   | 8886    |
| 21    | 377     | 106   | 1974    | 191   | 9047    |
| 22    | 389     | 107   | 2010    | 192   | 9210    |
| 23    | 401     | 108   | 2046    | 193   | 9377    |
| 24    | 413     | 109   | 2083    | 194   | 9546    |
| 25    | 425     | 110   | 2121    | 195   | 9719    |
| 26    | 437     | 111   | 2159    | 196   | 9894    |
| 27    | 449     | 112   | 2198    | 197   | 10073   |
| 28    | 461     | 113   | 2238    | 198   | 10255   |
| 29    | 473     | 114   | 2279    | 199   | 10440   |
| 30    | 485     | 115   | 2320    | 200   | 10629   |
| 31    | 497     | 116   | 2362    | 201   | 10821   |
| 32    | 509     | 117   | 2404    | 202   | 11017   |
| 33    | 521     | 118   | 2448    | 203   | 11216   |
| 34    | 533     | 119   | 2492    | 204   | 11418   |
| 35    | 545     | 120   | 2537    | 205   | 11625   |
| 36    | 557     | 121   | 2583    | 206   | 11835   |
| 37    | 569     | 122   | 2630    | 207   | 12048   |
| 38    | 581     | 123   | 2677    | 208   | 12266   |
| 39    | 593     | 124   | 2726    | 209   | 12488   |
| 40    | 605     | 125   | 2775    | 210   | 12713   |
| 41    | 616     | 126   | 2825    | 211   | 12943   |
| 42    | 627     | 127   | 2876    | 212   | 13177   |
| 43    | 639     | 128   | 2928    | 213   | 13415   |
| 44    | 650     | 129   | 2981    | 214   | 13657   |
| 45    | 662     | 130   | 3035    | 215   | 13904   |

|    |      |     |      |     |       |
|----|------|-----|------|-----|-------|
| 46 | 674  | 131 | 3090 | 216 | 14155 |
| 47 | 686  | 132 | 3145 | 217 | 14411 |
| 48 | 699  | 133 | 3202 | 218 | 14671 |
| 49 | 711  | 134 | 3260 | 219 | 14936 |
| 50 | 724  | 135 | 3319 | 220 | 15206 |
| 51 | 737  | 136 | 3379 | 221 | 15481 |
| 52 | 751  | 137 | 3440 | 222 | 15761 |
| 53 | 764  | 138 | 3502 | 223 | 16045 |
| 54 | 778  | 139 | 3565 | 224 | 16335 |
| 55 | 792  | 140 | 3630 | 225 | 16630 |
| 56 | 806  | 141 | 3695 | 226 | 16931 |
| 57 | 821  | 142 | 3762 | 227 | 17237 |
| 58 | 836  | 143 | 3830 | 228 | 17548 |
| 59 | 851  | 144 | 3899 | 229 | 17865 |
| 60 | 866  | 145 | 3970 | 230 | 18188 |
| 61 | 882  | 146 | 4042 | 231 | 18517 |
| 62 | 898  | 147 | 4115 | 232 | 18851 |
| 63 | 914  | 148 | 4189 | 233 | 19192 |
| 64 | 931  | 149 | 4265 | 234 | 19538 |
| 65 | 947  | 150 | 4342 | 235 | 19891 |
| 66 | 964  | 151 | 4420 | 236 | 20251 |
| 67 | 982  | 152 | 4500 | 237 | 20617 |
| 68 | 1000 | 153 | 4581 | 238 | 20989 |
| 69 | 1018 | 154 | 4664 | 239 | 21368 |
| 70 | 1036 | 155 | 4748 | 240 | 21754 |
| 71 | 1055 | 156 | 4834 | 241 | 22147 |
| 72 | 1074 | 157 | 4921 | 242 | 22548 |
| 73 | 1093 | 158 | 5010 | 243 | 22955 |
| 74 | 1113 | 159 | 5101 | 244 | 23370 |
| 75 | 1133 | 160 | 5193 | 245 | 23792 |
| 76 | 1154 | 161 | 5287 | 246 | 24222 |
| 77 | 1175 | 162 | 5382 | 247 | 24659 |
| 78 | 1196 | 163 | 5480 | 248 | 25105 |
| 79 | 1217 | 164 | 5579 | 249 | 25558 |
| 80 | 1239 | 165 | 5680 | 250 | 26020 |
| 81 | 1262 | 166 | 5782 | 251 | 26490 |
| 82 | 1285 | 167 | 5887 | 252 | 26969 |
| 83 | 1308 | 168 | 5993 | 253 | 27456 |
| 84 | 1331 | 169 | 6101 | 254 | 27952 |
| 85 | 1356 | 170 | 6211 |     |       |



The following table provides the mapping between  $k_t$  (as per the definition in subclause 9.2.3.1) and the HS-DSCH Transport Block Size ( $L(k_t)$ ) corresponding to table 9.2.3.2:

| Index | TB Size | Index | TB Size | Index | TB Size | Index | TB Size |
|-------|---------|-------|---------|-------|---------|-------|---------|
| 1     | 120     | 86    | 1000    | 171   | 4592    | 256   | 21000   |
| 2     | 128     | 87    | 1016    | 172   | 4672    | 257   | 21384   |
| 3     | 136     | 88    | 1040    | 173   | 4760    | 258   | 21768   |
| 4     | 144     | 89    | 1056    | 174   | 4848    | 259   | 22160   |
| 5     | 152     | 90    | 1072    | 175   | 4936    | 260   | 22560   |
| 6     | 160     | 91    | 1096    | 176   | 5024    | 261   | 22968   |
| 7     | 168     | 92    | 1112    | 177   | 5112    | 262   | 23384   |
| 8     | 176     | 93    | 1136    | 178   | 5208    | 263   | 23808   |
| 9     | 184     | 94    | 1152    | 179   | 5296    | 264   | 24232   |
| 10    | 192     | 95    | 1176    | 180   | 5392    | 265   | 24672   |
| 11    | 200     | 96    | 1200    | 181   | 5488    | 266   | 25120   |
| 12    | 208     | 97    | 1216    | 182   | 5592    | 267   | 25568   |
| 13    | 216     | 98    | 1240    | 183   | 5688    | 268   | 26032   |
| 14    | 224     | 99    | 1264    | 184   | 5792    | 269   | 26504   |
| 15    | 232     | 100   | 1288    | 185   | 5896    | 270   | 26976   |
| 16    | 240     | 101   | 1312    | 186   | 6008    | 271   | 27464   |
| 17    | 248     | 102   | 1336    | 187   | 6112    | 272   | 27960   |
| 18    | 256     | 103   | 1360    | 188   | 6224    | 273   | 28464   |
| 19    | 264     | 104   | 1384    | 189   | 6336    | 274   | 28976   |
| 20    | 272     | 105   | 1408    | 190   | 6448    | 275   | 29504   |
| 21    | 280     | 106   | 1432    | 191   | 6568    | 276   | 30032   |
| 22    | 288     | 107   | 1456    | 192   | 6688    | 277   | 30576   |
| 23    | 296     | 108   | 1488    | 193   | 6808    | 278   | 31128   |
| 24    | 304     | 109   | 1512    | 194   | 6928    | 279   | 31688   |
| 25    | 312     | 110   | 1536    | 195   | 7056    | 280   | 32264   |
| 26    | 320     | 111   | 1568    | 196   | 7184    | 281   | 32848   |
| 27    | 328     | 112   | 1600    | 197   | 7312    | 282   | 33440   |
| 28    | 336     | 113   | 1624    | 198   | 7440    | 283   | 34040   |
| 29    | 344     | 114   | 1656    | 199   | 7576    | 284   | 34656   |
| 30    | 352     | 115   | 1688    | 200   | 7712    | 285   | 35280   |
| 31    | 360     | 116   | 1712    | 201   | 7856    | 286   | 35920   |
| 32    | 368     | 117   | 1744    | 202   | 7992    | 287   | 36568   |
| 33    | 376     | 118   | 1776    | 203   | 8136    | 288   | 37224   |
| 34    | 384     | 119   | 1808    | 204   | 8288    | 289   | 37896   |
| 35    | 392     | 120   | 1840    | 205   | 8440    | 290   | 38576   |
| 36    | 400     | 121   | 1872    | 206   | 8592    | 291   | 39272   |
| 37    | 408     | 122   | 1912    | 207   | 8744    | 292   | 39984   |
| 38    | 416     | 123   | 1944    | 208   | 8904    | 293   | 40704   |
| 39    | 424     | 124   | 1976    | 209   | 9064    | 294   | 41440   |
| 40    | 440     | 125   | 2016    | 210   | 9224    | 295   | 42192   |
| 41    | 448     | 126   | 2048    | 211   | 9392    |       |         |
| 42    | 456     | 127   | 2088    | 212   | 9560    |       |         |
| 43    | 464     | 128   | 2128    | 213   | 9736    |       |         |
| 44    | 472     | 129   | 2168    | 214   | 9912    |       |         |
| 45    | 480     | 130   | 2200    | 215   | 10088   |       |         |
| 46    | 488     | 131   | 2240    | 216   | 10272   |       |         |
| 47    | 496     | 132   | 2288    | 217   | 10456   |       |         |
| 48    | 504     | 133   | 2328    | 218   | 10648   |       |         |
| 49    | 512     | 134   | 2368    | 219   | 10840   |       |         |
| 50    | 528     | 135   | 2408    | 220   | 11032   |       |         |
| 51    | 536     | 136   | 2456    | 221   | 11232   |       |         |
| 52    | 544     | 137   | 2496    | 222   | 11432   |       |         |

|    |     |     |      |     |       |
|----|-----|-----|------|-----|-------|
| 53 | 552 | 138 | 2544 | 223 | 11640 |
| 54 | 560 | 139 | 2592 | 224 | 11848 |
| 55 | 576 | 140 | 2632 | 225 | 12064 |
| 56 | 584 | 141 | 2680 | 226 | 12280 |
| 57 | 592 | 142 | 2736 | 227 | 12504 |
| 58 | 608 | 143 | 2784 | 228 | 12728 |
| 59 | 616 | 144 | 2832 | 229 | 12960 |
| 60 | 624 | 145 | 2880 | 230 | 13192 |
| 61 | 640 | 146 | 2936 | 231 | 13432 |
| 62 | 648 | 147 | 2984 | 232 | 13672 |
| 63 | 664 | 148 | 3040 | 233 | 13920 |
| 64 | 672 | 149 | 3096 | 234 | 14168 |
| 65 | 688 | 150 | 3152 | 235 | 14424 |
| 66 | 696 | 151 | 3208 | 236 | 14688 |
| 67 | 712 | 152 | 3264 | 237 | 14952 |
| 68 | 728 | 153 | 3328 | 238 | 15224 |
| 69 | 736 | 154 | 3384 | 239 | 15496 |
| 70 | 752 | 155 | 3448 | 240 | 15776 |
| 71 | 768 | 156 | 3512 | 241 | 16064 |
| 72 | 776 | 157 | 3576 | 242 | 16352 |
| 73 | 792 | 158 | 3640 | 243 | 16648 |
| 74 | 808 | 159 | 3704 | 244 | 16944 |
| 75 | 824 | 160 | 3768 | 245 | 17256 |
| 76 | 840 | 161 | 3840 | 246 | 17568 |
| 77 | 848 | 162 | 3912 | 247 | 17880 |
| 78 | 864 | 163 | 3976 | 248 | 18200 |
| 79 | 880 | 164 | 4048 | 249 | 18536 |
| 80 | 896 | 165 | 4120 | 250 | 18864 |
| 81 | 912 | 166 | 4200 | 251 | 19208 |
| 82 | 928 | 167 | 4272 | 252 | 19552 |
| 83 | 952 | 168 | 4352 | 253 | 19904 |
| 84 | 968 | 169 | 4432 | 254 | 20264 |
| 85 | 984 | 170 | 4512 | 255 | 20632 |

## Annex B (normative): E-DCH Transport Block Size Tables for FDD

The mapping between the chosen E-TFCI and the corresponding E-DCH transport block size is given in the following tables:

### B.1 2ms TTI E-DCH Transport Block Size Table 0

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|--------|----------------|--------|----------------|
| 0      | 18             | 30     | 342            | 60     | 1015           | 90     | 3008           | 120    | N/A            |
| 1      | 120            | 31     | 355            | 61     | 1053           | 91     | 3119           | 121    | 9241           |
| 2      | 124            | 32     | 368            | 62     | 1091           | 92     | 3234           | 122    | 9582           |
| 3      | 129            | 33     | 382            | 63     | 1132           | 93     | 3353           | 123    | 9935           |
| 4      | 133            | 34     | 396            | 64     | 1173           | 94     | 3477           | 124    | 10302          |
| 5      | 138            | 35     | 410            | 65     | 1217           | 95     | 3605           | 125    | 10681          |
| 6      | 143            | 36     | 426            | 66     | 1262           | 96     | 3738           | 126    | 11075          |
| 7      | 149            | 37     | 441            | 67     | 1308           | 97     | 3876           | 127    | 11484          |
| 8      | 154            | 38     | 458            | 68     | 1356           | 98     | 4019           |        |                |
| 9      | 160            | 39     | 474            | 69     | 1406           | 99     | 4167           |        |                |
| 10     | 166            | 40     | 492            | 70     | 1458           | 100    | 4321           |        |                |
| 11     | 172            | 41     | 510            | 71     | 1512           | 101    | 4480           |        |                |
| 12     | 178            | 42     | 529            | 72     | 1568           | 102    | 4645           |        |                |
| 13     | 185            | 43     | 548            | 73     | 1626           | 103    | 4816           |        |                |
| 14     | 192            | 44     | 569            | 74     | 1685           | 104    | 4994           |        |                |
| 15     | 199            | 45     | 590            | 75     | 1748           | 105    | 5178           |        |                |
| 16     | 206            | 46     | 611            | 76     | 1812           | 106    | 5369           |        |                |
| 17     | 214            | 47     | 634            | 77     | 1879           | 107    | 5567           |        |                |
| 18     | 222            | 48     | 657            | 78     | 1948           | 108    | 5772           |        |                |
| 19     | 230            | 49     | 682            | 79     | 2020           | 109    | 5985           |        |                |
| 20     | 238            | 50     | 707            | 80     | 2094           | 110    | 6206           |        |                |
| 21     | 247            | 51     | 733            | 81     | 2172           | 111    | 6435           |        |                |
| 22     | 256            | 52     | 760            | 82     | 2252           | 112    | 6672           |        |                |
| 23     | 266            | 53     | 788            | 83     | 2335           | 113    | 6918           |        |                |
| 24     | 275            | 54     | 817            | 84     | 2421           | 114    | 7173           |        |                |
| 25     | 286            | 55     | 847            | 85     | 2510           | 115    | 7437           |        |                |
| 26     | 296            | 56     | 878            | 86     | 2603           | 116    | 7711           |        |                |
| 27     | 307            | 57     | 911            | 87     | 2699           | 117    | 7996           |        |                |
| 28     | 318            | 58     | 944            | 88     | 2798           | 118    | 8290           |        |                |
| 29     | 330            | 59     | 979            | 89     | 2901           | 119    | 8596           |        |                |

NOTE: Non applicable E-TFCI values are marked as N/A.

### B.2 2ms TTI E-DCH Transport Block Size Table 1

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|
| 0      | 18             | 43     | 2724           | 86     | 7252           |
| 1      | 186            | 44     | 2742           | 87     | 7288           |

|    |      |    |      |     |       |
|----|------|----|------|-----|-------|
| 2  | 204  | 45 | 3042 | 88  | 7428  |
| 3  | 354  | 46 | 3060 | 89  | 7464  |
| 4  | 372  | 47 | 3078 | 90  | 7764  |
| 5  | 522  | 48 | 3298 | 91  | 7800  |
| 6  | 540  | 49 | 3316 | 92  | 7908  |
| 7  | 674  | 50 | 3334 | 93  | 7944  |
| 8  | 690  | 51 | 3378 | 94  | 8100  |
| 9  | 708  | 52 | 3396 | 95  | 8136  |
| 10 | 726  | 53 | 3414 | 96  | 8436  |
| 11 | 858  | 54 | 3732 | 97  | 8472  |
| 12 | 876  | 55 | 3750 | 98  | 8564  |
| 13 | 1026 | 56 | 3972 | 99  | 8600  |
| 14 | 1044 | 57 | 3990 | 100 | 8772  |
| 15 | 1062 | 58 | 4068 | 101 | 8808  |
| 16 | 1194 | 59 | 4086 | 102 | 9108  |
| 17 | 1212 | 60 | 4404 | 103 | 9144  |
| 18 | 1330 | 61 | 4422 | 104 | 9220  |
| 19 | 1348 | 62 | 4628 | 105 | 9256  |
| 20 | 1362 | 63 | 4646 | 106 | 9444  |
| 21 | 1380 | 64 | 4740 | 107 | 9480  |
| 22 | 1398 | 65 | 4758 | 108 | 9780  |
| 23 | 1530 | 66 | 5076 | 109 | 9816  |
| 24 | 1548 | 67 | 5094 | 110 | 9876  |
| 25 | 1698 | 68 | 5284 | 111 | 9912  |
| 26 | 1716 | 69 | 5302 | 112 | 10116 |
| 27 | 1734 | 70 | 5412 | 113 | 10152 |
| 28 | 1866 | 71 | 5430 | 114 | 10452 |
| 29 | 1884 | 72 | 5748 | 115 | N/A   |
| 30 | 1986 | 73 | 5766 | 116 | 10532 |
| 31 | 2004 | 74 | 5940 | 117 | 10568 |
| 32 | 2022 | 75 | 5958 | 118 | 10788 |
| 33 | 2034 | 76 | 6084 | 119 | 10824 |
| 34 | 2052 | 77 | 6102 | 120 | 11124 |
| 35 | 2070 | 78 | 6420 | 121 | 11178 |
| 36 | 2370 | 79 | 6438 | 122 | 11188 |
| 37 | 2388 | 80 | 6596 | 123 | 11242 |
| 38 | 2406 | 81 | 6614 | 124 | 11460 |
| 39 | 2642 | 82 | 6756 | 125 | 11478 |
| 40 | 2660 | 83 | 6774 |     |       |
| 41 | 2678 | 84 | 7092 |     |       |
| 42 | 2706 | 85 | 7110 |     |       |

NOTE: Non applicable E-TFCI values are marked as N/A.

## B.2a 2ms TTI E-DCH Transport Block Size Table 2

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|--------|----------------|--------|----------------|
| 0      | 18             | 30     | 402            | 60     | 1405           | 90     | 4913           | 120    | 17173          |
| 1      | 120            | 31     | 419            | 61     | 1465           | 91     | 5122           | 121    | N/A            |
| 2      | 125            | 32     | 437            | 62     | 1528           | 92     | 5341           | 122    | 18667          |
| 3      | 130            | 33     | 455            | 63     | 1593           | 93     | 5568           | 123    | 19462          |
| 4      | 135            | 34     | 475            | 64     | 1661           | 94     | 5805           | 124    | 20291          |
| 5      | 141            | 35     | 495            | 65     | 1731           | 95     | 6053           | 125    | 21155          |

|    |     |    |      |    |      |     |       |     |       |
|----|-----|----|------|----|------|-----|-------|-----|-------|
| 6  | 147 | 36 | 516  | 66 | 1805 | 96  | 6310  | 126 | 22056 |
| 7  | 154 | 37 | 538  | 67 | 1882 | 97  | 6579  | 127 | 22995 |
| 8  | 160 | 38 | 561  | 68 | 1962 | 98  | 6859  |     |       |
| 9  | 167 | 39 | 585  | 69 | 2046 | 99  | 7152  |     |       |
| 10 | 174 | 40 | 610  | 70 | 2133 | 100 | 7456  |     |       |
| 11 | 182 | 41 | 636  | 71 | 2224 | 101 | 7774  |     |       |
| 12 | 189 | 42 | 663  | 72 | 2319 | 102 | 8105  |     |       |
| 13 | 197 | 43 | 691  | 73 | 2417 | 103 | 8450  |     |       |
| 14 | 206 | 44 | 721  | 74 | 2520 | 104 | 8810  |     |       |
| 15 | 215 | 45 | 752  | 75 | 2628 | 105 | 9185  |     |       |
| 16 | 224 | 46 | 784  | 76 | 2740 | 106 | 9577  |     |       |
| 17 | 233 | 47 | 817  | 77 | 2856 | 107 | 9985  |     |       |
| 18 | 243 | 48 | 852  | 78 | 2978 | 108 | 10410 |     |       |
| 19 | 254 | 49 | 888  | 79 | 3105 | 109 | 10853 |     |       |
| 20 | 265 | 50 | 926  | 80 | 3237 | 110 | 11316 |     |       |
| 21 | 276 | 51 | 965  | 81 | 3375 | 111 | 11798 |     |       |
| 22 | 288 | 52 | 1007 | 82 | 3519 | 112 | 12300 |     |       |
| 23 | 300 | 53 | 1049 | 83 | 3669 | 113 | 12824 |     |       |
| 24 | 313 | 54 | 1094 | 84 | 3825 | 114 | 13370 |     |       |
| 25 | 326 | 55 | 1141 | 85 | 3988 | 115 | 13940 |     |       |
| 26 | 340 | 56 | 1189 | 86 | 4158 | 116 | 14534 |     |       |
| 27 | 354 | 57 | 1240 | 87 | 4335 | 117 | 15153 |     |       |
| 28 | 370 | 58 | 1293 | 88 | 4520 | 118 | 15798 |     |       |
| 29 | 385 | 59 | 1348 | 89 | 4712 | 119 | 16471 |     |       |

NOTE: Non applicable E-TFCI values are marked as N/A.

## B.2b 2ms TTI E-DCH Transport Block Size Table 3

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|--------|----------------|--------|----------------|
| 0      | 18             | 30     | 1902           | 60     | 6614           | 90     | 14184          | 120    | 21966          |
| 1      | 186            | 31     | 1986           | 61     | 6774           | 91     | 14538          | 121    | 22302          |
| 2      | 204            | 32     | 2004           | 62     | 7110           | 92     | 14874          | 122    | 22430          |
| 3      | 354            | 33     | 2034           | 63     | 7270           | 93     | 15210          | 123    | 22638          |
| 4      | 372            | 34     | 2052           | 64     | 7446           | 94     | 15546          | 124    | 22996          |
| 5      | 522            | 35     | 2370           | 65     | 7782           | 95     | 15882          |        |                |
| 6      | 540            | 36     | 2388           | 66     | 7926           | 96     | 16218          |        |                |
| 7      | 558            | 37     | 2642           | 67     | 8118           | 97     | 16554          |        |                |
| 8      | 674            | 38     | 2660           | 68     | 8454           | 98     | 16890          |        |                |
| 9      | 692            | 39     | 2706           | 69     | 8582           | 99     | 17226          |        |                |
| 10     | 708            | 40     | 2724           | 70     | 8790           | 100    | 17562          |        |                |
| 11     | 858            | 41     | 3042           | 71     | 9126           | 101    | N/A            |        |                |
| 12     | 876            | 42     | 3060           | 72     | 9238           | 102    | N/A            |        |                |
| 13     | 894            | 43     | 3298           | 73     | 9462           | 103    | 18252          |        |                |
| 14     | 1026           | 44     | 3316           | 74     | 9798           | 104    | 18476          |        |                |
| 15     | 1044           | 45     | 3378           | 75     | 9894           | 105    | 18588          |        |                |
| 16     | 1194           | 46     | 3396           | 76     | 10134          | 106    | 18924          |        |                |
| 17     | 1212           | 47     | 3750           | 77     | 10470          | 107    | 19132          |        |                |
| 18     | 1230           | 48     | 3990           | 78     | 10550          | 108    | 19260          |        |                |
| 19     | 1330           | 49     | 4086           | 79     | 10806          | 109    | 19596          |        |                |
| 20     | 1348           | 50     | 4422           | 80     | 11160          | 110    | 19788          |        |                |
| 21     | 1362           | 51     | 4646           | 81     | 11224          | 111    | 19932          |        |                |

|    |      |    |      |    |       |     |       |
|----|------|----|------|----|-------|-----|-------|
| 22 | 1380 | 52 | 4758 | 82 | 11496 | 112 | 20268 |
| 23 | 1530 | 53 | 5094 | 83 | 11880 | 113 | 20444 |
| 24 | 1548 | 54 | 5302 | 84 | 12168 | 114 | 20604 |
| 25 | 1566 | 55 | 5430 | 85 | 12536 | 115 | 20940 |
| 26 | 1698 | 56 | 5766 | 86 | 12840 | 116 | 21100 |
| 27 | 1716 | 57 | 5958 | 87 | 13192 | 117 | 21276 |
| 28 | 1866 | 58 | 6102 | 88 | 13512 | 118 | 21612 |
| 29 | 1884 | 59 | 6438 | 89 | 13848 | 119 | 21774 |

NOTE: Non applicable E-TFCI values are marked as N/A.

### B.3 10ms TTI E-DCH Transport Block Size Table 0

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|--------|----------------|--------|----------------|
| 0      | 18             | 30     | 389            | 60     | 1316           | 90     | 4452           | 120    | 15051          |
| 1      | 120            | 31     | 405            | 61     | 1371           | 91     | 4636           | 121    | 15675          |
| 2      | 124            | 32     | 422            | 62     | 1428           | 92     | 4828           | 122    | 16325          |
| 3      | 130            | 33     | 440            | 63     | 1487           | 93     | 5029           | 123    | 17001          |
| 4      | 135            | 34     | 458            | 64     | 1549           | 94     | 5237           | 124    | 17706          |
| 5      | 141            | 35     | 477            | 65     | 1613           | 95     | 5454           | 125    | 18440          |
| 6      | 147            | 36     | 497            | 66     | 1680           | 96     | 5680           | 126    | 19204          |
| 7      | 153            | 37     | 517            | 67     | 1749           | 97     | 5915           | 127    | 20000          |
| 8      | 159            | 38     | 539            | 68     | 1822           | 98     | 6161           |        |                |
| 9      | 166            | 39     | 561            | 69     | 1897           | 99     | 6416           |        |                |
| 10     | 172            | 40     | 584            | 70     | 1976           | 100    | 6682           |        |                |
| 11     | 180            | 41     | 608            | 71     | 2058           | 101    | 6959           |        |                |
| 12     | 187            | 42     | 634            | 72     | 2143           | 102    | 7247           |        |                |
| 13     | 195            | 43     | 660            | 73     | 2232           | 103    | 7547           |        |                |
| 14     | 203            | 44     | 687            | 74     | 2325           | 104    | 7860           |        |                |
| 15     | 211            | 45     | 716            | 75     | 2421           | 105    | 8186           |        |                |
| 16     | 220            | 46     | 745            | 76     | 2521           | 106    | 8525           |        |                |
| 17     | 229            | 47     | 776            | 77     | 2626           | 107    | 8878           |        |                |
| 18     | 239            | 48     | 809            | 78     | 2735           | 108    | 9246           |        |                |
| 19     | 249            | 49     | 842            | 79     | 2848           | 109    | 9629           |        |                |
| 20     | 259            | 50     | 877            | 80     | 2966           | 110    | 10028          |        |                |
| 21     | 270            | 51     | 913            | 81     | 3089           | 111    | 10444          |        |                |
| 22     | 281            | 52     | 951            | 82     | 3217           | 112    | 10877          |        |                |
| 23     | 293            | 53     | 991            | 83     | 3350           | 113    | 11328          |        |                |
| 24     | 305            | 54     | 1032           | 84     | 3489           | 114    | 11797          |        |                |
| 25     | 317            | 55     | 1074           | 85     | 3634           | 115    | 12286          |        |                |
| 26     | 331            | 56     | 1119           | 86     | 3784           | 116    | 12795          |        |                |
| 27     | 344            | 57     | 1165           | 87     | 3941           | 117    | 13325          |        |                |
| 28     | 359            | 58     | 1214           | 88     | 4105           | 118    | 13877          |        |                |
| 29     | 374            | 59     | 1264           | 89     | 4275           | 119    | 14453          |        |                |

### B.4 10ms TTI E-DCH Transport Block Size Table 1

| E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) | E-TFCI | TB Size (bits) |
|--------|----------------|--------|----------------|--------|----------------|
|        |                |        |                |        |                |

|    |      |    |       |     |       |
|----|------|----|-------|-----|-------|
| 0  | 18   | 41 | 5076  | 82  | 11850 |
| 1  | 186  | 42 | 5094  | 83  | 12132 |
| 2  | 204  | 43 | 5412  | 84  | 12186 |
| 3  | 354  | 44 | 5430  | 85  | 12468 |
| 4  | 372  | 45 | 5748  | 86  | 12522 |
| 5  | 522  | 46 | 5766  | 87  | 12804 |
| 6  | 540  | 47 | 6084  | 88  | 12858 |
| 7  | 690  | 48 | 6102  | 89  | 13140 |
| 8  | 708  | 49 | 6420  | 90  | 13194 |
| 9  | 858  | 50 | 6438  | 91  | 13476 |
| 10 | 876  | 51 | 6756  | 92  | 13530 |
| 11 | 1026 | 52 | 6774  | 93  | 13812 |
| 12 | 1044 | 53 | 7092  | 94  | 13866 |
| 13 | 1194 | 54 | 7110  | 95  | 14148 |
| 14 | 1212 | 55 | 7428  | 96  | 14202 |
| 15 | 1362 | 56 | 7464  | 97  | 14484 |
| 16 | 1380 | 57 | 7764  | 98  | 14556 |
| 17 | 1530 | 58 | 7800  | 99  | 14820 |
| 18 | 1548 | 59 | 8100  | 100 | 14892 |
| 19 | 1698 | 60 | 8136  | 101 | 15156 |
| 20 | 1716 | 61 | 8436  | 102 | 15228 |
| 21 | 1866 | 62 | 8472  | 103 | 15492 |
| 22 | 1884 | 63 | 8772  | 104 | 15564 |
| 23 | 2034 | 64 | 8808  | 105 | 15828 |
| 24 | 2052 | 65 | 9108  | 106 | 15900 |
| 25 | 2370 | 66 | 9144  | 107 | 16164 |
| 26 | 2388 | 67 | 9444  | 108 | 16236 |
| 27 | 2706 | 68 | 9480  | 109 | 16500 |
| 28 | 2724 | 69 | 9780  | 110 | 16572 |
| 29 | 3042 | 70 | 9816  | 111 | 17172 |
| 30 | 3060 | 71 | 10116 | 112 | 17244 |
| 31 | 3378 | 72 | 10152 | 113 | 17844 |
| 32 | 3396 | 73 | 10452 | 114 | 17916 |
| 33 | 3732 | 74 | 10488 | 115 | 18516 |
| 34 | 3750 | 75 | 10788 | 116 | 18606 |
| 35 | 4068 | 76 | 10824 | 117 | 19188 |
| 36 | 4086 | 77 | 11124 | 118 | 19278 |
| 37 | 4404 | 78 | 11178 | 119 | 19860 |
| 38 | 4422 | 79 | 11460 | 120 | 19950 |
| 39 | 4740 | 80 | 11514 |     |       |
| 40 | 4758 | 81 | 11796 |     |       |

# Annex BA (normative): E-DCH Transport Block Size Tables for 3.84 Mcps TDD

The mapping between the chosen E-TFC index and the corresponding E-DCH transport block size is given in the following tables:

## BA.1 10ms TTI E-DCH Transport Block Size Table 0

| $N_{slots}$ | 1   | 2   | 3   | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
|-------------|-----|-----|-----|------|------|------|------|------|------|------|------|------|
| $K_n$       | 0   | 18  | 28  | 36   | 42   | 46   | 50   | 54   | 57   | 60   | 62   | 65   |
| TBS index   | /   |     |     |      |      |      |      |      |      |      |      |      |
| 0           | 60  | 119 | 174 | 237  | 298  | 347  | 405  | 472  | 529  | 593  | 641  | 718  |
| 1           | 62  | 123 | 181 | 246  | 310  | 361  | 421  | 490  | 550  | 616  | 665  | 746  |
| 2           | 64  | 128 | 188 | 256  | 322  | 375  | 437  | 509  | 571  | 641  | 691  | 775  |
| 3           | 67  | 133 | 196 | 266  | 334  | 390  | 454  | 529  | 593  | 665  | 718  | 806  |
| 4           | 69  | 139 | 203 | 276  | 347  | 405  | 472  | 550  | 616  | 691  | 746  | 837  |
| 5           | 72  | 144 | 211 | 287  | 361  | 421  | 490  | 571  | 641  | 718  | 775  | 870  |
| 6           | 75  | 150 | 219 | 298  | 375  | 437  | 509  | 593  | 665  | 746  | 806  | 904  |
| 7           | 78  | 155 | 228 | 310  | 390  | 454  | 529  | 616  | 691  | 775  | 837  | 939  |
| 8           | 81  | 162 | 237 | 322  | 405  | 472  | 550  | 641  | 718  | 806  | 870  | 975  |
| 9           | 84  | 168 | 246 | 334  | 421  | 490  | 571  | 665  | 746  | 837  | 904  | 1013 |
| 10          | 87  | 174 | 256 | 347  | 437  | 509  | 593  | 691  | 775  | 870  | 939  | 1053 |
| 11          | 91  | 181 | 266 | 361  | 454  | 529  | 616  | 718  | 806  | 904  | 975  | 1094 |
| 12          | 94  | 188 | 276 | 375  | 472  | 550  | 641  | 746  | 837  | 939  | 1013 | 1136 |
| 13          | 98  | 196 | 287 | 390  | 490  | 571  | 665  | 775  | 870  | 975  | 1053 | 1181 |
| 14          | 102 | 203 | 298 | 405  | 509  | 593  | 691  | 806  | 904  | 1013 | 1094 | 1227 |
| 15          | 106 | 211 | 310 | 421  | 529  | 616  | 718  | 837  | 939  | 1053 | 1136 | 1275 |
| 16          | 110 | 219 | 322 | 437  | 550  | 641  | 746  | 870  | 975  | 1094 | 1181 | 1324 |
| 17          | 114 | 228 | 334 | 454  | 571  | 665  | 775  | 904  | 1013 | 1136 | 1227 | 1376 |
| 18          | 119 | 237 | 347 | 472  | 593  | 691  | 806  | 939  | 1053 | 1181 | 1275 | 1429 |
| 19          | 123 | 246 | 361 | 490  | 616  | 718  | 837  | 975  | 1094 | 1227 | 1324 | 1485 |
| 20          | 128 | 256 | 375 | 509  | 641  | 746  | 870  | 1013 | 1136 | 1275 | 1376 | 1543 |
| 21          | 133 | 266 | 390 | 529  | 665  | 775  | 904  | 1053 | 1181 | 1324 | 1429 | 1603 |
| 22          | 139 | 276 | 405 | 550  | 691  | 806  | 939  | 1094 | 1227 | 1376 | 1485 | 1665 |
| 23          | 144 | 287 | 421 | 571  | 718  | 837  | 975  | 1136 | 1275 | 1429 | 1543 | 1730 |
| 24          | 150 | 298 | 437 | 593  | 746  | 870  | 1013 | 1181 | 1324 | 1485 | 1603 | 1798 |
| 25          | 155 | 310 | 454 | 616  | 775  | 904  | 1053 | 1227 | 1376 | 1543 | 1665 | 1868 |
| 26          | 162 | 322 | 472 | 641  | 806  | 939  | 1094 | 1275 | 1429 | 1603 | 1730 | 1941 |
| 27          | 168 | 334 | 490 | 665  | 837  | 975  | 1136 | 1324 | 1485 | 1665 | 1798 | 2016 |
| 28          | 174 | 347 | 509 | 691  | 870  | 1013 | 1181 | 1376 | 1543 | 1730 | 1868 | 2095 |
| 29          | 181 | 361 | 529 | 718  | 904  | 1053 | 1227 | 1429 | 1603 | 1798 | 1941 | 2176 |
| 30          | 188 | 375 | 550 | 746  | 939  | 1094 | 1275 | 1485 | 1665 | 1868 | 2016 | 2261 |
| 31          | 196 | 390 | 571 | 775  | 975  | 1136 | 1324 | 1543 | 1730 | 1941 | 2095 | 2349 |
| 32          | 203 | 405 | 593 | 806  | 1013 | 1181 | 1376 | 1603 | 1798 | 2016 | 2176 | 2441 |
| 33          | 211 | 421 | 616 | 837  | 1053 | 1227 | 1429 | 1665 | 1868 | 2095 | 2261 | 2536 |
| 34          | 219 | 437 | 641 | 870  | 1094 | 1275 | 1485 | 1730 | 1941 | 2176 | 2349 | 2634 |
| 35          | 228 | 454 | 665 | 904  | 1136 | 1324 | 1543 | 1798 | 2016 | 2261 | 2441 | 2737 |
| 36          | 237 | 472 | 691 | 939  | 1181 | 1376 | 1603 | 1868 | 2095 | 2349 | 2536 | 2844 |
| 37          | 246 | 490 | 718 | 975  | 1227 | 1429 | 1665 | 1941 | 2176 | 2441 | 2634 | 2954 |
| 38          | 256 | 509 | 746 | 1013 | 1275 | 1485 | 1730 | 2016 | 2261 | 2536 | 2737 | 3070 |
| 39          | 266 | 529 | 775 | 1053 | 1324 | 1543 | 1798 | 2095 | 2349 | 2634 | 2844 | 3189 |



|    |      |      |      |      |       |       |       |       |       |       |       |       |
|----|------|------|------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| 40 | 276  | 550  | 806  | 1094 | 1376  | 1603  | 1868  | 2176  | 2441  | 2737  | 2954  | 3313  |
| 41 | 287  | 571  | 837  | 1136 | 1429  | 1665  | 1941  | 2261  | 2536  | 2844  | 3070  | 3442  |
| 42 | 298  | 593  | 870  | 1181 | 1485  | 1730  | 2016  | 2349  | 2634  | 2954  | 3189  | 3576  |
| 43 | 310  | 616  | 904  | 1227 | 1543  | 1798  | 2095  | 2441  | 2737  | 3070  | 3313  | 3716  |
| 44 | 322  | 641  | 939  | 1275 | 1603  | 1868  | 2176  | 2536  | 2844  | 3189  | 3442  | 3861  |
| 45 | 334  | 665  | 975  | 1324 | 1665  | 1941  | 2261  | 2634  | 2954  | 3313  | 3576  | 4011  |
| 46 | 347  | 691  | 1013 | 1376 | 1730  | 2016  | 2349  | 2737  | 3070  | 3442  | 3716  | 4167  |
| 47 | 361  | 718  | 1053 | 1429 | 1798  | 2095  | 2441  | 2844  | 3189  | 3576  | 3861  | 4329  |
| 48 | 375  | 746  | 1094 | 1485 | 1868  | 2176  | 2536  | 2954  | 3313  | 3716  | 4011  | 4498  |
| 49 | 390  | 775  | 1136 | 1543 | 1941  | 2261  | 2634  | 3070  | 3442  | 3861  | 4167  | 4673  |
| 50 | 405  | 806  | 1181 | 1603 | 2016  | 2349  | 2737  | 3189  | 3576  | 4011  | 4329  | 4855  |
| 51 | 421  | 837  | 1227 | 1665 | 2095  | 2441  | 2844  | 3313  | 3716  | 4167  | 4498  | 5044  |
| 52 | 437  | 870  | 1275 | 1730 | 2176  | 2536  | 2954  | 3442  | 3861  | 4329  | 4673  | 5241  |
| 53 | 454  | 904  | 1324 | 1798 | 2261  | 2634  | 3070  | 3576  | 4011  | 4498  | 4855  | 5445  |
| 54 | 472  | 939  | 1376 | 1868 | 2349  | 2737  | 3189  | 3716  | 4167  | 4673  | 5044  | 5657  |
| 55 | 490  | 975  | 1429 | 1941 | 2441  | 2844  | 3313  | 3861  | 4329  | 4855  | 5241  | 5877  |
| 56 | 509  | 1013 | 1485 | 2016 | 2536  | 2954  | 3442  | 4011  | 4498  | 5044  | 5445  | 6106  |
| 57 | 529  | 1053 | 1543 | 2095 | 2634  | 3070  | 3576  | 4167  | 4673  | 5241  | 5657  | 6344  |
| 58 | 550  | 1094 | 1603 | 2176 | 2737  | 3189  | 3716  | 4329  | 4855  | 5445  | 5877  | 6591  |
| 59 | 571  | 1136 | 1665 | 2261 | 2844  | 3313  | 3861  | 4498  | 5044  | 5657  | 6106  | 6848  |
| 60 | 593  | 1181 | 1730 | 2349 | 2954  | 3442  | 4011  | 4673  | 5241  | 5877  | 6344  | 7115  |
| 61 | 616  | 1227 | 1798 | 2441 | 3070  | 3576  | 4167  | 4855  | 5445  | 6106  | 6591  | 7392  |
| 62 | 641  | 1275 | 1868 | 2536 | 3189  | 3716  | 4329  | 5044  | 5657  | 6344  | 6848  | 7680  |
| 63 | 665  | 1324 | 1941 | 2634 | 3313  | 3861  | 4498  | 5241  | 5877  | 6591  | 7115  | 7979  |
| 64 | 691  | 1376 | 2016 | 2737 | 3442  | 4011  | 4673  | 5445  | 6106  | 6848  | 7392  | 8289  |
| 65 | 718  | 1429 | 2095 | 2844 | 3576  | 4167  | 4855  | 5657  | 6344  | 7115  | 7680  | 8612  |
| 66 | 746  | 1485 | 2176 | 2954 | 3716  | 4329  | 5044  | 5877  | 6591  | 7392  | 7979  | 8948  |
| 67 | 775  | 1543 | 2261 | 3070 | 3861  | 4498  | 5241  | 6106  | 6848  | 7680  | 8289  | 9296  |
| 68 | 806  | 1603 | 2349 | 3189 | 4011  | 4673  | 5445  | 6344  | 7115  | 7979  | 8612  | 9658  |
| 69 | 837  | 1665 | 2441 | 3313 | 4167  | 4855  | 5657  | 6591  | 7392  | 8289  | 8948  | 10034 |
| 70 | 870  | 1730 | 2536 | 3442 | 4329  | 5044  | 5877  | 6848  | 7680  | 8612  | 9296  | 10425 |
| 71 | 904  | 1798 | 2634 | 3576 | 4498  | 5241  | 6106  | 7115  | 7979  | 8948  | 9658  | 10831 |
| 72 | 939  | 1868 | 2737 | 3716 | 4673  | 5445  | 6344  | 7392  | 8289  | 9296  | 10034 | 11253 |
| 73 | 975  | 1941 | 2844 | 3861 | 4855  | 5657  | 6591  | 7680  | 8612  | 9658  | 10425 | 11691 |
| 74 | 1013 | 2016 | 2954 | 4011 | 5044  | 5877  | 6848  | 7979  | 8948  | 10034 | 10831 | 12146 |
| 75 | 1053 | 2095 | 3070 | 4167 | 5241  | 6106  | 7115  | 8289  | 9296  | 10425 | 11253 | 12620 |
| 76 | 1094 | 2176 | 3189 | 4329 | 5445  | 6344  | 7392  | 8612  | 9658  | 10831 | 11691 | 13111 |
| 77 | 1136 | 2261 | 3313 | 4498 | 5657  | 6591  | 7680  | 8948  | 10034 | 11253 | 12146 | 13622 |
| 78 | 1181 | 2349 | 3442 | 4673 | 5877  | 6848  | 7979  | 9296  | 10425 | 11691 | 12620 | 14152 |
| 79 | 1227 | 2441 | 3576 | 4855 | 6106  | 7115  | 8289  | 9658  | 10831 | 12146 | 13111 | 14703 |
| 80 | 1275 | 2536 | 3716 | 5044 | 6344  | 7392  | 8612  | 10034 | 11253 | 12620 | 13622 | 15276 |
| 81 | 1324 | 2634 | 3861 | 5241 | 6591  | 7680  | 8948  | 10425 | 11691 | 13111 | 14152 | 15871 |
| 82 | 1376 | 2737 | 4011 | 5445 | 6848  | 7979  | 9296  | 10831 | 12146 | 13622 | 14703 | 16489 |
| 83 | 1429 | 2844 | 4167 | 5657 | 7115  | 8289  | 9658  | 11253 | 12620 | 14152 | 15276 | 17131 |
| 84 | 1485 | 2954 | 4329 | 5877 | 7392  | 8612  | 10034 | 11691 | 13111 | 14703 | 15871 | 17798 |
| 85 | 1543 | 3070 | 4498 | 6106 | 7680  | 8948  | 10425 | 12146 | 13622 | 15276 | 16489 | 18491 |
| 86 | 1603 | 3189 | 4673 | 6344 | 7979  | 9296  | 10831 | 12620 | 14152 | 15871 | 17131 | 19212 |
| 87 | 1665 | 3313 | 4855 | 6591 | 8289  | 9658  | 11253 | 13111 | 14703 | 16489 | 17798 | 19960 |
| 88 | 1730 | 3442 | 5044 | 6848 | 8612  | 10034 | 11691 | 13622 | 15276 | 17131 | 18491 | 20737 |
| 89 | 1798 | 3576 | 5241 | 7115 | 8948  | 10425 | 12146 | 14152 | 15871 | 17798 | 19212 | 21545 |
| 90 | 1868 | 3716 | 5445 | 7392 | 9296  | 10831 | 12620 | 14703 | 16489 | 18491 | 19960 | 22384 |
| 91 | 1941 | 3861 | 5657 | 7680 | 9658  | 11253 | 13111 | 15276 | 17131 | 19212 | 20737 | 23256 |
| 92 | 2016 | 4011 | 5877 | 7979 | 10034 | 11691 | 13622 | 15871 | 17798 | 19960 | 21545 | 24161 |

|     |      |       |       |       |       |       |       |       |       |       |       |       |
|-----|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 93  | 2095 | 4167  | 6106  | 8289  | 10425 | 12146 | 14152 | 16489 | 18491 | 20737 | 22384 | 25102 |
| 94  | 2176 | 4329  | 6344  | 8612  | 10831 | 12620 | 14703 | 17131 | 19212 | 21545 | 23256 | 26080 |
| 95  | 2261 | 4498  | 6591  | 8948  | 11253 | 13111 | 15276 | 17798 | 19960 | 22384 | 24161 | 27095 |
| 96  | 2349 | 4673  | 6848  | 9296  | 11691 | 13622 | 15871 | 18491 | 20737 | 23256 | 25102 | 28151 |
| 97  | 2441 | 4855  | 7115  | 9658  | 12146 | 14152 | 16489 | 19212 | 21545 | 24161 | 26080 | 29247 |
| 98  | 2536 | 5044  | 7392  | 10034 | 12620 | 14703 | 17131 | 19960 | 22384 | 25102 | 27095 | 30386 |
| 99  | 2634 | 5241  | 7680  | 10425 | 13111 | 15276 | 17798 | 20737 | 23256 | 26080 | 28151 | 31569 |
| 100 | 2737 | 5445  | 7979  | 10831 | 13622 | 15871 | 18491 | 21545 | 24161 | 27095 | 29247 | 32799 |
| 101 | 2844 | 5657  | 8289  | 11253 | 14152 | 16489 | 19212 | 22384 | 25102 | 28151 | 30386 | 34076 |
| 102 | 2954 | 5877  | 8612  | 11691 | 14703 | 17131 | 19960 | 23256 | 26080 | 29247 | 31569 | 35403 |
| 103 | 3070 | 6106  | 8948  | 12146 | 15276 | 17798 | 20737 | 24161 | 27095 | 30386 | 32799 | 36782 |
| 104 | 3189 | 6344  | 9296  | 12620 | 15871 | 18491 | 21545 | 25102 | 28151 | 31569 | 34076 | 38214 |
| 105 | 3313 | 6591  | 9658  | 13111 | 16489 | 19212 | 22384 | 26080 | 29247 | 32799 | 35403 | 39703 |
| 106 | 3442 | 6848  | 10034 | 13622 | 17131 | 19960 | 23256 | 27095 | 30386 | 34076 | 36782 | 41249 |
| 107 | 3576 | 7115  | 10425 | 14152 | 17798 | 20737 | 24161 | 28151 | 31569 | 35403 | 38214 | 42855 |
| 108 | 3716 | 7392  | 10831 | 14703 | 18491 | 21545 | 25102 | 29247 | 32799 | 36782 | 39703 | 44524 |
| 109 | 3861 | 7680  | 11253 | 15276 | 19212 | 22384 | 26080 | 30386 | 34076 | 38214 | 41249 | 46258 |
| 110 | 4011 | 7979  | 11691 | 15871 | 19960 | 23256 | 27095 | 31569 | 35403 | 39703 | 42855 | 48060 |
| 111 | 4167 | 8289  | 12146 | 16489 | 20737 | 24161 | 28151 | 32799 | 36782 | 41249 | 44524 | 49932 |
| 112 | 4329 | 8612  | 12620 | 17131 | 21545 | 25102 | 29247 | 34076 | 38214 | 42855 | 46258 | 51876 |
| 113 | 4498 | 8948  | 13111 | 17798 | 22384 | 26080 | 30386 | 35403 | 39703 | 44524 | 48060 | 53896 |
| 114 | 4673 | 9296  | 13622 | 18491 | 23256 | 27095 | 31569 | 36782 | 41249 | 46258 | 49932 | 55995 |
| 115 | 4855 | 9658  | 14152 | 19212 | 24161 | 28151 | 32799 | 38214 | 42855 | 48060 | 51876 | 58176 |
| 116 | 5044 | 10034 | 14703 | 19960 | 25102 | 29247 | 34076 | 39703 | 44524 | 49932 | 53896 | 60442 |
| 117 | 5241 | 10425 | 15276 | 20737 | 26080 | 30386 | 35403 | 41249 | 46258 | 51876 | 55995 | 62796 |
| 118 | 5445 | 10831 | 15871 | 21545 | 27095 | 31569 | 36782 | 42855 | 48060 | 53896 | 58176 | 65241 |
| 119 | 5657 | 11253 | 16489 | 22384 | 28151 | 32799 | 38214 | 44524 | 49932 | 55995 | 60442 | 67782 |
| 120 | 5877 | 11691 | 17131 | 23256 | 29247 | 34076 | 39703 | 46258 | 51876 | 58176 | 62796 | 70422 |
| 121 | 6106 | 12146 | 17798 | 24161 | 30386 | 35403 | 41249 | 48060 | 53896 | 60442 | 65241 | 73164 |
| 122 | 6344 | 12620 | 18491 | 25102 | 31569 | 36782 | 42855 | 49932 | 55995 | 62796 | 67782 | 76013 |
| 123 | 6591 | 13111 | 19212 | 26080 | 32799 | 38214 | 44524 | 51876 | 58176 | 65241 | 70422 | 78974 |
| 124 | 6848 | 13622 | 19960 | 27095 | 34076 | 39703 | 46258 | 53896 | 60442 | 67782 | 73164 | 82049 |
| 125 | 7115 | 14152 | 20737 | 28151 | 35403 | 41249 | 48060 | 55995 | 62796 | 70422 | 76013 | 85245 |
| 126 | 7392 | 14703 | 21545 | 29247 | 36782 | 42855 | 49932 | 58176 | 65241 | 73164 | 78974 | 88565 |
| 127 | 7680 | 15276 | 22384 | 30386 | 38214 | 44524 | 51876 | 60442 | 67782 | 76013 | 82049 | 92014 |

## Annex BB (normative): E-DCH Transport Block Size Tables for 7.68 Mcps TDD

The mapping between the chosen E-TFC index and the corresponding E-DCH transport block size is given in the following tables:

### BB.1 10ms TTI E-DCH Transport Block Size Table 0

| Nslots    | 1   | 2   | 3   | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   |
|-----------|-----|-----|-----|------|------|------|------|------|------|------|------|------|
| kn        | 0   | 15  | 25  | 31   | 36   | 41   | 44   | 47   | 50   | 52   | 54   | 56   |
| TBS index |     |     |     |      |      |      |      |      |      |      |      |      |
| 0         | 60  | 115 | 178 | 232  | 288  | 359  | 409  | 467  | 532  | 581  | 634  | 691  |
| 1         | 62  | 120 | 186 | 242  | 301  | 375  | 428  | 487  | 556  | 606  | 662  | 722  |
| 2         | 65  | 126 | 195 | 253  | 315  | 392  | 447  | 509  | 581  | 634  | 691  | 755  |
| 3         | 68  | 131 | 203 | 264  | 329  | 409  | 467  | 532  | 606  | 662  | 722  | 788  |
| 4         | 71  | 137 | 212 | 276  | 344  | 428  | 487  | 556  | 634  | 691  | 755  | 823  |
| 5         | 74  | 143 | 222 | 288  | 359  | 447  | 509  | 581  | 662  | 722  | 788  | 860  |
| 6         | 77  | 150 | 232 | 301  | 375  | 467  | 532  | 606  | 691  | 755  | 823  | 899  |
| 7         | 81  | 156 | 242 | 315  | 392  | 487  | 556  | 634  | 722  | 788  | 860  | 939  |
| 8         | 85  | 163 | 253 | 329  | 409  | 509  | 581  | 662  | 755  | 823  | 899  | 981  |
| 9         | 88  | 171 | 264 | 344  | 428  | 532  | 606  | 691  | 788  | 860  | 939  | 1024 |
| 10        | 92  | 178 | 276 | 359  | 447  | 556  | 634  | 722  | 823  | 899  | 981  | 1070 |
| 11        | 96  | 186 | 288 | 375  | 467  | 581  | 662  | 755  | 860  | 939  | 1024 | 1118 |
| 12        | 101 | 195 | 301 | 392  | 487  | 606  | 691  | 788  | 899  | 981  | 1070 | 1168 |
| 13        | 105 | 203 | 315 | 409  | 509  | 634  | 722  | 823  | 939  | 1024 | 1118 | 1220 |
| 14        | 110 | 212 | 329 | 428  | 532  | 662  | 755  | 860  | 981  | 1070 | 1168 | 1275 |
| 15        | 115 | 222 | 344 | 447  | 556  | 691  | 788  | 899  | 1024 | 1118 | 1220 | 1331 |
| 16        | 120 | 232 | 359 | 467  | 581  | 722  | 823  | 939  | 1070 | 1168 | 1275 | 1391 |
| 17        | 126 | 242 | 375 | 487  | 606  | 755  | 860  | 981  | 1118 | 1220 | 1331 | 1453 |
| 18        | 131 | 253 | 392 | 509  | 634  | 788  | 899  | 1024 | 1168 | 1275 | 1391 | 1518 |
| 19        | 137 | 264 | 409 | 532  | 662  | 823  | 939  | 1070 | 1220 | 1331 | 1453 | 1586 |
| 20        | 143 | 276 | 428 | 556  | 691  | 860  | 981  | 1118 | 1275 | 1391 | 1518 | 1656 |
| 21        | 150 | 288 | 447 | 581  | 722  | 899  | 1024 | 1168 | 1331 | 1453 | 1586 | 1730 |
| 22        | 156 | 301 | 467 | 606  | 755  | 939  | 1070 | 1220 | 1391 | 1518 | 1656 | 1808 |
| 23        | 163 | 315 | 487 | 634  | 788  | 981  | 1118 | 1275 | 1453 | 1586 | 1730 | 1888 |
| 24        | 171 | 329 | 509 | 662  | 823  | 1024 | 1168 | 1331 | 1518 | 1656 | 1808 | 1973 |
| 25        | 178 | 344 | 532 | 691  | 860  | 1070 | 1220 | 1391 | 1586 | 1730 | 1888 | 2061 |
| 26        | 186 | 359 | 556 | 722  | 899  | 1118 | 1275 | 1453 | 1656 | 1808 | 1973 | 2153 |
| 27        | 195 | 375 | 581 | 755  | 939  | 1168 | 1331 | 1518 | 1730 | 1888 | 2061 | 2249 |
| 28        | 203 | 392 | 606 | 788  | 981  | 1220 | 1391 | 1586 | 1808 | 1973 | 2153 | 2349 |
| 29        | 212 | 409 | 634 | 823  | 1024 | 1275 | 1453 | 1656 | 1888 | 2061 | 2249 | 2454 |
| 30        | 222 | 428 | 662 | 860  | 1070 | 1331 | 1518 | 1730 | 1973 | 2153 | 2349 | 2564 |
| 31        | 232 | 447 | 691 | 899  | 1118 | 1391 | 1586 | 1808 | 2061 | 2249 | 2454 | 2678 |
| 32        | 242 | 467 | 722 | 939  | 1168 | 1453 | 1656 | 1888 | 2153 | 2349 | 2564 | 2798 |
| 33        | 253 | 487 | 755 | 981  | 1220 | 1518 | 1730 | 1973 | 2249 | 2454 | 2678 | 2922 |
| 34        | 264 | 509 | 788 | 1024 | 1275 | 1586 | 1808 | 2061 | 2349 | 2564 | 2798 | 3053 |
| 35        | 276 | 532 | 823 | 1070 | 1331 | 1656 | 1888 | 2153 | 2454 | 2678 | 2922 | 3189 |
| 36        | 288 | 556 | 860 | 1118 | 1391 | 1730 | 1973 | 2249 | 2564 | 2798 | 3053 | 3331 |
| 37        | 301 | 581 | 899 | 1168 | 1453 | 1808 | 2061 | 2349 | 2678 | 2922 | 3189 | 3480 |
| 38        | 315 | 606 | 939 | 1220 | 1518 | 1888 | 2153 | 2454 | 2798 | 3053 | 3331 | 3636 |

|    |      |      |       |       |       |       |       |       |       |       |       |       |
|----|------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 39 | 329  | 634  | 981   | 1275  | 1586  | 1973  | 2249  | 2564  | 2922  | 3189  | 3480  | 3798  |
| 40 | 344  | 662  | 1024  | 1331  | 1656  | 2061  | 2349  | 2678  | 3053  | 3331  | 3636  | 3967  |
| 41 | 359  | 691  | 1070  | 1391  | 1730  | 2153  | 2454  | 2798  | 3189  | 3480  | 3798  | 4144  |
| 42 | 375  | 722  | 1118  | 1453  | 1808  | 2249  | 2564  | 2922  | 3331  | 3636  | 3967  | 4329  |
| 43 | 392  | 755  | 1168  | 1518  | 1888  | 2349  | 2678  | 3053  | 3480  | 3798  | 4144  | 4523  |
| 44 | 409  | 788  | 1220  | 1586  | 1973  | 2454  | 2798  | 3189  | 3636  | 3967  | 4329  | 4725  |
| 45 | 428  | 823  | 1275  | 1656  | 2061  | 2564  | 2922  | 3331  | 3798  | 4144  | 4523  | 4935  |
| 46 | 447  | 860  | 1331  | 1730  | 2153  | 2678  | 3053  | 3480  | 3967  | 4329  | 4725  | 5156  |
| 47 | 467  | 899  | 1391  | 1808  | 2249  | 2798  | 3189  | 3636  | 4144  | 4523  | 4935  | 5386  |
| 48 | 487  | 939  | 1453  | 1888  | 2349  | 2922  | 3331  | 3798  | 4329  | 4725  | 5156  | 5626  |
| 49 | 509  | 981  | 1518  | 1973  | 2454  | 3053  | 3480  | 3967  | 4523  | 4935  | 5386  | 5877  |
| 50 | 532  | 1024 | 1586  | 2061  | 2564  | 3189  | 3636  | 4144  | 4725  | 5156  | 5626  | 6140  |
| 51 | 556  | 1070 | 1656  | 2153  | 2678  | 3331  | 3798  | 4329  | 4935  | 5386  | 5877  | 6414  |
| 52 | 581  | 1118 | 1730  | 2249  | 2798  | 3480  | 3967  | 4523  | 5156  | 5626  | 6140  | 6700  |
| 53 | 606  | 1168 | 1808  | 2349  | 2922  | 3636  | 4144  | 4725  | 5386  | 5877  | 6414  | 6999  |
| 54 | 634  | 1220 | 1888  | 2454  | 3053  | 3798  | 4329  | 4935  | 5626  | 6140  | 6700  | 7311  |
| 55 | 662  | 1275 | 1973  | 2564  | 3189  | 3967  | 4523  | 5156  | 5877  | 6414  | 6999  | 7638  |
| 56 | 691  | 1331 | 2061  | 2678  | 3331  | 4144  | 4725  | 5386  | 6140  | 6700  | 7311  | 7979  |
| 57 | 722  | 1391 | 2153  | 2798  | 3480  | 4329  | 4935  | 5626  | 6414  | 6999  | 7638  | 8335  |
| 58 | 755  | 1453 | 2249  | 2922  | 3636  | 4523  | 5156  | 5877  | 6700  | 7311  | 7979  | 8707  |
| 59 | 788  | 1518 | 2349  | 3053  | 3798  | 4725  | 5386  | 6140  | 6999  | 7638  | 8335  | 9095  |
| 60 | 823  | 1586 | 2454  | 3189  | 3967  | 4935  | 5626  | 6414  | 7311  | 7979  | 8707  | 9501  |
| 61 | 860  | 1656 | 2564  | 3331  | 4144  | 5156  | 5877  | 6700  | 7638  | 8335  | 9095  | 9925  |
| 62 | 899  | 1730 | 2678  | 3480  | 4329  | 5386  | 6140  | 6999  | 7979  | 8707  | 9501  | 10368 |
| 63 | 939  | 1808 | 2798  | 3636  | 4523  | 5626  | 6414  | 7311  | 8335  | 9095  | 9925  | 10831 |
| 64 | 981  | 1888 | 2922  | 3798  | 4725  | 5877  | 6700  | 7638  | 8707  | 9501  | 10368 | 11314 |
| 65 | 1024 | 1973 | 3053  | 3967  | 4935  | 6140  | 6999  | 7979  | 9095  | 9925  | 10831 | 11819 |
| 66 | 1070 | 2061 | 3189  | 4144  | 5156  | 6414  | 7311  | 8335  | 9501  | 10368 | 11314 | 12347 |
| 67 | 1118 | 2153 | 3331  | 4329  | 5386  | 6700  | 7638  | 8707  | 9925  | 10831 | 11819 | 12898 |
| 68 | 1168 | 2249 | 3480  | 4523  | 5626  | 6999  | 7979  | 9095  | 10368 | 11314 | 12347 | 13474 |
| 69 | 1220 | 2349 | 3636  | 4725  | 5877  | 7311  | 8335  | 9501  | 10831 | 11819 | 12898 | 14075 |
| 70 | 1275 | 2454 | 3798  | 4935  | 6140  | 7638  | 8707  | 9925  | 11314 | 12347 | 13474 | 14703 |
| 71 | 1331 | 2564 | 3967  | 5156  | 6414  | 7979  | 9095  | 10368 | 11819 | 12898 | 14075 | 15360 |
| 72 | 1391 | 2678 | 4144  | 5386  | 6700  | 8335  | 9501  | 10831 | 12347 | 13474 | 14703 | 16045 |
| 73 | 1453 | 2798 | 4329  | 5626  | 6999  | 8707  | 9925  | 11314 | 12898 | 14075 | 15360 | 16761 |
| 74 | 1518 | 2922 | 4523  | 5877  | 7311  | 9095  | 10368 | 11819 | 13474 | 14703 | 16045 | 17509 |
| 75 | 1586 | 3053 | 4725  | 6140  | 7638  | 9501  | 10831 | 12347 | 14075 | 15360 | 16761 | 18291 |
| 76 | 1656 | 3189 | 4935  | 6414  | 7979  | 9925  | 11314 | 12898 | 14703 | 16045 | 17509 | 19107 |
| 77 | 1730 | 3331 | 5156  | 6700  | 8335  | 10368 | 11819 | 13474 | 15360 | 16761 | 18291 | 19960 |
| 78 | 1808 | 3480 | 5386  | 6999  | 8707  | 10831 | 12347 | 14075 | 16045 | 17509 | 19107 | 20851 |
| 79 | 1888 | 3636 | 5626  | 7311  | 9095  | 11314 | 12898 | 14703 | 16761 | 18291 | 19960 | 21781 |
| 80 | 1973 | 3798 | 5877  | 7638  | 9501  | 11819 | 13474 | 15360 | 17509 | 19107 | 20851 | 22753 |
| 81 | 2061 | 3967 | 6140  | 7979  | 9925  | 12347 | 14075 | 16045 | 18291 | 19960 | 21781 | 23769 |
| 82 | 2153 | 4144 | 6414  | 8335  | 10368 | 12898 | 14703 | 16761 | 19107 | 20851 | 22753 | 24830 |
| 83 | 2249 | 4329 | 6700  | 8707  | 10831 | 13474 | 15360 | 17509 | 19960 | 21781 | 23769 | 25938 |
| 84 | 2349 | 4523 | 6999  | 9095  | 11314 | 14075 | 16045 | 18291 | 20851 | 22753 | 24830 | 27095 |
| 85 | 2454 | 4725 | 7311  | 9501  | 11819 | 14703 | 16761 | 19107 | 21781 | 23769 | 25938 | 28305 |
| 86 | 2564 | 4935 | 7638  | 9925  | 12347 | 15360 | 17509 | 19960 | 22753 | 24830 | 27095 | 29568 |
| 87 | 2678 | 5156 | 7979  | 10368 | 12898 | 16045 | 18291 | 20851 | 23769 | 25938 | 28305 | 30888 |
| 88 | 2798 | 5386 | 8335  | 10831 | 13474 | 16761 | 19107 | 21781 | 24830 | 27095 | 29568 | 32266 |
| 89 | 2922 | 5626 | 8707  | 11314 | 14075 | 17509 | 19960 | 22753 | 25938 | 28305 | 30888 | 33706 |
| 90 | 3053 | 5877 | 9095  | 11819 | 14703 | 18291 | 20851 | 23769 | 27095 | 29568 | 32266 | 35211 |
| 91 | 3189 | 6140 | 9501  | 12347 | 15360 | 19107 | 21781 | 24830 | 28305 | 30888 | 33706 | 36782 |
| 92 | 3331 | 6414 | 9925  | 12898 | 16045 | 19960 | 22753 | 25938 | 29568 | 32266 | 35211 | 38424 |
| 93 | 3480 | 6700 | 10368 | 13474 | 16761 | 20851 | 23769 | 27095 | 30888 | 33706 | 36782 | 40139 |

|     |       |       |       |       |       |       |        |        |        |        |        |        |
|-----|-------|-------|-------|-------|-------|-------|--------|--------|--------|--------|--------|--------|
| 94  | 3636  | 6999  | 10831 | 14075 | 17509 | 21781 | 24830  | 28305  | 32266  | 35211  | 38424  | 41930  |
| 95  | 3798  | 7311  | 11314 | 14703 | 18291 | 22753 | 25938  | 29568  | 33706  | 36782  | 40139  | 43801  |
| 96  | 3967  | 7638  | 11819 | 15360 | 19107 | 23769 | 27095  | 30888  | 35211  | 38424  | 41930  | 45756  |
| 97  | 4144  | 7979  | 12347 | 16045 | 19960 | 24830 | 28305  | 32266  | 36782  | 40139  | 43801  | 47798  |
| 98  | 4329  | 8335  | 12898 | 16761 | 20851 | 25938 | 29568  | 33706  | 38424  | 41930  | 45756  | 49932  |
| 99  | 4523  | 8707  | 13474 | 17509 | 21781 | 27095 | 30888  | 35211  | 40139  | 43801  | 47798  | 52160  |
| 100 | 4725  | 9095  | 14075 | 18291 | 22753 | 28305 | 32266  | 36782  | 41930  | 45756  | 49932  | 54488  |
| 101 | 4935  | 9501  | 14703 | 19107 | 23769 | 29568 | 33706  | 38424  | 43801  | 47798  | 52160  | 56920  |
| 102 | 5156  | 9925  | 15360 | 19960 | 24830 | 30888 | 35211  | 40139  | 45756  | 49932  | 54488  | 59460  |
| 103 | 5386  | 10368 | 16045 | 20851 | 25938 | 32266 | 36782  | 41930  | 47798  | 52160  | 56920  | 62114  |
| 104 | 5626  | 10831 | 16761 | 21781 | 27095 | 33706 | 38424  | 43801  | 49932  | 54488  | 59460  | 64886  |
| 105 | 5877  | 11314 | 17509 | 22753 | 28305 | 35211 | 40139  | 45756  | 52160  | 56920  | 62114  | 67782  |
| 106 | 6140  | 11819 | 18291 | 23769 | 29568 | 36782 | 41930  | 47798  | 54488  | 59460  | 64886  | 70807  |
| 107 | 6414  | 12347 | 19107 | 24830 | 30888 | 38424 | 43801  | 49932  | 56920  | 62114  | 67782  | 73967  |
| 108 | 6700  | 12898 | 19960 | 25938 | 32266 | 40139 | 45756  | 52160  | 59460  | 64886  | 70807  | 77268  |
| 109 | 6999  | 13474 | 20851 | 27095 | 33706 | 41930 | 47798  | 54488  | 62114  | 67782  | 73967  | 80717  |
| 110 | 7311  | 14075 | 21781 | 28305 | 35211 | 43801 | 49932  | 56920  | 64886  | 70807  | 77268  | 84319  |
| 111 | 7638  | 14703 | 22753 | 29568 | 36782 | 45756 | 52160  | 59460  | 67782  | 73967  | 80717  | 88082  |
| 112 | 7979  | 15360 | 23769 | 30888 | 38424 | 47798 | 54488  | 62114  | 70807  | 77268  | 84319  | 92014  |
| 113 | 8335  | 16045 | 24830 | 32266 | 40139 | 49932 | 56920  | 64886  | 73967  | 80717  | 88082  | 96120  |
| 114 | 8707  | 16761 | 25938 | 33706 | 41930 | 52160 | 59460  | 67782  | 77268  | 84319  | 92014  | 100410 |
| 115 | 9095  | 17509 | 27095 | 35211 | 43801 | 54488 | 62114  | 70807  | 80717  | 88082  | 96120  | 104891 |
| 116 | 9501  | 18291 | 28305 | 36782 | 45756 | 56920 | 64886  | 73967  | 84319  | 92014  | 100410 | 109573 |
| 117 | 9925  | 19107 | 29568 | 38424 | 47798 | 59460 | 67782  | 77268  | 88082  | 96120  | 104891 | 114463 |
| 118 | 10368 | 19960 | 30888 | 40139 | 49932 | 62114 | 70807  | 80717  | 92014  | 100410 | 109573 | 119572 |
| 119 | 10831 | 20851 | 32266 | 41930 | 52160 | 64886 | 73967  | 84319  | 96120  | 104891 | 114463 | 124908 |
| 120 | 11314 | 21781 | 33706 | 43801 | 54488 | 67782 | 77268  | 88082  | 100410 | 109573 | 119572 | 130483 |
| 121 | 11819 | 22753 | 35211 | 45756 | 56920 | 70807 | 80717  | 92014  | 104891 | 114463 | 124908 | 136306 |
| 122 | 12347 | 23769 | 36782 | 47798 | 59460 | 73967 | 84319  | 96120  | 109573 | 119572 | 130483 | 142390 |
| 123 | 12898 | 24830 | 38424 | 49932 | 62114 | 77268 | 88082  | 100410 | 114463 | 124908 | 136306 | 148744 |
| 124 | 13474 | 25938 | 40139 | 52160 | 64886 | 80717 | 92014  | 104891 | 119572 | 130483 | 142390 | 155383 |
| 125 | 14075 | 27095 | 41930 | 54488 | 67782 | 84319 | 96120  | 109573 | 124908 | 136306 | 148744 | 162318 |
| 126 | 14703 | 28305 | 43801 | 56920 | 70807 | 88082 | 100410 | 114463 | 130483 | 142390 | 155383 | 169562 |
| 127 | 15360 | 29568 | 45756 | 59460 | 73967 | 92014 | 104891 | 119572 | 136306 | 148744 | 162318 | 177130 |

## Annex BC (normative): E-DCH Transport Block Size Tables for 1.28 Mcps TDD

The mapping between the TB index  $k$  ( $k = \{0,1,\dots,63\}$ ) and the corresponding E-DCH transport block size is given in the following tables.

### BC.1 5ms TTI E-DCH Transport Block Size Table 0

| TB index | Category 1-2   |                 |                 | Category 3-6   |                 |                 |                 |                 |
|----------|----------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|-----------------|
|          | 1 Timeslot TBS | 2 Timeslots TBS | 3 Timeslots TBS | 1 Timeslot TBS | 2 Timeslots TBS | 3 Timeslots TBS | 4 Timeslots TBS | 5 Timeslots TBS |
| 0        | 23             | 23              | 23              | 23             | 23              | 23              | 23              | 23              |
| 1        | 116            | 116             | 116             | 116            | 116             | 116             | 116             | 116             |
| 2        | 162            | 162             | 162             | 162            | 162             | 162             | 162             | 162             |
| 3        | 167            | 169             | 170             | 169            | 171             | 172             | 173             | 173             |
| 4        | 173            | 177             | 180             | 177            | 181             | 184             | 186             | 186             |
| 5        | 179            | 186             | 190             | 186            | 192             | 196             | 199             | 199             |
| 6        | 186            | 195             | 200             | 194            | 204             | 209             | 213             | 213             |
| 7        | 192            | 204             | 211             | 204            | 216             | 223             | 229             | 229             |
| 8        | 199            | 214             | 222             | 213            | 229             | 238             | 245             | 245             |
| 9        | 206            | 224             | 235             | 223            | 242             | 254             | 263             | 263             |
| 10       | 213            | 234             | 247             | 234            | 257             | 271             | 282             | 282             |
| 11       | 221            | 246             | 261             | 245            | 272             | 289             | 302             | 302             |
| 12       | 229            | 257             | 275             | 257            | 288             | 309             | 324             | 324             |
| 13       | 237            | 270             | 290             | 269            | 306             | 329             | 347             | 347             |
| 14       | 245            | 282             | 306             | 282            | 324             | 351             | 372             | 372             |
| 15       | 254            | 296             | 323             | 295            | 343             | 375             | 399             | 399             |
| 16       | 263            | 310             | 341             | 309            | 364             | 400             | 427             | 427             |

|    |     |      |      |      |      |      |      |      |
|----|-----|------|------|------|------|------|------|------|
| 17 | 272 | 325  | 359  | 324  | 385  | 427  | 458  | 458  |
| 18 | 282 | 340  | 379  | 339  | 408  | 455  | 491  | 491  |
| 19 | 292 | 356  | 400  | 355  | 433  | 486  | 526  | 526  |
| 20 | 302 | 373  | 422  | 372  | 459  | 518  | 564  | 564  |
| 21 | 313 | 391  | 445  | 390  | 486  | 553  | 605  | 605  |
| 22 | 324 | 410  | 469  | 408  | 515  | 589  | 648  | 648  |
| 23 | 335 | 429  | 495  | 427  | 546  | 629  | 695  | 695  |
| 24 | 347 | 450  | 522  | 448  | 578  | 671  | 745  | 745  |
| 25 | 359 | 471  | 550  | 469  | 613  | 716  | 799  | 799  |
| 26 | 372 | 493  | 581  | 491  | 649  | 764  | 856  | 856  |
| 27 | 385 | 517  | 612  | 514  | 688  | 815  | 918  | 918  |
| 28 | 399 | 541  | 646  | 539  | 729  | 869  | 983  | 983  |
| 29 | 413 | 567  | 681  | 564  | 773  | 927  | 1054 | 1054 |
| 30 | 428 | 594  | 718  | 591  | 819  | 989  | 1130 | 1130 |
| 31 | 443 | 622  | 758  | 619  | 867  | 1055 | 1211 | 1211 |
| 32 | 458 | 652  | 799  | 648  | 919  | 1125 | 1298 | 1298 |
| 33 | 475 | 683  | 843  | 679  | 974  | 1201 | 1392 | 1392 |
| 34 | 491 | 716  | 889  | 711  | 1032 | 1281 | 1492 | 1492 |
| 35 | 509 | 750  | 937  | 745  | 1094 | 1366 | 1599 | 1599 |
| 36 | 527 | 785  | 989  | 780  | 1159 | 1458 | 1714 | 1714 |
| 37 | 545 | 823  | 1043 | 817  | 1228 | 1555 | 1837 | 1837 |
| 38 | 565 | 862  | 1100 | 856  | 1301 | 1659 | 1969 | 1969 |
| 39 | 585 | 903  | 1160 | 896  | 1379 | 1770 | 2110 | 2110 |
| 40 | 605 | 946  | 1223 | 938  | 1461 | 1888 | 2262 | 2262 |
| 41 | 627 | 991  | 1290 | 983  | 1548 | 2014 | 2425 | 2425 |
| 42 | 649 | 1038 | 1361 | 1029 | 1640 | 2148 | 2599 | 2599 |
| 43 | 672 | 1087 | 1435 | 1078 | 1738 | 2292 | 2786 | 2786 |
| 44 | 696 | 1139 | 1514 | 1129 | 1841 | 2445 | 2986 | 2986 |
| 45 | 720 | 1193 | 1596 | 1183 | 1951 | 2608 | 3200 | 3200 |
| 46 | 746 | 1250 | 1684 | 1239 | 2067 | 2782 | 3430 | 3430 |
| 47 | 772 | 1309 | 1776 | 1297 | 2191 | 2968 | 3677 | 3677 |

|    |      |      |      |      |      |      |       |       |
|----|------|------|------|------|------|------|-------|-------|
| 48 | 799  | 1372 | 1873 | 1359 | 2321 | 3166 | 3941  | 3941  |
| 49 | 827  | 1437 | 1975 | 1423 | 2460 | 3377 | 4224  | 4224  |
| 50 | 857  | 1505 | 2083 | 1491 | 2606 | 3603 | 4528  | 4528  |
| 51 | 887  | 1577 | 2197 | 1561 | 2762 | 3843 | 4853  | 4853  |
| 52 | 918  | 1652 | 2317 | 1635 | 2926 | 4100 | 5202  | 5202  |
| 53 | 951  | 1730 | 2444 | 1712 | 3101 | 4374 | 5576  | 5576  |
| 54 | 984  | 1813 | 2578 | 1794 | 3285 | 4666 | 5976  | 5976  |
| 55 | 1019 | 1899 | 2719 | 1878 | 3481 | 4977 | 6406  | 6406  |
| 56 | 1055 | 1989 | 2867 | 1967 | 3689 | 5310 | 6866  | 6866  |
| 57 | 1092 | 2084 | 3024 | 2060 | 3908 | 5664 | 7359  | 7359  |
| 58 | 1131 | 2183 | 3189 | 2158 | 4141 | 6042 | 7888  | 7888  |
| 59 | 1171 | 2287 | 3364 | 2260 | 4388 | 6446 | 8455  | 8455  |
| 60 | 1212 | 2395 | 3547 | 2367 | 4650 | 6876 | 9062  | 9062  |
| 61 | 1255 | 2509 | 3741 | 2479 | 4927 | 7335 | 9713  | 9713  |
| 62 | 1300 | 2629 | 3946 | 2597 | 5220 | 7825 | 10411 | 10411 |
| 63 | 1346 | 2754 | 4162 | 2720 | 5532 | 8348 | 11160 | 11160 |



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## Annex C (informative): Pseudo-Code for E-TFC Selection (FDD)

The pseudo-code below describes one possible implementation of the E-TFC Selection as described in subclause 11.8.1.4:

- 1> determine whether to take the scheduled and non-scheduled grants into account in the upcoming transmission.
- 1> if scheduled and/or non-scheduled data can be transmitted:
  - 2> select a MAC-d flow that allows highest-priority data to be transmitted (when more than one MAC-d flow allows data of the same highest priority to be transmitted, it is left to implementation to select which MAC-d flow to prefer);
  - 2> identify the MAC-d flow(s) whose multiplexing lists allow them to be transmitted in the same TTI as this MAC-d flow, and whose grants allow them to transmit in this TTI and ignore the one(s) that cannot.
  - 2> based on the HARQ profile of this MAC-d flow, identify the power offset to use;
  - 2> based on this power offset and the E-TFC restriction procedure, determine the "Maximum Supported Payload" (i.e. maximum MAC-e or MAC-i PDU size or E-TFC that can be sent by the UE during the upcoming transmission);
  - 2> if the upcoming transmission overlaps with a compressed mode gap on 10ms TTI, scale down the current serving grant (SG);
  - 2> set "Remaining Scheduled Grant Payload" to the highest payload that could be transmitted according to SG and selected power offset;
  - 2> for each MAC-d flow with a non-scheduled grant, set the "Remaining Non-scheduled Payload" to the value of the grant;
  - 2> if Scheduling Information needs to be transmitted:
    - 3> set "Total Granted Payload" to the sum of "Remaining Non Scheduled Payload" for all non-scheduled MAC-d flows + "Remaining Scheduled Grant Payload" + size of the scheduling information.
  - 2> else:
    - 3> set "Total Granted Payload" to the sum of "Remaining Non Scheduled Payload" for all non-scheduled MAC-d flows + "Remaining Scheduled Grant Payload".
  - 2> set "Remaining Available Payload" to MIN ("Max Supported Payload", "Total Granted Payload");
  - 2> if "Remaining Available Payload" = an ETFC size:
    - 3> set "Quantisation Loss" to zero.
  - 2> else:
    - 3> set "Quantization Loss" to the value of "Remaining Available Payload" – ("Remaining Available Payload" rounded down to the next smaller E-TFC).
  - 2> if scheduling information needs to be transmitted:
    - 3> subtract the size of scheduling information from "Remaining Available Payload".
  - 2> set "Quantisation Applied" to FALSE;
  - 2> perform the following loop for each logical channel, in the order of their priorities:
    - 3> if this logical channel belongs to a MAC-d flow with a non-scheduled grant, then:

- 4> consider the "Remaining Non-scheduled Payload" corresponding to the MAC-d flow on which this logical channel is mapped;
  - 4> fill the MAC-e or MAC-i PDU with SDU(s) from this logical channel up to MIN ("Remaining Non-scheduled Payload" taking into account the MAC-e/es or MAC-i/is headers, Available Data for this logical channel, "Remaining Available Payload" taking into account the MAC-e/es or MAC-i/is headers);
  - 4> subtract the corresponding bits if any from "Remaining Available Payload" and "Remaining Non-scheduled Payload" taking into account the MAC-e/es or MAC-i/is headers.
- 3> else:
- 4> If "Quantisation Applied" is TRUE:
    - 5> fill the MACe PDU with SDU(s) from this logical channel up to MIN ("Remaining Scheduled Grant Payload" taking into account the MAC-e/es or MAC-i/is headers, Available Data for this logical channel, "Remaining Available Payload" taking into account the MAC-e/es or MAC-i/is headers);
    - 5> subtract the corresponding bits if any from "Remaining Available Payload" and "Remaining Scheduled Grant Payload" taking into account the MAC-e/es or MAC-i/is headers.
  - 4> else:
    - 5> fill the MAC-e or MAC-i PDU with SDU(s) from this logical channel up to MIN ("Remaining Scheduled Grant Payload" taking into account the MAC-e/es or MAC-i/is headers, Available Data for this logical channel, "Remaining Available Payload" – "Quantisation Loss" taking into account the MAC-e/es or MAC-i/is headers);
    - 5> if bits can be transmitted on this logical channel:
      - 6> set "Remaining Available Payload" to ("Remaining Available Payload" – "Quantisation Loss");
      - 6> subtract the corresponding bits from "Remaining Available Payload" and "Remaining Scheduled Grant Payload" taking into account the MAC-e/es or MAC-i/is headers;
      - 6> set "Quantisation Applied" to TRUE.
- 2> if Scheduling Information needs to be transmitted:
- 3> add Scheduling Information to the MAC-e or MAC-i PDU;
  - 3> determine the smallest E-TFC that can carry the resulting MAC-e or MAC-i PDU;
  - 3> if the padding allows a  $DDI_0$  to be sent, add it to the end of the MAC-e header.
- 2> else:
- 3> determine the smallest E-TFC that can carry the resulting MAC-e or MAC-i PDU;
  - 3> if the padding allows a Scheduling Information to be sent, add it to the MAC-e or MAC-i PDU;
  - 3> if a Scheduling Information was added to the PDU and if the padding allows a  $DDI_0$  or  $LCH-ID_0$  to be sent, add it to the end of the MAC-e or MAC-i header.
- 2> set the maximum number of HARQ transmissions to the maximum among the maximum number of HARQ transmissions of the HARQ profiles of the MAC-d flows selected for transmissions.
- 1> else if Scheduling Information needs to be transmitted:
- 2> select the "control-only" HARQ profile;
  - 2> fill the MAC-e or MAC-i PDU with the scheduling information;
  - 2> select the smallest E-TFC.

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## Annex CA (informative): Pseudo-Code for E-TFC Selection (TDD)

The pseudo-code below describes one possible implementation of UE E-TFC Selection as described in subclause 11.9.1.4. It consists of three separate procedures which are normally executed Procedure 1, 2 and then 3:

### Procedure 1:

- 1> Determine set B, the set of logical channels which consist of a) the highest priority logical channel which has data buffered for transmission b) the set of logical channels which have data buffered for transmission and which may be multiplexed with the highest priority channel. The detailed steps involved are as follows:
  - 2> Determine whether or not a TTI is designated for scheduled or non scheduled transmission.
  - 2> Determine the set A of logical channels which have data buffered for transmission and which are consistent with the TTI designation (scheduled or non-scheduled).
  - 2> Determine X, the highest priority logical channel in set A.
  - 2> Select the HARQ profile of the MAC-d flow, flow Y, to which logical channel X belongs. (*Note: A logical channel can only belong to one MAC-d flow and can therefore only have one HARQ profile*)
  - 2> Determine set B, the set of logical channels which are in set A and which belong to flow Y or to a flow which may be multiplexed with flow Y

### Procedure 2:

- 1> Generate the largest block size that can be supported by the resources granted. The detailed steps involved are as follows:
  - 2> Determine the sets of TFCs  $C_1$  (QPSK) and  $C_2$  (16-QAM) whose code rates fall within the allowed maximum and minimum (inclusive) coderates specified by RRC for the assigned number of time slots and the assigned channelisation code (the UE is not allowed to use more or less slots than are assigned nor to use a code associated with a lower spreading factor). For 1.28 Mcps TDD, the spreading factor can not be changed by the UE and the current value of ENI should be considered when choosing the allowed maximum and minimum code rates if a scheduled transmission is designated.
  - 2> Determine the subsets  $D_1$  and  $D_2$  of  $C_1$  and  $C_2$  respectively which require transmit power that is less than or equal to the power available taking into account of the power offset of the HARQ profile of flow y,  $P_{e-base}$ , Pathloss and beta values (see [18]) associated with TFCs for QPSK and 16QAM.
  - 2> Determine k, the largest MAC-e PDU block size that can be supported, from the sets  $D_1$  and  $D_2$
  - 2> If k belongs exclusively to set  $D_1$ , select QPSK modulation. If k belongs exclusively to set  $D_2$ , select 16-QAM modulation. If k appears in both sets  $D_1$  and  $D_2$ , select 16-QAM modulation only if it offers a lower power requirement than QPSK, otherwise select QPSK modulation.

### Procedure 3:

- 1> Generate the largest MAC-e PDU, having a size  $\leq k$ , by taking MAC-d PDUs from logical channels in set B (in order of priority) and select SF (for 1.28 Mcps TDD, the SF can not be changed) and modulation so as to minimise the power used. The detailed steps are as follows:
  - 2> Generate the largest MAC-e PDU  $\leq k$ , taking MAC-d PDUs from logical channels belonging to set B (in priority order);
  - 2> If this is successful (i.e. sufficient resources granted):
    - 3> select the SF (for 1.28 Mcps TDD, the SF cannot be changed) and modulation to use in order to minimise the power used to transmit the MAC-e PDU;
    - 3> transmit the MAC-e PDU.
  - 2> If this is not successful (i.e. the MAC-e PDU is empty due to insufficient resources granted):

3>  $A := A - B$ ;

3> if A is not empty (i.e. other logical channels have data buffered for transmission):

4> determine a new set B (repeat Procedure 1 and then Procedure 3).

3> if A is empty (i.e. no other logical channels have data buffered for transmission):

4> transmit scheduling information only in the MAC-e PDU.

## Annex D (informative): Change history

| Change history |           |           |          |                                             |                                                                                                                         |                                           |       |       |
|----------------|-----------|-----------|----------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------|-------|
| Date           | TSG #     | TSG Doc.  | CR       | Rev                                         | Subject/Comment                                                                                                         | Old                                       | New   |       |
| 06/1999        | RP-04     | RP-99312  | -        |                                             | Approved at TSG-RAN #4 and placed under Change Control                                                                  | -                                         | 3.0.0 |       |
| 10/1999        | RP-05     | RP-99463  | 001      | 1                                           | Modified MAC handling of PCH and FACH                                                                                   | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 002      |                                             | Modifications of MAC primitives                                                                                         | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 003      | 2                                           | RACH/FACH MAC header – Channel type identification                                                                      | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 004      |                                             | Support for USCH/DSCH signalling in TDD                                                                                 | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 006      |                                             | Clarification on RACH partitioning and prioritization via access service class (ASC) and relation to back-off algorithm | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 010      | 1                                           | Modifications on UE-Id formats                                                                                          | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 011      |                                             | CPCH primitives                                                                                                         | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 012      |                                             | Timing advance for TDD                                                                                                  | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 013      | 1                                           | Traffic volume measurement report procedure                                                                             | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 014      |                                             | Mapping of BCCH logical channel onto FACH transport channel                                                             | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 015      | 1                                           | MAC PDU formats for DCCH/DTCH on DSCH and for PCCH                                                                      | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 016      | 1                                           | Informative parts that shall not specify or constrain implementations                                                   | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 017      | 1                                           | Modification of RACH transmission control procedure                                                                     | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 018      |                                             | Removal of MAC function for system information and paging scheduling                                                    | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 019      | 1                                           | RACH transmission control procedure on MAC for TDD mod                                                                  | 3.0.0                                     | 3.1.0 |       |
|                | RP-05     | RP-99463  | 021      | 1                                           | Removal of Annex A and B of TS 25.321                                                                                   | 3.0.0                                     | 3.1.0 |       |
|                | 12/1999   | RP-06     | RP-99638 | 022                                         | 3                                                                                                                       | Modified MAC header field sizes           | 3.1.0 | 3.2.0 |
|                |           | RP-06     | RP-99638 | 023                                         |                                                                                                                         | MAC: Multiple shared channels (DSCH/USCH) | 3.1.0 | 3.2.0 |
| RP-06          |           | RP-99638  | 024      |                                             | Parameters for Status Primitive                                                                                         | 3.1.0                                     | 3.2.0 |       |
| RP-06          |           | RP-99638  | 025      | 1                                           | Support of shared channel operation in TDD                                                                              | 3.1.0                                     | 3.2.0 |       |
| RP-06          |           | RP-99638  | 028      |                                             | Modification of Cell Broadcast Service (CBS)                                                                            | 3.1.0                                     | 3.2.0 |       |
| RP-06          |           | RP-99637  | 030      | 1                                           | Editorial changes                                                                                                       | 3.1.0                                     | 3.2.0 |       |
| RP-06          | RP-99638  | 031       | 1        | Simultaneous mapping of logical channels on | 3.1.0                                                                                                                   | 3.2.0                                     |       |       |
| 03/2000        | RP-07     | RP-000039 | 032      |                                             | Bit Aligned TDD MAC Headers                                                                                             | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 035      | 2                                           | CPCH including Channel Assignment                                                                                       | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 036      |                                             | UE-ID type indication                                                                                                   | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 037      | 1                                           | RACH transmission control procedure                                                                                     | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 039      |                                             | CPCH start of message indication                                                                                        | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 040      |                                             | Removal of SCH and SCCH                                                                                                 | 3.2.0                                     | 3.3.0 |       |
|                | RP-07     | RP-000039 | 041      | 1                                           | Clarification of bit order                                                                                              | 3.2.0                                     | 3.3.0 |       |
| 06/2000        | RP-08     | RP-000219 | 042      |                                             | CPCH correction                                                                                                         | 3.3.0                                     | 3.4.0 |       |
|                | RP-08     | RP-000219 | 043      | 1                                           | End of CPCH transmission                                                                                                | 3.3.0                                     | 3.4.0 |       |
|                | RP-08     | RP-000219 | 044      | 2                                           | Clarification of prioritisation of logical channels in UE                                                               | 3.3.0                                     | 3.4.0 |       |
|                | RP-08     | RP-000219 | 045      | 1                                           | CPCH MAC procedures                                                                                                     | 3.3.0                                     | 3.4.0 |       |
|                | RP-08     | RP-000219 | 046      |                                             | Traffic Volume Measurement for dynamic radio bearer control                                                             | 3.3.0                                     | 3.4.0 |       |
| 09/2000        | RP-09     | RP-000357 | 047      |                                             | Movement of primitives text to the correct section                                                                      | 3.4.0                                     | 3.5.0 |       |
|                | RP-09     | RP-000357 | 048      |                                             | Corrections to RACH procedure                                                                                           | 3.4.0                                     | 3.5.0 |       |
|                | RP-09     | RP-000357 | 049      |                                             | Clarification on the parameters of the MAC-RLC primitives                                                               | 3.4.0                                     | 3.5.0 |       |
|                | RP-09     | RP-000357 | 051      | 1                                           | Editorial Cleanup                                                                                                       | 3.4.0                                     | 3.5.0 |       |
| 12/2000        | RP-10     | RP-000567 | 053      | 2                                           | Corrections to logical channel priorities in MAC Protocol                                                               | 3.5.0                                     | 3.6.0 |       |
|                | RP-10     | RP-000567 | 055      | 1                                           | Removal of FAUSCH                                                                                                       | 3.5.0                                     | 3.6.0 |       |
|                | RP-10     | RP-000567 | 056      | 2                                           | General MAC clarification                                                                                               | 3.5.0                                     | 3.6.0 |       |
|                | RP-10     | RP-000567 | 057      | 1                                           | Error Handling in MAC                                                                                                   | 3.5.0                                     | 3.6.0 |       |
|                | RP-10     | RP-000567 | 058      | 1                                           | Error handling for MAC RACH and CPCH transmission control procedure                                                     | 3.5.0                                     | 3.6.0 |       |
|                | RP-10     | RP-000567 | 059      |                                             | Inclusion of stage 3 for ciphering                                                                                      | 3.5.0                                     | 3.6.0 |       |
| 03/2001        | RP-11     | RP-010025 | 061      |                                             | Removal of FAUSCH                                                                                                       | 3.6.0                                     | 3.7.0 |       |
|                | RP-11     | RP-010025 | 066      | 3                                           | TFC selection algorithm correction                                                                                      | 3.6.0                                     | 3.7.0 |       |
|                | RP-11     | RP-010025 | 067      | 3                                           | Miscellaneous corrections                                                                                               | 3.6.0                                     | 3.7.0 |       |
|                | RP-11     | RP-010025 | 068      | 2                                           | Clarification on Traffic Volume Measurement Procedure                                                                   | 3.6.0                                     | 3.7.0 |       |
|                | RP-11     | RP-010025 | 070      | 1                                           | Clarification on parameters of the primitives                                                                           | 3.6.0                                     | 3.7.0 |       |
| RP-11          | RP-010037 | 064       |          | 1.28Mcps TDD                                | 3.7.0                                                                                                                   | 4.0.0                                     |       |       |
| 06/2001        | RP-12     | RP-010308 | 074      |                                             | RLC Tr Discard                                                                                                          | 4.0.0                                     | 4.1.0 |       |
|                | RP-12     | RP-010308 | 076      |                                             | Clarification on compressed mode                                                                                        | 4.0.0                                     | 4.1.0 |       |
|                | RP-12     | RP-010308 | 078      |                                             | Correction of relation between MAC functions and transport channels                                                     | 4.0.0                                     | 4.1.0 |       |
|                | RP-12     | RP-010308 | 080      |                                             | Rate adaptation                                                                                                         | 4.0.0                                     | 4.1.0 |       |
|                | RP-12     | RP-010308 | 082      |                                             | Cleanup of MAC services and functions                                                                                   | 4.0.0                                     | 4.1.0 |       |
|                | RP-12     | RP-010322 | 083      |                                             | Correction to control of RACH Transmissions for 1.28Mcps TDD                                                            | 4.0.0                                     | 4.1.0 |       |

| Change history |         |           |           |     |                                                                             |                                                              |       |       |
|----------------|---------|-----------|-----------|-----|-----------------------------------------------------------------------------|--------------------------------------------------------------|-------|-------|
| Date           | TSG #   | TSG Doc.  | CR        | Rev | Subject/Comment                                                             | Old                                                          | New   |       |
| 09/2001        | RP-13   | RP-010541 | 085       |     | Setting of UE Id in MAC                                                     | 4.1.0                                                        | 4.2.0 |       |
|                | RP-13   | RP-010541 | 087       |     | MAC ASC selection operation when access class is used to determine ASC      | 4.1.0                                                        | 4.2.0 |       |
|                | RP-13   | RP-010541 | 089       |     | Addition of neighbour cell BCH to MAC-b model for the UE                    | 4.1.0                                                        | 4.2.0 |       |
|                | RP-13   | RP-010541 | 093       | 1   | Clarification on TFC selection                                              | 4.1.0                                                        | 4.2.0 |       |
|                | 12/2001 | RP-14     | RP-010760 | 091 | 1                                                                           | Cautionary Note for Interfrequency Measurements in Cell-FACH | 4.2.0 | 4.3.0 |
|                |         | RP-14     | RP-010760 | 095 |                                                                             | Correction on Control of RACH Transmissions                  | 4.2.0 | 4.3.0 |
| RP-14          |         | RP-010760 | 097       |     | Correction on Traffic Volume Control                                        | 4.2.0                                                        | 4.3.0 |       |
|                | RP-14   | RP-010760 | 099       |     | General correction on Access Service Class selection                        | 4.2.0                                                        | 4.3.0 |       |
|                | RP-14   | RP-010760 | 101       |     | TFC selection in compressed mode                                            | 4.2.0                                                        | 4.3.0 |       |
|                | 03/2002 | RP-15     | RP-020067 | 103 |                                                                             | Clarification on ciphering                                   | 4.3.0 | 4.4.0 |
| RP-15          |         | RP-020067 | 106       |     | TDD MAC Layer Subchannel Assignment                                         | 4.3.0                                                        | 4.4.0 |       |
| RP-15          |         | RP-020067 | 110       |     | Missing DTCH channel type in UE-ID Type Indicator                           | 4.3.0                                                        | 4.4.0 |       |
|                | RP-15   | RP-020067 | 112       |     | Correction on UE Id for DSCH                                                | 4.3.0                                                        | 4.4.0 |       |
|                | RP-15   | RP-020067 | 114       |     | UE undefined behaviour when padding is required                             | 4.3.0                                                        | 4.4.0 |       |
|                | RP-15   | RP-020094 | 104       | 2   | Introduction of HSDPA                                                       | 4.4.0                                                        | 5.0.0 |       |
| 06/2002        | RP-16   | RP-020326 | 117       |     | Update References to include 25.123 (TDD)                                   | 5.0.0                                                        | 5.1.0 |       |
|                | RP-16   | RP-020326 | 120       |     | TFCS selection guideline correction                                         | 5.0.0                                                        | 5.1.0 |       |
|                | RP-16   | RP-020341 | 121       |     | HSDPA related MAC corrections                                               | 5.0.0                                                        | 5.1.0 |       |
|                | RP-16   | RP-020341 | 122       |     | Description for MAC-hs reset                                                | 5.0.0                                                        | 5.1.0 |       |
|                | 09/2002 | RP-17     | RP-020538 | 130 |                                                                             | MAC TVM Corrections                                          | 5.1.0 | 5.2.0 |
|                |         | RP-17     | RP-020538 | 133 |                                                                             | MAC header for DTCH and DCCH                                 | 5.1.0 | 5.2.0 |
| RP-17          |         | RP-020556 | 123       |     | Optional use of a maximum transmission delay for MAC-hs SDUs                | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 124       |     | MAC-hs: Scheduler and HARQ entity functions for TSN                         | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 125       |     | Correction on C/T field definition for HS-DSCH                              | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 126       |     | Corrections to re-ordering protocol description                             | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 127       |     | Limiting of number of PDUs per TTI                                          | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 134       |     | Signaling of Transport Block Sizes for HS-DSCH                              | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 135       |     | Transport block size signalling 3.84 Mcps TDD                               | 5.1.0                                                        | 5.2.0 |       |
|                | RP-17   | RP-020556 | 136       |     | Static HSDPA Transport Block Sizes for 1.28 Mcps TDD                        | 5.1.0                                                        | 5.2.0 |       |
|                | 12/2002 | RP-18     | RP-020718 | 142 | 1                                                                           | TFC selection for RACH transmissions                         | 5.2.0 | 5.3.0 |
|                |         | RP-18     | RP-020718 | 145 |                                                                             | RB id in ciphering                                           | 5.2.0 | 5.3.0 |
| RP-18          |         | RP-020718 | 148       |     | Correction to TFC selection for TDD                                         | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020718 | 151       |     | Unblockable TFCs in excess power state                                      | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020735 | 137       |     | Generation of RLC Status Reports to coordinate with MAC-hs reset            | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020735 | 138       |     | Re-ordering Mechanism                                                       | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020735 | 139       |     | Transport Block Size Signalling for 1.28Mcps TDD                            | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020735 | 153       |     | Limitation on number of PDUs per single TTI for 1.28 Mcps TDD               | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020735 | 154       |     | The Number of mac-d pdu's in a single mac-hs PDU for TDD                    | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020851 | 155       |     | HSDPA Retransmission block Size                                             | 5.2.0                                                        | 5.3.0 |       |
|                | RP-18   | RP-020874 | 158       |     | Ciphering of multiple PDUs per TTI                                          | 5.2.0                                                        | 5.3.0 |       |
|                | RP-19   | RP-030100 | 166       |     | Setting of ciphering activation time for TM bearers                         | 5.3.0                                                        | 5.4.0 |       |
|                | RP-19   | RP-030100 | 169       | 1   | TFC Control Implementation                                                  | 5.3.0                                                        | 5.4.0 |       |
|                | RP-19   | RP-030115 | 159       |     | TDD HCSN determination in MAC-hs                                            | 5.3.0                                                        | 5.4.0 |       |
|                | RP-19   | RP-030115 | 160       |     | Correction to the use of Transport Block Size index equal to 111111 for TDD | 5.3.0                                                        | 5.4.0 |       |
|                | RP-19   | RP-030115 | 163       |     | Editorial changes to MAC-hs                                                 | 5.3.0                                                        | 5.4.0 |       |
|                | RP-19   | RP-030115 | 170       |     | Re-ordering entity corrections                                              | 5.3.0                                                        | 5.4.0 |       |
|                | 06/2003 | RP-20     | RP-030302 | 171 |                                                                             | Text clean up of the description of the reordering entity    | 5.4.0 | 5.5.0 |
| RP-20          |         | RP-030302 | 172       |     | MAC header for DTCH and DCCH mapped to HS-DSCH                              | 5.4.0                                                        | 5.5.0 |       |
| 09/2003        | RP-21   | RP-030501 | 178       |     | TFCS selection guidelines for TFC Subset                                    | 5.5.0                                                        | 5.6.0 |       |
|                | RP-21   | RP-030536 | 174       | 2   | MAC-hs Re-ordering Protocol Correction & MAC-hs window re-ordering          | 5.5.0                                                        | 5.6.0 |       |
|                | RP-21   | RP-030494 | 175       |     | Addition of HS-DSCH Provided Bit Rate measurement                           | 5.5.0                                                        | 5.6.0 |       |
| 12/2003        | RP-22   | RP-030624 | 179       |     | Corrections Relating to HSDPA TB Sizes for 1.28Mcps TDD                     | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | RP-030624 | 180       |     | HSDPA Transport block size table for 3.84Mcps TDD                           | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | RP-030624 | 181       |     | HSDPA TB size table                                                         | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | RP-030624 | 182       |     | Unwarranted HARQ re-transmissions                                           | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | RP-030624 | 183       |     | MAC-hs Re-ordering Protocol Flushing correction                             | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | RP-030624 | 184       |     | Correction to window based stall avoidance mechanism                        | 5.6.0                                                        | 5.7.0 |       |
|                | RP-22   | -         | -         |     | Upgrade to Release 6 - no technical change                                  | 5.7.0                                                        | 6.0.0 |       |
|                | 03/2004 | RP-23     | RP-040104 | 186 | 1                                                                           | UE handling of NDI and TBS for HSDPA                         | 6.0.0 | 6.1.0 |
|                |         | RP-23     | RP-040104 | 188 |                                                                             | HSDPA related corrections on MAC-hs reconfiguration          | 6.0.0 | 6.1.0 |
| RP-23          |         | RP-040104 | 190       |     | Reconfiguration of soft memory buffer partitioning                          | 6.0.0                                                        | 6.1.0 |       |
| 06/2004        | RP-24   | RP-040200 | 194       |     | Use of U-RNTI in downlink                                                   | 6.1.0                                                        | 6.2.0 |       |
|                | RP-24   | RP-040234 | 196       |     | State variables arithmetic comparison                                       | 6.1.0                                                        | 6.2.0 |       |
| 12/2004        | RP-26   | RP-040480 | 198       |     | MAC-hs header extension                                                     | 6.2.0                                                        | 6.3.0 |       |
|                | RP-26   | RP-040480 | 200       |     | Clarification on the C/T field use in the HSDPA Mac-d header                | 6.2.0                                                        | 6.3.0 |       |
|                | RP-26   | RP-040489 | 201       | 1   | Introduction of MBMS MAC header                                             | 6.2.0                                                        | 6.3.0 |       |

| Change history |       |           |      |     |                                                                                              |       |       |
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|                | RP-26 | RP-040489 | 202  |     | Introduction of MBMS                                                                         | 6.2.0 | 6.3.0 |
|                | RP-26 | RP-040497 | 203  |     | Introduction of EUL in MAC specification                                                     | 6.2.0 | 6.3.0 |
| 03/2005        | RP-27 | RP-050078 | 204  |     | Correction to MBMS header for MBMS                                                           | 6.3.0 | 6.4.0 |
| 06/2005        | RP-28 | RP-050301 | 0207 |     | Correction of HSDPA state variable                                                           | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050319 | 0208 |     | Corrections to the description of TCTF field                                                 | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050301 | 0210 |     | Reconfiguration of MAC-hs parameters                                                         | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050308 | 0212 |     | Feature Clean-up: Removal of DSCH (FDD)                                                      | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050309 | 0214 |     | Feature Clean Up: Removal of CPCH                                                            | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050323 | 0215 |     | HS-DSCH Provided Bit Rate measurement per Cell Portion                                       | 6.4.0 | 6.5.0 |
|                | RP-28 | RP-050375 | 0216 | 2   | Additional text on EUL in MAC specification                                                  | 6.4.0 | 6.5.0 |
| 09/2005        | RP-29 | RP-050462 | 0218 |     | Correction of TB size for 1.28 Mcps TDD                                                      | 6.5.0 | 6.6.0 |
|                | RP-29 | RP-050602 | 0219 | 5   | Additional text on EUL in MAC specification                                                  | 6.5.0 | 6.6.0 |
|                | RP-29 | RP-050452 | 0220 |     | Definition of UE power Headroom                                                              | 6.5.0 | 6.6.0 |
|                | RP-29 | RP-050457 | 0222 |     | Feature Clean Up: Removal of CPCH                                                            | 6.5.0 | 6.6.0 |
| 12/2005        | RP-30 | RP-050791 | 0223 |     | Multi-step handling for E-RGCH                                                               | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0224 |     | Clarifications and Corrections of E-TFC Selection                                            | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0225 | 1   | Criteria for the Happy Bit                                                                   | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0226 | 1   | Correction to definition of reference_ETPR                                                   | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0227 |     | TEBS and HLBS Coding                                                                         | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0228 |     | Correction on MAC-e PDU format                                                               | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0229 |     | SI Triggering Timer                                                                          | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0230 |     | Maximum number of transmissions for control-only information                                 | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0231 |     | Additional error case on the Absolute Grant channel                                          | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0232 |     | HARQ process restriction/reservation                                                         | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050791 | 0233 |     | Behavior at E-DCH TTI change                                                                 | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0234 |     | Buffer status for Scheduling Information                                                     | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0235 |     | Buffer definition for Happy Bit setting                                                      | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0236 |     | Specification of rate control combining rules in baseline procedure for Serving Grant update | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0237 |     | Definition of sample for E-DCH bit rate measurement                                          | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0238 |     | Size of Absolute Grant field                                                                 | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0239 |     | Transmission of Scheduling Information without higher layer data                             | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0241 |     | Size of UPH field and assembly of Scheduling Information message                             | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0242 |     | E-DCH SI MAC-e PDU and SI timers                                                             | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0243 |     | MAC es/e reset indicator                                                                     | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0244 |     | E-DCH handling at serving cell change                                                        | 6.6.0 | 6.7.0 |
|                | RP-30 | RP-050792 | 0245 |     | RSN sequence in the presence of compressed mode transmission gaps                            | 6.6.0 | 6.7.0 |
| 03/2006        | RP-31 | RP-060085 | 0246 |     | Definition of reference_ETPR                                                                 | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0247 | 1   | AG_Timer for IE 'Serving Grant'                                                              | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0248 |     | TEBS and HLBS Coding                                                                         | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060194 | 0249 | 1   | Correction related to automatic triggering of SI retransmissions                             | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0250 |     | Clarifications at TTI Change                                                                 | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0251 | 2   | MAC-es/e and MAC-hs reset procedure                                                          | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0254 |     | Enhanced Uplink Corrections                                                                  | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0255 |     | E-TFC Selection Pseudo Code Correction                                                       | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060088 | 0256 |     | Correction of MBMS-Id field (MAC header of MTCH)                                             | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0257 |     | E-DCH Serving Grant Update                                                                   | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060085 | 0258 |     | One PDU size per logical channel per TTI                                                     | 6.7.0 | 6.8.0 |
|                | RP-31 | RP-060098 | 0253 |     | 7.68 Mcps TDD Option (Release 7)                                                             | 6.8.0 | 7.0.0 |
| 06/2006        | RP-32 | RP-060352 | 0260 |     | Buffer Status for the Happy Bit and Scheduling Information Reporting                         | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060352 | 0262 |     | Serving RG and Scheduling Information                                                        | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060352 | 0264 |     | Definition of RG_step_size                                                                   | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060352 | 0266 |     | Correction to AG_Timer Start                                                                 | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060352 | 0268 |     | Miscellaneous corrections for E-DCH                                                          | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060353 | 0270 |     | Correction to Notification of SI transmission failure and variable resets                    | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060353 | 0272 |     | Correction to Handling at Start of E-DCH Transmission                                        | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060353 | 0274 |     | Additional inconsistent information on E-AGCH                                                | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060370 | 0276 |     | Clarifications on E-TFCI                                                                     | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060353 | 0282 |     | Transmission of SI if TEBS is zero                                                           | 7.0.0 | 7.1.0 |
|                | RP-32 | RP-060419 | 0284 | 1   | Serving_Grant and Unquantized E-DPDCH to DPCCH power ratios                                  | 7.0.0 | 7.1.0 |
| 09/2006        | RP-33 | RP-060625 | 0286 | 2   | Maximum number of transmissions                                                              | 7.1.0 | 7.2.0 |
|                | RP-33 | RP-060574 | 0289 |     | HLBS values in Scheduling Information message                                                | 7.1.0 | 7.2.0 |
|                | RP-33 | RP-060580 | 0290 | 1   | Note on Serving Grant Update with Zero Grant                                                 | 7.1.0 | 7.2.0 |
|                | RP-33 | RP-060586 | 0291 |     | Introduction of 3.84 Mcps and 7.68 Mcps TDD E-DCH                                            | 7.1.0 | 7.2.0 |

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|                | RP-33 | RP-060578 | 0293 |     | MAC-hs reset                                                                         | 7.1.0 | 7.2.0 |
| 12/2006        | RP-34 | RP-060716 | 0301 |     | Grant and MAC-e/es headers for E-DCH                                                 | 7.2.0 | 7.3.0 |
|                | RP-34 | RP-060716 | 0303 |     | Clarification to Maximum channelisation codes and E-TFC selection                    | 7.2.0 | 7.3.0 |
|                | RP-34 | RP-060716 | 0305 | 1   | Correction for E-DCH SG and compressed mode                                          | 7.2.0 | 7.3.0 |
|                | RP-34 | RP-060716 | 0307 |     | SG update procedure correction                                                       | 7.2.0 | 7.3.0 |
| 03/2007        | RP-35 | RP-070150 | 0310 |     | Modification of HS-DSCH TB size for LCR TDD                                          | 7.3.0 | 7.4.0 |
|                | RP-35 | RP-070163 | 0312 | 1   | Introduction of 64QAM in MAC specification                                           | 7.3.0 | 7.4.0 |
|                | RP-35 | RP-070157 | 0313 |     | Introduction of 1.28 Mcps TDD E-DCH                                                  | 7.3.0 | 7.4.0 |
|                | RP-35 | RP-070160 | 0314 |     | Editorial Corrections for 3.84/7.68 Mcps TDD E-DCH                                   | 7.3.0 | 7.4.0 |
|                | RP-35 | RP-070158 | 0315 |     | Introduction of DTX-DRX and HS-SCCH less in MAC                                      | 7.3.0 | 7.4.0 |
|                | RP-35 | RP-070161 | 0316 |     | Introducing MIMO in MAC specification                                                | 7.3.0 | 7.4.0 |
| 06/2007        | RP-36 | RP-070402 | 0311 | 2   | Introducing 16QAM uplink support                                                     | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070393 | 0317 | -   | 'Maximum_Serving_Grant' setting at TTI change                                        | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070405 | 0318 | 3   | Introduction of Improved L2 support for high data rates and Enhanced CELL_FACH state | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070407 | 0319 | -   | Removing an incomplete optimization for RLC operations during HSDPA cell change      | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070397 | 0321 | -   | Clarification for control of E-RUCCH transmission in LCR TDD                         | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070397 | 0322 | -   | Some Small Editorial Corrections to TS 25.321                                        | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070397 | 0323 | -   | Introduction of E-TFC Selection for 1.28Mcps TDD                                     | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070397 | 0324 | -   | Some clarifications related to E-DCH Scheduling Information in TDD mode              | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070393 | 0326 | -   | Clarification on calculation of 'Scheduled Grant Payload'                            | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070393 | 0327 | -   | Recommandation on RLC PDU size selection on E-DCH                                    | 7.4.0 | 7.5.0 |
|                | RP-36 | RP-070491 | 0329 |     | Clarifications on priority of requirements in E-TFC selection                        | 7.4.0 | 7.5.0 |
| 09/2007        | RP-37 | RP-070623 | 0333 |     | Correction on E-DCH compress mode                                                    | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070670 | 0337 |     | Correction to HS-DSCH transport block size table                                     | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070626 | 0338 |     | Correction to operation of SI field in reassembly entity                             | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0339 |     | MAC DTX timing start restrictions & compressed mode                                  | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0340 | 1   | Handling of long preambles in CPC                                                    | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0341 |     | L1 parameter name changes                                                            | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070670 | 0343 | 1   | Removing MIMO requirements from MAC-hs                                               | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070623 | 0345 |     | Serving grant 'HOLD'                                                                 | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070623 | 0347 |     | Correction to quantisation requirements in E-TFC selection                           | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070671 | 0348 |     | Periodic MAC-ehs reset and setting of the expected TSN                               | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070626 | 0349 |     | Enhanced L2 processing                                                               | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070626 | 0350 |     | Correction to MAC-ehs PDU definition                                                 | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070626 | 0351 | 1   | Defining of reordering SDU and correction to the definition of the SI field          | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0352 | 1   | Clarification on the HARQ procedure for HS-SCCH less operation                       | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0354 |     | Clarifications of CPC Grant Channel Monitoring                                       | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070627 | 0355 |     | Avoid unnecessarily decreasing UE DRX possibility                                    | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070629 | 0356 |     | Timing Advance Corrections for 3.84/7.68 Mcps TDD EDCH                               | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070631 | 0357 |     | 3.84/7.68 Mcps TDD EDCH: Sending Scheduling Information Periodically                 | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070670 | 0358 | 1   | Correction to HARQ operation in MIMO                                                 | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070670 | 0360 |     | Calculation of "Scheduled Grant Payload" in Rel-7                                    | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070650 | 0361 |     | Introduction of multi-frequency operation for 1.28Mcps TDD                           | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070636 | 0362 |     | Addition of an SI trigger when UE grant <= 0 and at least one process is activated   | 7.5.0 | 7.6.0 |
|                | RP-37 | RP-070623 | 0364 |     | Reference_ETPR definition alignment                                                  | 7.5.0 | 7.6.0 |
| 12/2007        | RP-38 | RP-070903 | 0365 |     | Introduction of an additional UE category for 1.28Mcps TDD E-DCH                     | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070903 | 0366 |     | Clarification on E-TFC selection for 1.28Mcps TDD                                    | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070903 | 0367 |     | Clarification of TEBS and HLBS in Scheduling Information for TDD mode                | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070938 | 0368 |     | Scheduled Grant setting in DTX Cycle 2 during CPC operation                          | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070901 | 0369 |     | Clarification on SG table for 16QAM                                                  | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070900 | 0370 |     | Correction to the UE behaviour when receiving RV=0                                   | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070905 | 0371 |     | Reassembly Unit                                                                      | 7.6.0 | 7.7.0 |
|                | RP-38 | RP-070911 | 0372 |     | Clarification on E-DPDCH power extrapolation/interpolation                           | 7.6.0 | 7.7.0 |
|                | RP-38 | -         | -    |     | Upgrade to the Release 8 - no technical change                                       | 7.7.0 | 8.0.0 |
| 03/2008        | RP-39 | RP-080189 | 0374 | -   | Inconsistency of MAC header when BCCH mapped to HS-DSCH                              | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080189 | 0376 | -   | Correction to the operation of the timer Treset                                      | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080203 | 0381 | -   | Correction of the EUL relative grant from non-serving cell                           | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080176 | 0384 | -   | Correction to UTRAN side MAC-e depiction                                             | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080190 | 0386 | -   | Support of octet aligned HS-DSCH transport block sizes for non-64QAM                 | 8.0.0 | 8.1.0 |



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|                | RP-39 | RP-080190 | 0388 | -   | transmission scheduling in MAC-ehs entity                                                                       | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080185 | 0390 | -   | Clarification of Scheduling Information Fields for TDD E-DCH                                                    | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080184 | 0392 | -   | Persistence scaling values and scheduling information for 3.84/7.68 Mcps TDD E-DCH                              | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080190 | 0394 | -   | Editorial corrections to MAC-ehs                                                                                | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080187 | 0396 | -   | Definition of Default-SG-in-DTX-Cycle-2                                                                         | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080202 | 0397 | -   | Introducing MAC-i/is                                                                                            | 8.0.0 | 8.1.0 |
|                | RP-39 | RP-080185 | 0399 | -   | Clarification of SI transmission priority over Non-scheduled MAC-e PDU                                          | 8.0.0 | 8.1.0 |
| 05/2008        | RP-40 | RP-080440 | 0400 | 2   | HS-SCCH orders for HS-SCCH-less operation                                                                       | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080400 | 0402 | -   | Correction on the Mapping of TRRI field and MSB/LSB for 1.28Mcps TDD EUL                                        | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080404 | 0404 | -   | Completion of the mechanism for Scheduling Information transmission on MAC-e PDU alone for 1.28 Mcps TDD in EUL | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080414 | 0405 | -   | Correction of a spelling error of E-TFC selection and addition of a missing figure                              | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080395 | 0407 | -   | Change of MAC-d flow definition for MAC-ehs                                                                     | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080400 | 0409 | 1   | Clarification of method in determining State of a E-TFC for TDD                                                 | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080397 | 0411 | -   | Modification of TBS tables and E-TFC selection for LCR TDD                                                      | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080398 | 0415 | -   | Clarification of the definition of PRRI for TDD                                                                 | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080400 | 0417 | -   | HARQ power offset selection during multiplexing of multiple MAC-d flows                                         | 8.1.0 | 8.2.0 |
|                | RP-40 | RP-080417 | 0418 | -   | Introduction of 64QAM in MAC for LCR TDD                                                                        | 8.1.0 | 8.2.0 |
| 09/2008        | RP-41 | RP-080677 | 0423 | -   | HSDPA TBS Table correction for LCR TDD                                                                          | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080682 | 0425 | -   | Ki restriction for FDD UE HS-DSCH categories 13 and 15                                                          | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080683 | 0427 | 1   | LCH-ID field structure and mapping to logical channel identity                                                  | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080679 | 0429 | -   | MAC-es/e RESET for LCR TDD                                                                                      | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080696 | 0430 | 1   | Introduction of Enhanced Uplink in CELL_FACH state and Idle mode in 25.321                                      | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080686 | 0432 | -   | TEBS definition update for MAC-i/is                                                                             | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080679 | 0434 | -   | Modification of TBS tables and E-TFC selection for LCR TDD                                                      | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080679 | 0436 | 1   | Triggers and transmission of Scheduling Information for LCR TDD                                                 | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080683 | 0438 | -   | Editorial correction to MAC-ehs entity UTRAN Side                                                               | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080679 | 0442 | 1   | Clarifications and Corrections of HARQ process for TDD                                                          | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080679 | 0444 | -   | Recommandation on RLC PDU size selection on E-DCH for TDD                                                       | 8.2.0 | 8.3.0 |
|                | RP-41 | RP-080685 | 0446 | 1   | The number of reordering PDUs belonging to the same reordering queue                                            | 8.2.0 | 8.3.0 |
| 12/2008        | RP-42 | RP-081002 | 0448 | -   | Removal of the reference to E-TFCI threshold                                                                    | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0449 | -   | Resource release after collision resolution failure                                                             | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081013 | 0450 | -   | Happy Bit Setting with Improved L2 for UL                                                                       | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081013 | 0451 | -   | Add MAC-i PDU in the description of HARQ entity                                                                 | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0452 | 1   | Replacement of E-AICH in 25.321                                                                                 | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081002 | 0454 | 2   | Correcting E-TFC minimum set behaviour when DCH is configured                                                   | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081024 | 0455 | -   | Introduction of additional UE categories for 1.28Mcps TDD 64QAM DL                                              | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081007 | 0457 | 1   | Clarification of E-RUCCH transmission in 25.321                                                                 | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0458 | -   | Correction to the segmentation status field                                                                     | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0459 | -   | HARQ feedback with Enhanced Uplink in Cell_FACH state                                                           | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0460 | -   | Clarification of common E-DCH resource usage in 25.321                                                          | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081001 | 0463 | 1   | UE restrictions on E-TFCIs                                                                                      | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081008 | 0465 | -   | Setting of NDI after MIMO to non-MIMO configuration                                                             | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081030 | 0467 | -   | Introduction of Dual Cell HSDPA operation                                                                       | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0468 | 1   | CRC attachment point for MAC-is when transmitting MAC-c PDU                                                     | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081025 | 0469 | -   | Introduction of the Enhanced CELL_FACH, CELL_PCH, URA_PCH state for 1.28 Mcps TDD                               | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0471 | -   | Clarification on SI transmission for CCCH in CELL_FACH state and idle mode                                      | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081022 | 0472 | -   | Correction to E-TFC selection in CELL_FACH                                                                      | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081013 | 0473 | -   | Extension of some procedures to MAC-i/is                                                                        | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081007 | 0475 | -   | Clarification of RX-TIMER reset in 25.321 for 1.28Mcps TDD                                                      | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081009 | 0476 | -   | Removal of sentence on RRC provisioning of configuration parameters to the UE for MAC-hs on UTRAN side.         | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081011 | 0477 | -   | Removal of sentence on RRC provisioning of configuration parameters to the UE for MAC-ehs on UTRAN side         | 8.3.0 | 8.4.0 |
|                | RP-42 | RP-081007 | 0478 | -   | Modification of E-RUCCH uplink sync transmission for 1.28Mcps TDD                                               | 8.3.0 | 8.4.0 |

NOTE: CR0413r1 to 25.321 v8.1.0 "Triggers and transmission of Scheduling Information for LCR TDD" was approved in RP-080443 at RAN #40 but it but could not be implemented in the specification as CR was based on an older specification version. See therefore CR0436r1 of RAN #41.

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## History

| <b>Document history</b> |              |             |
|-------------------------|--------------|-------------|
| V8.2.0                  | October 2008 | Publication |
| V8.3.0                  | October 2008 | Publication |
| V8.4.0                  | January 2009 | Publication |
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