ETSI TS 138 420 V17.1.0 (2022-07)

5G;
NG-RAN;
Xn general aspects and principles
(3GPP TS 38.420 version 17.1.0 Release 17)

Reference
RTS/TSGR-0338420vh10

Keywords
5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Contents

Foreword

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

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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document is an introduction to the TSG RAN TS 38.42x series of Technical Specifications that define the Xn interface. It is an interface for the interconnection of two NG-RAN nodes within the NG-RAN architecture (TS 38.401 [2]).

2 References

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

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

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.401: "NG-RAN; Architecture description".

[3] 3GPP TS 38.421: "NG-RAN; Xn layer 1".

[4] 3GPP TS 38.422: "NG-RAN; Xn signalling transport".

[5] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[6] 3GPP TS 38.424: "NG-RAN; Xn data transport".

[7] 3GPP TS 38.425: "NG-RAN; NR user plane protocol".

[8] 3GPP TS 38.300: "NR; Overall Description; Stage 2".

[9] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".

[10] 3GPP TS 38.415: "PDU Session User Plane protocol".

[11] 3GPP TS 29.281: "General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Boundary IAB-node: as defined in TS 38.401 [2].

corresponding node: as defined in TS 38.425 [7].

F1-terminating IAB-donor-CU: as defined in TS 38.401 [2].

IAB-DU: as defined in TS 38.300 [8].

IAB-MT: as defined in TS 38.300 [8].

Non-F1-terminating IAB-donor-CU: as defined in TS 38.401 [2].

NG-RAN node: as defined in TS 38.300 [8].

secondary node: as defined in TS 37.340 [9].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

IAB	Integrated Access and Backhaul
MBS	Multicast Broadcast Service
QMC	QoE Measurement Collection
QoE	Quality of Experience
SCTP	Stream Control Transmission Protocol
Xn-C	Xn Control plane
Xn-U	Xn User plane

4 General aspects

4.1 Introduction

The interface allowing to interconnect NG-RAN nodes with each other is referred to as the Xn interface.

4.2 Xn interface general principles

The general principles for the specification of the Xn interface are as follows:

- the Xn interface is open;
- the Xn interface supports the exchange of signalling information between two NG-RAN nodes, and the forwarding of PDUs to the respective tunnel endpoints;
- from a logical standpoint, the Xn is a point-to-point interface between two NG-RAN nodes. A point-to-point logical interface should be feasible even in the absence of a physical direct connection between the two NG-RAN nodes.

4.3 Xn interface specification objectives

The Xn interface specifications facilitate the following:

- inter-connection of NG-RAN nodes supplied by different manufacturers;
- support of continuation between NG-RAN nodes of the NG-RAN services offered via the NG interface;
- separation of Xn interface Radio Network functionality and Transport Network functionality to facilitate introduction of future technology.

4.4 Xn interface capabilities

The Xn interface supports:

- procedures to support intra-NG-RAN mobility;
- procedures to support dual connectivity between NG-RAN nodes.

5 Functions of the Xn interface

5.1 General

The following clauses describe the functions supported in Xn interface.

5.2 Functions of Xn-C

5.2.1 Xn-C interface management and error handling functions

5.2.1.1 General

These functions allow for managing of signalling associations between NG-RAN nodes, surveying the Xn interface and recovering from errors.

5.2.1.2 Xn Setup function

This function allows for the initial setup of an Xn interface between two NG-RAN nodes, including exchange of application level data.

5.2.1.3 Error Indication function

This function allows the reporting of general error situations on application level.

5.2.1.4 Xn reset function

This function allows an NG-RAN node to inform a second NG-RAN node that it has recovered from an abnormal failure and that either all or some of the contexts (except the application level data) related to the first node and stored in the second shall be deleted, and the associated resources released.

5.2.1.5 Xn configuration data update function

This function allows two NG-RAN nodes to update application level data at any time.

5.2.1.6 Xn removal function

This function allows two NG-RAN nodes to remove the respective Xn interface.

5.2.2 UE mobility management functions

5.2.2.1 Handover preparation function

This function allows the exchange of information between source and target NG-RAN nodes in order to initiate the handover of a certain UE to the target.

5.2.2.2 Handover cancellation function

This function allows informing an already prepared target NG-RAN node that a prepared handover will not take place. It allows releasing the resources allocated during a preparation.

5.2.2.3 Retrieve UE Context function

The Retrieve UE context function is used for a NG-RAN node to retrieve UE context from another one.

5.2.2.4 RAN Paging function

The RAN paging function allows a NG-RAN node to initiate the paging for a UE in the inactive state.

5.2.2.5 Data Forwarding control function

The data forwarding control function allows establishing and releasing transport bearers between source and target NG-RAN nodes for data forwarding.

5.2.2.6 Handover Success Indication Function

This function allows informing a source NG-RAN node that the UE has successfully accessed a target NG-RAN node.

5.2.2.7 Conditional Handover cancellation function

This function allows informing a source NG-RAN node that resources reserved for candidate target cell(s) during a conditional handover preparation are about to be released by the target NG-RAN node.

5.2.3 Dual connectivity function

The dual connectivity function enables usage of additional resources in a secondary node in the NG-RAN.

5.2.4 Energy saving function

This function enables decreasing energy consumption by indication of cell activation/deactivation over the Xn interface.

5.2.5 Resource coordination function

This function enables coordination of cell resource usage between two NG-RAN nodes.

5.2.6 Secondary RAT Data Volume Report function

This function enables the NG-RAN node to report Secondary RAT usage data information in case of MR-DC with 5GC, either with a dedicated procedure or by including Secondary RAT usage data information in other messages.

5.2.7 Trace function

The Trace function provides means to control trace sessions for a UE over Xn interface.

5.2.8 Load management function

This function allows exchanging resource status and traffic load information between NG-RAN nodes, such that the NG-RAN node can control the traffic load appropriately.

5.2.9 Data exchange for self-optimisation function

This function allows two NG-RAN nodes to exchange information in order to support self-optimization functionality.

5.2.10 IAB support function

5.2.10.1 F1-C Traffic Transfer function

This function is used to deliver F1-C traffic between the M-NG-RAN node and the S-NG-RAN node serving a dual-connected IAB-node, where the F1-C traffic is either received from the IAB-node or sent to the IAB-node.

5.2.10.2 IAB Transport Migration function

This function allows the exchange of information between the F1-terminating IAB-donor-CU and the non-F1-terminating IAB-donor-CU of a boundary IAB-node, for the purpose of managing the migration of the boundary and descendant IAB-node traffic between the topologies managed by the two IAB-donor-CUs.

5.2.10.3 IAB Resource Coordination function

This function is used to exchange information between the F1-terminating IAB-donor-CU and the non-F1-terminating IAB-donor-CU of a boundary IAB-node in order to support resource multiplexing between the IAB-MT and the IAB-DU of the boundary IAB-node.

5.2.11 Small data transmission function

5.2.11.1 General

This function supports small data transmission sessions in RRC_INACTIVE both with and without anchor relocation, in case the UE is served by a new NG-RAN node.

5.2.11.2 Partial UE Context Transfer function

The Partial UE Context Transfer function is used for the last serving NG-RAN node to provide part of the UE Context to the receiving gNB.

5.2.12 QMC support function

The QMC function provides means to support the mobility of QMC sessions over the Xn interface.

5.2.13 MBS management support function

This function is used to support the management of MBS Sessions, including the addition of MBS related information in interface management and mobility procedures, and the support of RAN Multicast paging.

5.3 Functions of Xn-U

5.3.1 Data transfer function

The data transfer function allows the transfer of data between NG-RAN nodes to support dual connectivity or mobility operation.

5.3.2 Flow control function

The flow control function enables a NG-RAN node receiving user plane data from a second NG-RAN node to provide feedback information associated with the data flow.

5.3.3 Assistance information function

The assistance information function enables a NG-RAN node receiving user plane data from a second NG-RAN node to provide assistance information to the second node (e.g. related to radio conditions).

5.3.4 Fast retransmission function

The fast retransmission function provides coordination between PDCP-hosting node and corresponding node in case of outage in one of the nodes, to enables the node in good RF conditions to handle data previously forwarded to the node in outage.

6 Xn interface procedures

6.1 General

The Xn interface supports procedures over the control plane (Xn-C) and user plane (Xn-U).

6.2 Control plane protocol procedures

6.2.1 Mobility management procedures

The mobility management procedures are used to manage the UE mobility in Connected or RRC_Inactive modes:

- Handover Preparation
- Handover Cancel
- SN Status Transfer
- Retrieve UE Context
- RAN Paging
- Xn-U Address Indication
- UE Context Release
- Handover Success Indication
- Conditional Handover Cancel
- Retrieve UE Context Confirm

6.2.2 Dual Connectivity procedures

The dual connectivity procedures are used to add, modify and releases resources for the operation of Dual Connectivity:

- S-NG-RAN-node Addition Preparation
- S-NG-RAN-node Reconfiguration Completion
- M-NG-RAN-node initiated S-NG-RAN-node Modification Preparation
- S-NG-RAN-node initiated S-NG-RAN-node Modification
- M-NG-RAN-node initiated S-NG-RAN-node Release
- S-NG-RAN-node initiated S-NG-RAN-node Release
- S-NG-RAN-node Counter Check
- RRC Transfer
- Notification Control Indication
- Activity Notification
- Secondary RAT Data Usage Report
- Conditional PSCell Change Cancel

6.2.3 Global procedures

The global procedures are used to exchange configuration level data between two NG-RAN nodes, or to remove Xn connectivity between two NG-RAN nodes in a controlled manner:

- Xn Setup
- NG-RAN-node Configuration Update
- Xn Removal

6.2.4 Interface Management procedures

The interface management procedures are used to align resources between two NG-RAN nodes in the event of failures, and to report detected protocol errors:

- Reset
- Error Indication

6.2.5 Energy saving procedures

- Cell Activation procedure: enables an NG-RAN node to request the activation of a previously deactivated cell hosted in another NG-RAN node.

6.2.6 Resource coordination procedures

- E-UTRA - NR Cell Resource Coordination procedure: enables an ng-eNB and a gNB to interact for resource coordination purposes.

6.2.7 UE Tracing procedures

The following procedures are used to trace the UE:

- Trace Start procedure
- Deactivate Trace procedure
- Cell Traffic Trace

6.2.8 Load management procedures

The load management procedures are used by NG-RAN nodes to indicate resource status, overload and traffic load to each other.

- Resource Status Reporting Initiation
- Resource Status Reporting

6.2.9 Data exchange for self-optimisation procedures

The data exchange for self-optimisation procedures are used to transfer failure and mobility related information among NG-RAN nodes to enable self-optimisation

- Failure Indication
- Handover report
- Mobility Settings Change
- Access and Mobility Indication

- SCG Failure Information Report
- SCG Failure Transfer

6.2.10 IAB procedures

The IAB procedures are used to enable the transfer of F1-C traffic for IAB, to exchange information between the F1-terminating IAB-donor-CU and the non-F1-terminating IAB-donor-CU of a boundary IAB-node, to enable the delivery of F1-C traffic between the M-NG-RAN node and the S-NG-RAN node serving a dual-connected non-boundary IAB-node, and to exchange resource multiplexing related information between the F1-terminating IAB-donor-CU and the non-F1-terminating IAB-donor-CU of a boundary IAB-node:

- F1-C Traffic Transfer
- IAB Transport Migration Management
- IAB Transport Migration Modification
- IAB Resource Coordination

6.2.11 MBS Management procedures

The MBS management procedures are used to manage the MBS Session:

- RAN Multicast Group Paging procedure

6.2.12 Small data transmission procedures

- Partial UE Context Transfer: enables exchange of information between NG-RAN nodes for SDT transmission without anchor relocation

Small data transmission is also supported by the following procedures:

- RRC Transfer
- Retrieve UE Context Confirm

6.2.13 QMC support procedures

The following procedures are used to transfer QMC configuration and session information to the target NG-RAN node during a UE's intra-system intra-RAT mobility:

- Handover Preparation
- Retrieve UE Context

6.3 User plane protocol procedures

The user plane protocol procedures are used to exchange user plane information between Xn-U protocol peers:

- Transfer of Downlink User Data procedure: enables the node hosting the NR PDCP entity to provide user plane information to the corresponding node.
- Downlink Data Delivery Status procedure: enables the corresponding node to provide feedback to the node hosting the NR PDCP entity.
- Transfer of Assistance Information: enables the corresponding node to provide assistance information to the node hosting the NR PDCP entity.
- Transfer of PDU Session Information procedure: enables an NG-RAN node to provide user plane information associated with the forwarding of data towards a peer NG-RAN node, when using PDU session tunnels.

7 Xn interface protocol structure

7.1 Xn Control Plane

The control plane protocol stack of the Xn interface is shown on Figure 7.1-1. The transport network layer is built on IP transport. For the reliable transport of signalling messages, SCTP is added on top of IP. The application layer signalling protocol is referred to as XnAP (Xn Application Protocol).

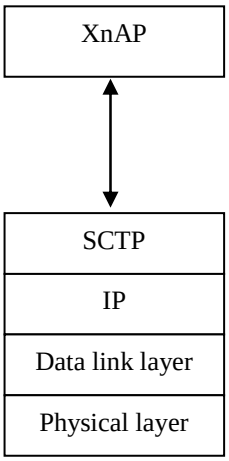

Figure 7.1-1: Xn Interface Control Plane

7.2 Xn User Plane

The Xn user plane (Xn-U) interface is defined between two NG-RAN nodes. The Xn-U interface provides non-guaranteed delivery of user plane PDUs between two NG-RAN nodes.

The protocol stack for Xn-U is shown in Figure 7.2-1.

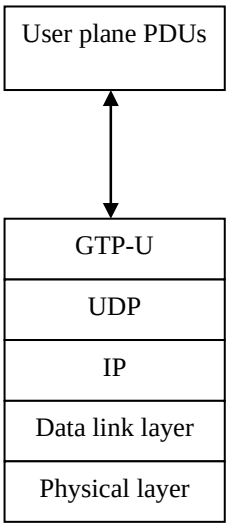

Figure 7.2-1: Xn-U protocol structure

The user plane packets conveyed by GTP-U may be PDCP PDUs (e.g. in case of dual connectivity), PDCP SDUs (e.g. in case of DRB level data forwarding), or SDAP SDUs (e.g. in PDU Session level data forwarding).

User plane protocol messages (as defined in TS 38.425 [7] and TS 38.415 [10]) are carried by container fields in the GTP-U extension header as specified in TS 29.281 [11]. A single GTP-U packet may carry a user plane packet and/or a

user plane protocol message. The mapping between container fields and Xn user plane protocol procedures and functions is described in Table 7.2-1.

Table 7.2-1: Mapping between container fields and Xn user plane procedures / functions

Xn-U Function	Container Type	Xn UP Protocol Procedure
Data transfer	NR RAN Container, as per TS 29.281 [11] (Note 1)	Transfer of Downlink User Data, TS 38.425 [7]
	PDU Session Container, as per TS 29.281 [11] (Note 2)	Transfer of DL PDU Session Information, TS 38.415 [10] Transfer of UL PDU Session Information, TS 38.415 [10]
	No container (Note 3)	NA
Flow control	NR RAN Container as per TS 29.281 [11] (Note 4)	Downlink Data Delivery Status, TS 38.425 [7] Transfer of Downlink User Data, TS 38.425 [7]
Fast retransmission	NR RAN Container as per TS 29.281 [11] (Note 4)	Downlink Data Delivery Status, TS 38.425 [7] Transfer of Downlink User Data, TS 38.425 [7]
Assistance information	NR RAN Container as per TS 29.281 [11] (Note 4)	Transfer of Assistance Information, TS 38.425 [7]

Note 1: optionally used in Dual Connectivity DL data transfer.
Note 2: in case of PDU Session level forwarding only.
Note 3: all other cases of data transfer when no other Xn-U functionality is required
Note 4: optionally used in Dual Connectivity

8 Other Xn interface specifications

8.1 NG-RAN Xn interface: Xn layer 1 (TS 38.421)

TS 38.421 [3] specifies the physical layer technologies that may be used to support the Xn interface.

8.2 NG-RAN Xn interface: Xn signalling transport (TS 38.422)

TS 38.422 [4] specifies how the XnAP signalling messages are transported over Xn.

8.3 NG-RAN Xn interface: Xn application protocol (XnAP) (TS 38.423)

TS 38.423 [5] specifies the radio network layer signalling procedures of the control plane between NG-RAN nodes.

8.4 NG-RAN Xn interface: Xn data transport (TS 38.424)

TS 38.424 [6] specifies the standards for user data transport protocols over the NG-RAN Xn interface.

8.5 NG-RAN Xn interface: NR user plane protocol (TS 38.425)

TS 38.425 [7] specifies the user plane protocol procedures for dual connectivity over the NG-RAN Xn interface.

8.6 NG-RAN Xn interface: PDU Session User Plane Protocol (TS 38.415)

TS 38.415 [10] specifies the user plane protocol procedures for data forwarding using PDU Session tunnels over the NG-RAN Xn interface.

8.7 Summary of NG-RAN Xn interface Technical Specifications

The relationship between the technical specifications that define the NG-RAN Xn interface is shown in Figure 8.7-1.

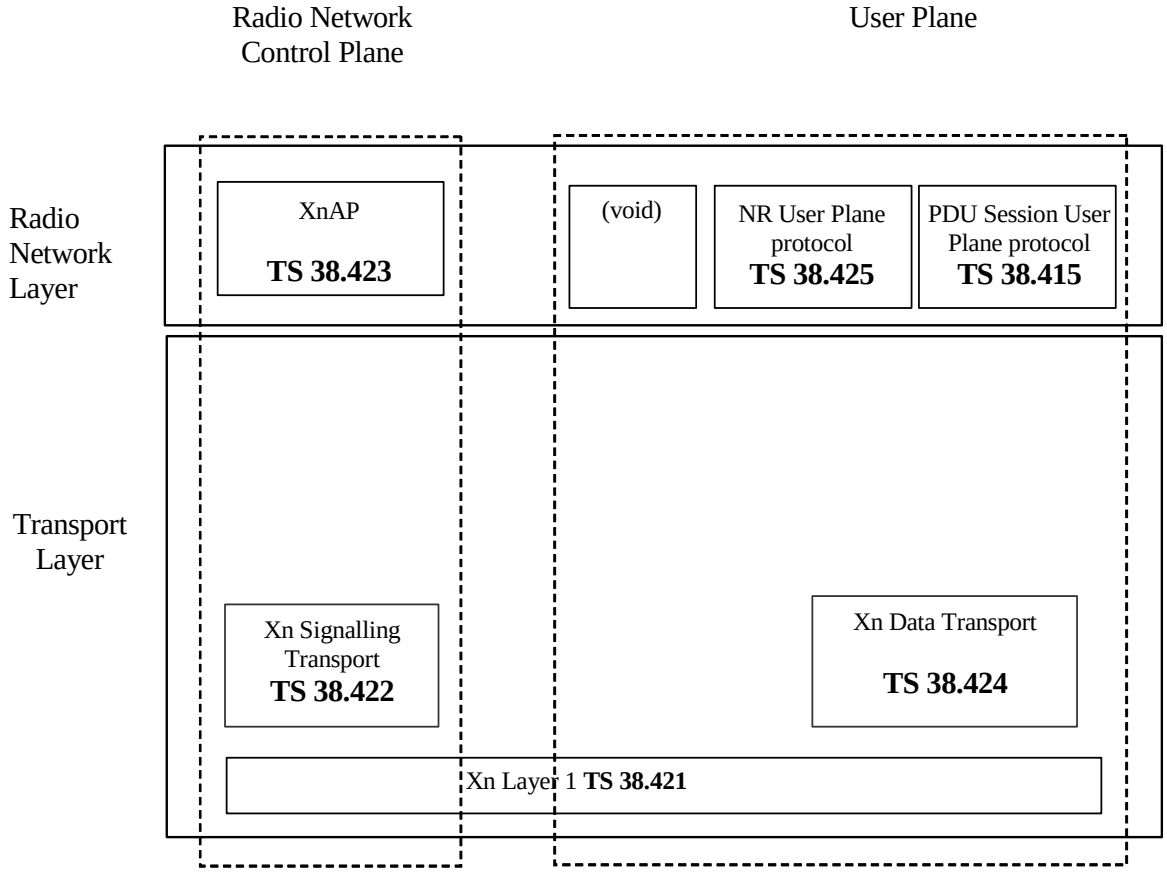

Figure 8.7-1: Xn Interface Technical Specifications

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-04	R3#95b	R3-171313				TS skeleton	0.0.1
2017-05	R3#96	R3-171807				Change of structure of clause 5	0.0.2
2017-05	R3#96	R3-171967				Further skeleton change following agreements at R3#96 Initial text for clauses 4, 7 and 8 (R3-171966) Functions from R3-171927 Add change history	0.1.0
2017-07	R3 NR AH	R3-172636				TP from R3-172596	0.2.0
2017-09	R3#97	R3-173453				TPs from R3-173320 and R3-173321	0.3.0
2017-10	R3#97bis	R3-174241				TP from R3-173636	0.4.0
2017-12	R3#98	R3-175057				TPs from R3-174451 and R3-174764	0.5.0
2018-02	R3 NR AH 1801	R3-180653				TP from R3-180543	0.6.0
2018-03	R3#99	R3-181590				TP from R3-181388	0.7.0
2018-04	R3#99bis	R3-182526				TP from R3-181866	0.8.0
2018-06	R3#100	R3-183595				TPs from R3-183098, R3-182719 and R3-183375	0.9.0
2018-06	RP#80	RP-180687				Presentation to RAN for one step approval	1.0.0
2018-06	RAN#80	-	-	-	-	Specification approved at TSG-RAN and placed under change control	15.0.0
2018-09	RAN#81	RP-181922	0001	2	F	NR Corrections (38.420 Baseline CR covering RAN3-101 agreements)	15.1.0
2018-12	RAN#82	RP-182446	0004	1	F	Rapporteur's CR for TS 38.420	15.2.0
2018-12	RAN#82	RP-182447	0006	-	B	Introduction of Data Volume Reporting for MR-DC	15.2.0
2018-12	RAN#82	RP-182447	0007	-	F	Rename the Data Forwarding Address Indication procedure	15.2.0
2020-07	RAN#88-e	RP-201075	0008	8	B	Baseline CR for introducing Rel-16 NR mobility enhancement	16.0.0
2020-07	RAN#88-e	RP-201082	0018	3	B	BLCR to 38.420: Addition of MDT feature	16.0.0
2020-07	RAN#88-e	RP-201082	0019	3	B	BLCR to 38.420: Addition of SON feature	16.0.0
2022-03	RAN#95-e	RP-220222	0020	7	B	CR on CP-UP separation for Rel-17 IAB	17.0.0
2022-03	RAN#95-e	RP-220224	0022	3	B	BL CR to TS38.420	17.0.0
2022-03	RAN#95-e	RP-220218	0023	2	B	CPAC BL CR to TS 38.420	17.0.0
2022-03	RAN#95-e	RP-220233	0024	2	B	RA-SDT BLCR to TS 38.420	17.0.0
2022-03	RAN#95-e	RP-220236	0025	1	B	Addition of the Retrieve UE Context Confirm procedure [InterMNResume]	17.0.0
2022-03	RAN#95-e	RP-220229	0026	-	B	BLCR to 38.420: Support of QoE Measurement Collection for NR	17.0.0
2022-06	RAN#96	RP-221141	0027	-	F	Alignment with rel-17 changes in XnAP	17.1.0
2022-06	RAN#96	RP-221134	0028	1	F	Alignment with rel-17 changes in XnAP	17.1.0
2022-06	RAN#96	RP-221136	0029	-	F	Alignment with rel-17 changes in XnAP	17.1.0
2022-06	RAN#96	RP-221128	0030	1	F	IAB Rel-17 Corrections	17.1.0
2022-06	RAN#96	RP-221143	0031	-	F	QoE Rel-17 Corrections	17.1.0

History

Document history		
V17.0.0	May 2022	Publication
V17.1.0	July 2022	Publication