ETSI TS 138 470 V15.6.0 (2019-07)

5G;
NG-RAN;
F1 general aspects and principles
(3GPP TS 38.470 version 15.6.0 Release 15)

Reference
RTS/TSGR-0338470vf60

Keywords
5G

ETSI

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Contents

Foreword

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1 Scope

The present document is an introduction to the 3GPP TS 38.47x series of technical specifications that define the F1 interface. The F1 interface provides means for interconnecting a gNB-CU and a gNB-DU of a gNB within an NG-RAN, or for interconnecting a gNB-CU and a gNB-DU of an en-gNB within an E-UTRAN.

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 38.471: "NG-RAN; F1 layer 1".

[4] 3GPP TS 38.472: "NG-RAN; F1 signalling transport".

[5] 3GPP TS 38.473: "NG-RAN; F1 Application Protocol (FnAP)".

[6] 3GPP TS 38.474: "NG-RAN; F1 data transport".

[7] 3GPP TS 38.425: "NG-RAN; Xn interface 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 38.321: "NR; Medium Access Control (MAC) protocol specification".

[11] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

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].

en-gNB: as defined in TS 37.340 [9]

gNB-CU: as defined in TS 38.401 [2]

gNB-DU: as defined in TS 38.401 [2]

gNB: as defined in TS 38.300 [8]

3.3 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].

DRB	Data Radio Bearers
F1-U	F1 User plane interface
F1-C	F1 Control plane interface
F1AP	F1 Application Protocol
GTP-U	GPRS Tunnelling Protocol
IP	Internet Protocol
NR-MIB	NR-Master Information Block
O&M	Operation and Maintenance
PA	Paging Area
PF	Paging Frame
PO	Paging Occasion
QoS	Quality of Service
RRC	Radio Resource Control
SCTP	Stream Control Transmission Protocol
SRB	Signalling Radio Bearers
SIB1	System Information Block 1
TNL	Transport Network Layer

4 General aspects

This clause captures the F1 interface principles and characteristics.

4.1 F1 interface general principles

The general principles for the specification of the F1 interface are as follows:

- the F1 interface is open;
- the F1 interface supports the exchange of signalling information between the endpoints, in addition the interface supports data transmission to the respective endpoints;
- from a logical standpoint, the F1 is a point-to-point interface between the endpoints.

NOTE: A point-to-point logical interface should be feasible even in the absence of a physical direct connection between the endpoints.

- the F1 interface supports control plane and user plane separation;
- the F1 interface separates Radio Network Layer and Transport Network Layer;
- the F1 interface enables exchange of UE associated information and non-UE associated information;
- the F1 interface is designed in a future proof way to fulfil different new requirements, support new services and new functions;
- one gNB-CU and a set of gNB-DUs are visible to other logical nodes as a gNB or an en-gNB where the gNB terminates the Xn and the NG interfaces, and the en-gNB terminates the X2 and the S1-U interfaces;
- the gNB-CU may be separated in control plane (CP) and user plane (UP).

4.2 F1 interface specification objectives

The F1 interface specifications facilitate the following:

- inter-connection of a gNB-CU and a gNB-DU supplied by different manufacturers.

4.3 F1 interface capabilities

The F1 interface supports:

- procedures to establish, maintain and release radio bearers for the NG-RAN part of PDU sessions and for E-UTRAN Radio Access Bearers;
- the separation of each UE on the protocol level for user specific signalling management;- the transfer of RRC signalling messages between the UE and the gNB-CU.

4.4 Void

5 Functions of the F1 interface

5.1 General

The following clauses describe the functions supported over F1-C and F1-U.

5.2 F1-C functions

5.2.1 F1 interface management function

The error indication function is used by the gNB-DU or gNB-CU to indicate to the gNB-CU or gNB-DU that an error has occurred.

The reset function is used to initialize the peer entity after node setup and after a failure event occurred. This procedure can be used by both the gNB-DU and the gNB-CU.

The F1 setup function allows to exchange application level data needed for the gNB-DU and gNB-CU to interoperate correctly on the F1 interface. The F1 setup is initiated by the gNB-DU.

The gNB-CU Configuration Update and gNB-DU Configuration Update functions allow to update application level configuration data needed between gNB-CU and gNB-DU to interoperate correctly over the F1 interface, and may activate or deactivate cells. With the gNB-CU Configuration Update function, energy saving with cell activation/deactivation can be supported as defined in TS 38.300 [8].

The F1 setup and gNB-DU Configuration Update functions allow to inform the S-NSSAI(s) supported by the gNB-DU.

The F1 resource coordination function is used to transfer information about frequency resource sharing between gNB-CU and gNB-DU.

The gNB-DU status indication function allows the gNB-DU to indicate overload status to gNB-CU.

5.2.2 System Information management function

Scheduling of system broadcast information is carried out in the gNB-DU. The gNB-DU is responsible for transmitting the system information according to the scheduling parameters available.

The gNB-DU is responsible for the encoding of NR-MIB. In case broadcast of SIB1 and other SI messages is needed, the gNB-DU is responsible for the encoding of SIB1 and the gNB-CU is responsible for the encoding of other SI messages. The gNB-DU may re-encode SIB9.

To support Msg3 based on-demand SI as described in TS 38.331 [11], the gNB-CU can confirm the received SI request from the UE by including the UE identity, and command the gNB-DU to broadcast the requested other SIs.

5.2.3 F1 UE context management function

The F1 UE context management function supports the establishment and modification of the necessary overall UE context.

The establishment of the F1 UE context is initiated by the gNB-CU and accepted or rejected by the gNB-DU based on admission control criteria (e.g., resource not available).

The modification of the F1 UE context can be initiated by either gNB-CU or gNB-DU. The receiving node can accept or reject the modification. The F1 UE context management function also supports the release of the context previously established in the gNB-DU. The release of the context is triggered by the gNB-CU either directly or following a request received from the gNB-DU. The gNB-CU request the gNB-DU to release the UE Context when the UE enters RRC_IDLE or RRC_INACTIVE.

This function can be also used to manage DRBs and SRBs, i.e., establishing, modifying and releasing DRB and SRB resources. The establishment and modification of DRB resources are triggered by the gNB-CU and accepted/rejected by the gNB-DU based on resource reservation information and QoS information to be provided to the gNB-DU. For each DRB to be setup or modified, the S-NSSAI may be provided by gNB-CU to the gNB-DU in the UE Context Setup procedure and the UE Context Modification procedure.

The mapping between QoS flows and radio bearers is performed by gNB-CU and the granularity of bearer related management over F1 is radio bearer level. For NG-RAN, the gNB-CU decides an aggregated DRB QoS profile for each radio bearer based on received QoS flow profile, and provides both aggregated DRB QoS profile and QoS flow profile to the gNB-DU, and the gNB-DU either accepts the request or rejects it with appropriate cause value. With this function, gNB-DU could also notify gNB-CU whether the QoS for already established DRBs is not fulfilled any longer or it is fulfilled again. To support packet duplication for intra-gNB-DU CA as described in TS 38.300 [8], one data radio bearer should be configured with two GTP-U tunnels between gNB-CU and a gNB-DU.

With this function, gNB-CU requests the gNB-DU to setup or change of the SpCell (as defined in TS 38.321 [10]) for the UE, and the gNB-DU either accepts or rejects the request with appropriate cause value.

With this function, the gNB-CU requests the setup of the SCell(s) at the gNB-DU side, and the gNB-DU accepts all, some or none of the SCell(s) and replies to the gNB-CU. The gNB-CU requests the removal of the SCell(s) for the UE.

With this function, the gNB-CU indicates the UL UE AMBR limit to the gNB-DU, and the gNB-DU enforces the indicated limit.

With this function, the gNB-DU indicates that a bearer, or a UE is inactive or active. The gNB-CU consolidates all the serving gNB-DUs for the UE and takes further action.

5.2.4 RRC message transfer function

This function allows to transfer RRC messages between gNB-CU and gNB-DU. RRC messages are transferred over F1-C. The gNB-CU is responsible for the encoding of the dedicated RRC message with assistance information provided by gNB-DU. This function also allows gNB-DU to report to gNB- CU if the downlink RRC message has been successfully delivered to UE or not.

5.2.5 Paging function

The gNB-DU is responsible for transmitting the paging information according to the scheduling parameters provided.

The gNB-CU provides paging information to enable the gNB-DU to calculate the exact PO and PF. The gNB-CU determines the PA. The gNB-DU consolidates all the paging records for a particular PO, PF and PA, and encodes the final RRC message and broadcasts the paging message on the respective PO, PF in the PA.

5.2.6 Warning messages information transfer function

This function allows to cooperate with the warning message transmission procedures over NG interface. The gNB-CU is responsible for encoding the warning related SI message and sending it together with other warning related information for the gNB-DU to broadcast over the radio interface.

5.3 F1-U functions

5.3.1 Transfer of user data

This function allows to transfer of user data between gNB-CU and gNB-DU.

5.3.2 Flow control function

This function allows to control the downlink user data flow to the gNB-DU. The detailed protocol is specified in TS 38.425 [7].

5.4 TEIDs allocation

The gNB-DU is responsible for the allocation of the F1-U DL GTP TEID for each data radio bearer.

6 Procedures of the F1 interface

6.1 Control plane procedures

6.1.1 Interface Management procedures

The F1 Interface management procedures are listed below:

- Reset procedure
- Error Indication procedure
- F1 Setup procedure
- gNB-DU Configuration Update procedure
- gNB-CU Configuration Update procedure
- gNB-DU Resource Coordination procedure
- gNB-DU Status Indication procedure

6.1.2 Context Management procedures

The F1 Context management procedures are listed below:

- UE Context setup procedure
- UE Context Release Request (gNB-DU initiated) procedure
- UE Context Release (gNB-CU initiated) procedure
- UE Context Modification (gNB-CU initiated) procedure
- UE Context Modification Required (gNB-DU initiated) procedure
- UE Inactivity Notification Procedure
- Notify procedure

6.1.3 RRC Message Transfer procedures

The F1 RRC message transfer procedures are listed below:

- Initial UL RRC Message Transfer procedure
- UL RRC Message Transfer procedure
- DL RRC Message Transfer procedure
- RRC Delivery Report procedure

6.1.3A Warning Message Transmission procedures

The F1 Warning message transmission procedures are listed below:

- Write-Replace Warning procedure
- PWS Cancel procedure
- PWS Restart Indication procedure
- PWS Failure Indication procedure

6.1.4 System Information procedures

The F1 System information procedures are listed below:

- System Information Delivery procedure

6.1.5 Paging procedures

The F1 Paging procedures are listed below:

- Paging procedure

6.1.6 Void

6.2 User plane procedures

7 F1 interface protocol structure

7.1 F1 Control Plane Protocol (F1-C)

Figure 7.1-1 shows the protocol structure for F1-C. The TNL is based on IP transport, comprising the SCTP on top of IP. The application layer signalling protocol is referred to as F1AP (F1 Application Protocol).

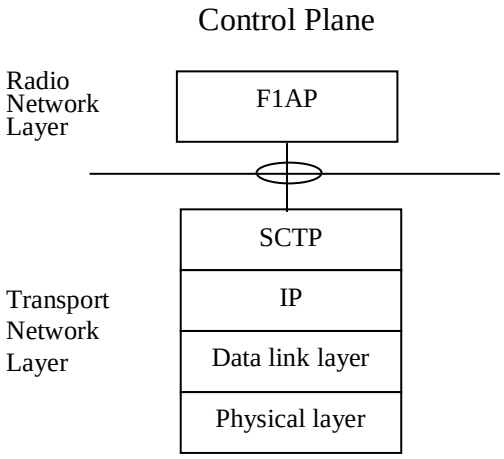

Figure 7.1-1: Interface protocol structure for F1-C

7.2 F1 User Plane Protocol (F1-U)

Figure 7.2-1 shows the protocol structure for F1-U. The TNL is based on IP transport, comprising the UDP and GTP-U on top of IP.

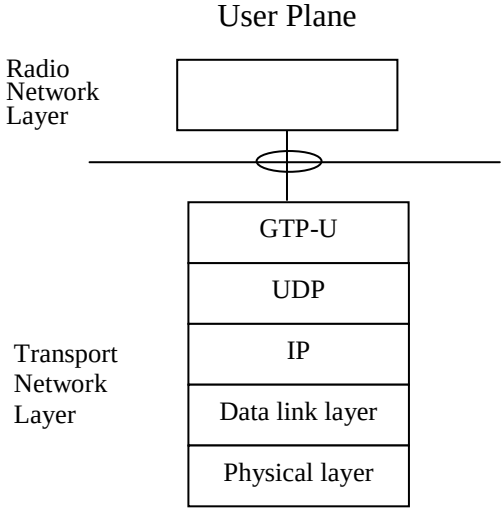

Figure 7.2-1: Interface protocol structure for F1-U

8 Other F1 interface specifications

This clause contains the description of the other related 3GPP specifications.

8.1 NG-RAN F1 interface: layer 1 (3GPP TS 38.471)

3GPP TS 38.471 [3] specifies the physical layer technologies that may be used to support the F1 interface.

8.2 NG-RAN F1 interface: signalling transport (3GPP TS 38.472)

3GPP TS 38.472 [4] specifies the signalling bearers for the F1AP for the F1-C interface.

8.3 NG-RAN F1 interface: F1AP specification (3GPP TS 38.473)

3GPP TS 38.473 [5] specifies the F1AP protocol for radio network control plane signalling over the F1 interface.

8.4 NG-RAN F1 interface: data transport and transport signalling (3GPP TS 38.474)

3GPP TS 38.474 [6] specifies the transport bearers for the user plane of the F1-U interface.

8.5 NG-RAN F1 interface: user plane protocol (3GPP TS 38.425)

3GPP TS 38.425 [7] specifies the user plane protocol being used over the F1-U interface.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-06	R3 NR#2	R3-172492	-	-	-	First version	0.1.0
2017-07	R3 NR#2	R3-172639	-	-	-	Incorporated agreed TPs from R3 NR#2 Adhoc	0.2.0
2017-08	R3#97	R3-173450	-	-	-	Incorporated agreed TPs from R3#97	0.3.0
2017-10	R3#97b	R3-174244	-	-	-	Incorporated agreed TPs from R3#97b	0.4.0
2017-10	R3#97b	R3-174259				Merged text from TS 38.401 v040	0.4.1
2017-12	R3#98	R3-175060				Incorporated agreed TPs from R3#98	0.5.0
2017-12	RAN#78	RP-172286				Submitted for approval to RAN	1.0.0
2018-01	RP-78					TS approved by RAN plenary	15.0.0
2018-03	RP-79	RP-180468	0002	-	F	UE Context Management Procedure Related with EN-DC Operation - Stage 2	15.1.0
2018-03	RP-79	RP-180468	0006	-	B	Correction of packet duplication	15.1.0
2018-03	RP-79	RP-180468	0007	1	B	SCell management	15.1.0
2018-06	RP-80	RP-181237	0003	6	B	Introduction of SA NR (38.470 Baseline CR covering RAN3 agreements)	15.2.0
2018-06	RP-80	RP-181238	0008	3	F	Adding new F1 procedure for UE Inactivity Notification	15.2.0
2018-06	RP-80	RP-181237	0010	-	B	Introduction of LTE-NR coexistence function	15.2.0
2018-09	RP-81	RP-181922	0011	3	F	NR Corrections (38.470 Baseline CR covering RAN3-101 agreements)	15.3.0
2018-12	RP-82	RP-182446	0015	1	F	F1 Load Management	15.4.0
2018-12	RP-82	RP-182446	0016	-	F	Alignment with stage3	15.4.0
2018-12	RP-82	RP-182446	0018	2	F	CR to 38.470 on the introduction of RRC Delivery Report procedure	15.4.0
2018-12	RP-82	RP-182448	0019	-	F	Rapporteur CR to 38.470	15.4.0
2019-03	RP-83	RP-190556	0023	1		Energy Saving Support over F1 Interface	15.5.0
2019-07	RP-84	RP-191396	0034	1	F	Rapporteur updates	15.6.0
2019-07	RP-84	RP-191396	0036	1	F	Encoding of SIB9 in the gNB-DU	15.6.0

History

Document history		
V15.2.0	July 2018	Publication
V15.3.0	September 2018	Publication
V15.4.0	April 2019	Publication
V15.5.0	May 2019	Publication
V15.6.0	July 2019	Publication