3GPP TSG-RAN WG3 Meeting #115-e R3-222585

**Online, 21th February - 3rd March 2022 was R3-222060**

Agenda Item: 22.2.4

Source: Ericsson

Title: [TP for BL CR 38.401] Multicast and Broadcast F1 and E1 stage 2

Document for: Discussions & Approval

# 1 Introduction

This TP follows the common understanding to apply on F1 the same principles for broadcast and multicast as on NG.

TPs for E1 and F1 can be found in R3-222062 (F1) and R3-222061 (E1).

The following principles have been followed:

- separate sets of procedures for multicast and broadcast

- for broadcast,

- the setup of shared F1-U and NG-U tunnels is preformed by the same procedure that established/modifies the broadcast context at the DU/gNB, E1 follows accordingly.

- In case of multiple F1-U/NG-U tunnels (e.g. location dependent sessions), the broadcast context procedures are able to establish all F1-U/NG-U bearers with a single context procedure.

- for multicast,

- the setup of shared F1-U and NG-U tunnels is performed by a DU/gNB triggered “distribution” procedure.

- In case of multiple F1-U/NG-U tunnels (e.g. location dependent sessions), only a single F1-U/NG-U tunnel is established by means of those “distribution” procedures.

- in case of shared NG-U terminations,

- the 5GC may provide information about one or several already established NG-U termination that can be shared among gNBs. In return, gNBs may offer NG-U terminations to be shared. This has impact on E1

- alternatively, the gNB-CU-UP may provide information for which TMGIs pre-configured NG-U terminations are available to be used.

- the MBS QoS Flow to MRB mapping proposed by the gNB-CU-CP may be overwritten by the gNB-CU-UP in case an NG-U termination is already existing, if the gNB-CU-CP allows it.

# 2 Text Proposal for TS 38.401

***--------------------------------Start of the First Change-----------------------------***

# 2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[3] 3GPP TS 23.501: "System Architecture for the 5G System".

[4] 3GPP TS 38.473: "NG-RAN; F1 application protocol (F1AP)".

[5] 3GPP TS 38.414: "NG-RAN; NG data transport".

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

[7] 3GPP TS 38.474: "NG-RAN; F1 data transport".

[8] ITU-T Recommendation G.823 (2000-03): "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[9] ITU-T Recommendation G.824 (2000-03): "The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy".

[10] ITU-T Recommendation G.825 (2001-08): "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".

[11] ITU-T Recommendation G.8261/Y.1361 (2008-04): "Timing and Synchronization aspects in Packet networks".

[12] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".

[13] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[14] 3GPP TS 38.410: "NG-RAN; NG general aspect and principles".

[15] 3GPP TS 38.420: "NG-RAN; Xn general aspects and principles"

[16] 3GPP TS 38.470: "NG-RAN; F1 general aspects and principles".

[17] 3GPP TS 38.460: "NG-RAN; E1 general aspects and principles".

[18] 3GPP TS 33.210: "3G security; Network Domain Security (NDS); IP Network Layer Security".

[19] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA), Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[20] 3GPP TS 32.422: "Trace control and configuration management".

[21] 3GPP TS 37.470: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN) and NG-RAN; W1 general aspects and principles; Stage-2".

[22] 3GPP TS 38.340: "NR; Backhaul Adaptation Protocol (BAP) specification".

[23] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[24] 3GPP TS 38.425: "NG-RAN; NR user plane Protocol".

[25] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[26] 3GPP TS 38.472: "NG-RAN; F1 signalling transport".

# [xx] 3GPP TS 23.247: " Architectural enhancements for 5G multicast-broadcast services; Stage 2".3 Definitions and abbreviations

## 3.1 Definitions

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

**Associated QoS Flow:** as defined in TS 23.247 [xx].

**Associated QoS flow information:** Information encompassing: QoS flow QoS parameters for associated QoS flows and mapping information between mapped (unicast) QoS flows and associated QoS flows. The respective information is included in a way that non-supporting RAN nodes would not establish respective RAN resources irrespective the multicast session state.

**Conditional Handover:** as defined in TS 38.300 [2].

**Conditional PSCell Change:** as defined in TS 37.340 [12].

**DAPS Handover:** as defined in TS 38.300 [2].

**en-gNB**: as defined in TS 37.340 [12].

**Early Data Forwarding**: as defined in TS 38.300 [2].

**gNB:** as defined in TS 38.300 [2].

**gNB Central Unit (gNB-CU):** a logical node hosting RRC, SDAP and PDCP protocols of the gNB or RRC and PDCP protocols of the en-gNB that controls the operation of one or more gNB-DUs. The gNB-CU terminates the F1 interface connected with the gNB-DU.

**gNB Distributed Unit (gNB-DU):** a logical node hosting RLC, MAC and PHY layers of the gNB or en-gNB, and its operation is partly controlled by gNB-CU. One gNB-DU supports one or multiple cells. One cell is supported by only one gNB-DU. The gNB-DU terminates the F1 interface connected with the gNB-CU.

**gNB-CU-Control Plane (gNB-CU-CP):** a logical node hosting the RRC and the control plane part of the PDCP protocol of the gNB-CU for an en-gNB or a gNB. The gNB-CU-CP terminates the E1 interface connected with the gNB-CU-UP and the F1-C interface connected with the gNB-DU.

**gNB-CU-User Plane (gNB-CU-UP):** a logical node hosting the user plane part of the PDCP protocol of the gNB-CU for an en-gNB, and the user plane part of the PDCP protocol and the SDAP protocol of the gNB-CU for a gNB. The gNB-CU-UP terminates the E1 interface connected with the gNB-CU-CP and the F1-U interface connected with the gNB-DU.

**IAB-node**: as defined in TS 38.300 [2].

**IAB-donor**:as defined in TS 38.300 [2].

**IAB-donor-CU**: the gNB-CU of an IAB-donor, terminating the F1 interface towards IAB-nodes and IAB-donor-DU.

**IAB-donor-DU**: the gNB-DU of an IAB-donor, hosting the IAB BAP sublayer (as defined in TS 38.340 [22]), providing wireless backhaul to IAB-nodes.

**IAB-DU**: as defined in TS 38.300 [2].

**IAB-MT**: as defined in TS 38.300 [2].

**Mapped QoS flows:** Unicast QoS flows requested to be established, i.e. included in the legacy QoS flow lists in a way, that non-support RAN nodes would attempt to establish unicast QoS flows and supporting RAN nodes can identify them as mapped QoS flows based on the associated QoS information.

**ng-eNB:** as defined in TS 38.300 [2].

**ng-eNB Central Unit (ng-eNB-CU):** as defined in TS 37.470 [21].

**ng-eNB Distributed Unit (ng-eNB-DU):** as defined in TS 37.470 [21].

**NG-RAN node:** as defined in TS 38.300 [2].

**PDU Session Resource**: This term is used for specification of NG, Xn, and E1 interfaces. It denotes NG-RAN interface and radio resources provided to support a PDU Session.

**Public Network Integrated NPN:** as defined in TS 23.501 [3].

**Stand-alone Non-Public Network:** as defined in TS 23.501 [3].

## 3.2 Abbreviations

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

5GC 5G Core Network

AMF Access and Mobility Management Function

AP Application Protocol

AS Access Stratum

BH Backhaul

CAG Closed Access Group

CHO Conditional Handover

CLI Cross-Link Interference

CM Connection Management

CMAS Commercial Mobile Alert Service

DAPS Dual Active Protocol Stack

ETWS Earthquake and Tsunami Warning System

F1-U F1 User plane interface

F1-C F1 Control plane interface

F1AP F1 Application Protocol

FDD Frequency Division Duplex

GTP-U GPRS Tunnelling Protocol

IAB Integrated Access and Backhaul

IP Internet Protocol

MBS Multicast Broadcast Service

NAS Non-Access Stratum

NID Network identifier

NPN Non-Public Network

PNI-NPN Public Network Integrated Non-Public Network

PTP Point to Point

PTM Point to Multipoint

O&M Operation and Maintenance

PWS Public Warning System

QoS Quality of Service

RET Remote Electrical Tilting

RIM Remote Interference Management

RIM-RS Remote Interference Management Reference Signal

RNL Radio Network Layer

RRC Radio Resource Control

SAP Service Access Point

SCTP Stream Control Transmission Protocol

SFN System Frame Number

SM Session Management

SMF Session Management Function

SNPN Stand-alone Non-Public Network

TDD Time Division Duplex

TDM Time Division Multiplexing

TMA Tower Mounted Amplifier

TNL Transport Network Layer

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## 6.1 Overview

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### 6.1.x Overall Architecture of NR MBS

The overall architecture specified in section 6.1.1 and 6.1.2 applies for NR MBS.

Editor’s Note: Applicability of specified cardinalities may need to be revisited.

Upon establishment of a MBS Session resource by the 5GC, the gNB-CU triggers the establishment of MBS radio bearers, involving the gNB-DU. If E1 is deployed, the gNB-CU-CP triggers establishment of respective MBS UP resources in the gNB-CU-UP.

The gNB-DU assigns the G-RNTI.

A shared F1-U tunnel is used between the gNB-CU and the gNB-DU for PTM transmission of a MBS radio bearer, and for the data transmission of a split MBS radio bearer. The gNB-DU assigns the DL GTP-U TEID and provides it to the gNB-CU. If E1 is deployed the gNB-CU-CP forwards it to the gNB-CU-UP.

Editor’s Note: It is FFS whether the F1-U tunnel for the PTM transmission is established per DU or per cell. The definition and usage of the term “PTM” is FFS. Also, the definition of the term “MBS radio bearer” is FFS.

Editor’s Note: for the split MBS radio bearer with common PDCP, the statement may be re-visited after further progress in RAN2 and RAN3 on the data re-transmission and forwarding.

For both broadcast and multicast, DL flow control maybe used for the shared F1-U tunnel established for the MBS radio bearer, as specified in TS 38.425 [24].

Editor’s Note: existing NR user plane protocol functions need to be reviewed for their applicability for MBS.

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## 6.4 UE associations in NG-RAN Node

There are several types of UE associations needed in the NG-RAN node: the "NG-RAN node UE context" used to store all information needed for a UE and the associations between the UE and the logical NG and Xn connections used for NG/XnAP UE associated messages. An "NG-RAN node UE context" exists for a UE in CM\_CONNECTED.

**Definitions:**

**NG-RAN node UE context:**

An NG-RAN node UE context is a block of information in an NG-RAN node associated to one UE. The block of information contains the necessary information required to maintain the NG-RAN services towards the active UE. An NG-RAN node UE context is established when the transition to RRC CONNECTED for a UE is completed or in the target NG-RAN node after completion of handover resource allocation during handover preparation, in which case at least UE state information, security information, UE capability information and the identities of the UE-associated logical NG-connection shall be included in the NG-RAN node UE context.

For Dual Connectivity an NG-RAN node UE context is also established in the S-NG-RAN node after completion of S-NG-RAN node Addition Preparation procedure.

If radio bearers are requested to be setup during a UE Context setup or modification procedure, the UE capabilities are signalled to the receiving node as part of the UE context setup or modification procedures.

**Bearer context:**

A bearer context is a block of information in a gNB-CU-UP node associated to one UE that is used for the sake of communication over the E1 interface. It may include the information about data radio bearers, PDU sessions and QoS-flows associated to the UE. The block of information contains the necessary information required to maintain user-plane services toward the UE.

**MBS Session context in a gNB-DU:**

The definition of an MBS Session context in a gNB-DU applicable for broadcast and multicast.

An MBS Session context in a gNB-DU

- is a block of information associated to an MBS Session, which may consist of one or several MRB Contexts;

- corresponds to either one or several F1-U tunnels.

**MRB Context in a gNB-DU:**

An MRB Context is a block of information in a gNB-DU node associated to one or several MRBs (MRB “instances”). The gNB-DU sets up resources for each MRB

- based on information provided within MBS Session Context related information as received by the gNB-DU (e.g. MRB QoS, MBS service area information, etc.), and,

- for multicast, based on the UE Contexts established for RRC\_CONNECTED UEs within the gNB-DU containing joining information of the UE for the respective multicast session.

- for broadcast, the gNB-DU determines whether F1-U tunnels are setup per DU or per Area Session ID served by the DU.

- for multicast, the gNB-DU determines whether F1-U tunnels are setup per DU or per cell served by the DU or per Area Session ID served by the DU or for ptp restransmissions or for a ptp-only MRB leg.

For multicast, for each MRB, the MBR specific Uu configuration is incorporated into each UE’s individual CellGroupConfig, and the gNB-DU provides such information to the gNB-CU to configure the UE.

Editor’s Note: The statement above concerning the incorporation of the MBR specific Uu configuration into the RRC *CellGroupConfig* IE needs to be checked against respective RAN2 decisions.

**UE-associated logical NG/Xn/F1/E1 -connection:**

NGAP, XnAP, F1AP and E1AP provide means to exchange control plane messages associated with the UE over the respectively NG-C, Xn-C, F1-C or E1 interface.

A UE-associated logical connection is established during the first NGAP/XnAP/F1AP message exchange between the NG/Xn/F1 peer nodes.

The connection is maintained as long as UE associated NG/XnAP/F1AP messages need to be exchanged over the NG/Xn/F1 interface.

The UE-associated logical NG-connection uses the identities AMF UE NGAP ID and RAN UE NGAP ID.

The UE-associated logical Xn-connection uses the identities Old NG-RAN node UE XnAP ID and New NG-RAN node UE XnAP ID, or M-NG-RAN node UE XnAP ID and S-NG-RAN node UE XnAP ID.

The UE-associated logical F1-connection uses the identities gNB-CU UE F1AP ID and gNB-DU UE F1AP ID.

The UE-associated logical E1-connection uses the identities gNB-CU-CP UE E1AP ID and gNB-CU-UP UE E1AP ID.

When a node (AMF or gNB) receives a UE associated NGAP/XnAP/F1AP/E1AP message the node retrieves the associated UE based on the NGAP/XnAP/F1AP/E1AP ID.

**UE-associated signalling:**

UE-associated signalling is an exchange of NGAP/XnAP/F1AP/E1AP messages associated with one UE over the UE-associated logical NG/Xn/F1/E1-connection.

NOTE1: The UE-associated logical NG-connection may exist before the NG-RAN node UE context is setup in the NG-RAN node.

NOTE2: The UE-associated logical F1-connection may exist before the UE context is setup in the gNB-DU.

NOTE3: The general principle described in this section also applies to ng-eNB and W1 interface, if not explicitly specified otherwise.

**MBS-associated logical F1/E1 -connection:**

F1AP and E1AP provide means to exchange control plane messages associated with an MBS session over the respective F1/E1 interface.

An MBS-associated logical connection is established during the first F1AP/E1AP message exchange between the F1/E1 peer nodes.

The connection is maintained as long as MBS associated F1AP/E1AP messages need to be exchanged over the F1/E1 interface.

The MBS-associated logical F1-connection uses the identities gNB-CU MBS F1AP ID and gNB-DU MBS F1AP ID.

The MBS-associated logical E1-connection uses the identities gNB-CU-CP MBS E1AP ID and gNB-CU-UP MBS E1AP ID.

When a node (DU or CU or CU-CP and CU-UP) receives an MBS associated E1AP message the node retrieves the associated MBS session based on the F1AP/E1AP ID.

**MBS-associated signalling:**

MBS-associated signalling is an exchange of F1AP/E1AP messages associated with one MBS session over the MBS-associated logical F1/E1-connection.

## 6.x MBS Session associations in NG-RAN Node

The following MBS Session associations are defined in the NG-RAN node to support NR MBS:

**NG RAN MBS Session Resource Context:** Encompasses CP and UP, transport and radio resources to support an MBS Session. For multicast it also encompasses the MBS Session state (active, de-activated) information about joined UEs. If an MBS Session Resource within a gNB serves multiple MBS service areas, as specified in TS 23.247 [x] the same NG MBS Session Resource context may be associated with multiple NG-U resources. During an ongoing multicast session, NG-U resources are setup or released by the gNB upon UE mobility or UEs leaving or joining the MBS multicast session.

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# 7 NG-RAN functions description

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## 7.x Support for NR MBS

The Support of NR MBS in non-split gNB case is specified in TS 38.300 [2].

### 7.X.1 Support of dynamic PTP and PTM switching

NG-RAN supports dynamic switch between PTP and PTM for MBS as specified in TS 38.300 [2].

In case of split gNB architecture, for a split MRB bearer with common PDCP, upon receiving the MBS data from the gNB-CU via a shared F1-U tunnel, the gNB-DU makes decision of using PTP (RLC leg) or PTM (RLC leg).

Editor’s note: The above paragraph would be re-visited after there is conclusion on flow control mechanism for shared F1-U tunnel.

***--------------------------------Start of the Next Change-----------------------------***

# 8 Overall procedures in gNB-CU/gNB-DU Architecture

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## 8.2 Intra-gNB-CU Mobility

### 8.2.1 Intra-NR Mobility

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## 8.xx Overall procedures for NR MBS

### 8.xx.1 General

The following clauses describe the overall procedures for NR MBS involving E1 and F1.

#### 8.xx.1.1 Broadcast MBS Session Setup

Figure 8.xx.1.1-1 illustrates an examplified interaction of NGAP, E1AP, F1AP and RRC protocol functions at Broadcast MBS Session Setup.



Figure 8.xx.1.1-1: Broadcast MBS Session Setup

1. The 5GC starts the broadcast session by sending the NGAP Broadcast Session Setup Request message to the gNB containing the TMGI, S-NSSAI, 5G QoS Profile, area information and transport information (for NG-U multicast transport it provides the IP multicast address and the IP source specific multicast address, for NG-U unicast transport it provides an GTP UL TEID) and optionally an alternative set of transport information.

2./3. The gNB-CU-CP sets up the broadcast bearer context, providing NG-U transport information from the 5GC and receiving from the gNB-CU-UP the NG-U GTP DL TEID in case NG-U unicast transport was selected and an F1-U GTP UL TEID per MRB.

4. In case of NG-U multicast transport, the gNB-CU-UP joins the NG-U multicast group.

5./6. The gNB-CU-CP establishes the Broadcast MBS Session Context at the DU, providing MRB configuration, other relevant session parameters and F1-U GTP UL TEID information, and receiving F1-U GTP DL TEID information.

9. The DU configured broadcast resources and provides broadcast configuration information to the UEs by means of MCCH.

10. The gNB successfully terminates the NGAP broadcast Session Setup procedure. In case the gNB has chosen NG-U unicast transport, NG-U GTP DL TEID information is provided to the 5GC.

11. The broadcast MBS media stream is provided to the UEs.

On NG-U, in case of location dependent broadcast MBS Sessions, multiple shared NG-U transport tunnels may need to be setup, one per Area Session ID served by the gNB.

In case of shared NG-U termination,

- the 5GC may provide the gNB with information about already established shared NG-U terminations in step 1, which is passed on to respective gNB-CU-UP in step 2. In return, the gNB-CU-UP in step 3 and the gNB in step 10 may offer the established NG-U termination to be shared with other gNBs. In case of multicast transport on NG-U the information about a shared NG-U termination is represented by a GTP-U TEID.

- the gNB-CU-UP may provide the gNB-CU-CP at E1 setup or configuration update about established shared NG-U terminations, indicated by one or several MBS Session IDs.

- at establishment of the BC bearer context in the gNB-CU-UP, the gNB-CU-UP may overwrite the QoS flow mapping indicated by the gNB-CU-CP, if the gNB-CU-CP provides its consent to do so at BC bearer context setup.

#### 8.xx.1.2 Multicast MBS Session Activation

Figure 8.xx.1.2-1 illustrates an examplified interaction of NGAP, E1AP, F1AP and RRC protocol functions at Multicast MBS Session Activation.



Figure 8.xx.1.2-1: Multicast MBS Session Context establishment

1. A multicast session context is established by the 5GC.

Editor’s Note: Whether multicast MBS Session parameters are included in the NGAP Multicast Session Activation Request message, like the TMGI, S-NSSAI, 5G QoS Profile, area information and transport information (for NG-U multicast transport it provides the IP multicast address and the IP source specific multicast address, for NG-U unicast transport it provides an GTP UL TEID) depends on discussions for NG Session Management for NR MBS. For now, step 1 could be named as “activation trigger”.

2./3. If not yet existing, the gNB-CU-CP establishes the multicast bearer context at the gNB-CU-UP, in order to retrieve for unicast NG-U transport the GTP DL TEID, or for multicast NG-U transport, in case a shared NG-U termination, a shared resource address (GTP DL TEID).

4./5. If applicable, the gNB-CU-CP establishes the Multicast Context at the DU, providing MRB configuration. It may contain MBS Area Session ID information.

6. Dependent on e.g. joined UEs, the gNB-CU-DU triggers the establishment of an F1-U tunnel, which is established either per DU or per cell or per MBS Area Session ID. The receiving gNB-DU-CP may need to fetch a gNB side NG-U TNL address information for the gNB-DU-UP by means of a E1AP MC Bearer Context Modification procedure.

7./8. The gNB triggers the NGAP Distribution Setup procedure. For unicast transport, DL/UL GTP TEIDs are exchanged, for multicast transport, multicast address information is fetched from the 5GC.

9./10. The gNB-CU-UP side of the F1-U and NG-U UP entity is established by means of the E1AP MC Bearer Context Modification procedure, providing the DU side F1-U TNL address and the 5GC NG-U TNL address to the gNB-CU-UP, which provides the gNB-CU-UP side F1-U TNL address in return.

11. The gNB-CU-UP side F1-U TNL address is provided to the DU.

12. In case of NG-U multicast transport, the gNB-CU-UP joins the NG-U multicast group.

13. The gNB-CU-CP RRC-configures each UE which has joined the multicast group.

14. The gNB successfully terminates the NGAP procedure for establishing the multicast session context.

15. The multicast MBS media stream is provided to the UEs.

On NG-U, in case of location dependent multicast MBS Sessions, multiple shared NG-U transport tunnels may need to be setup, one per Area Session ID served by the gNB.

In case of shared NG-U termination,

- the 5GC may provide the gNB with information about already established shared NG-U terminations in step 1, which is passed on to respective gNB-CU-UP in step 2. In return, the gNB-CU-UP in step 3 and the gNB in step 12 may inform the 5GC about existing NG-U termination which can be shared. In case of multicast transport on NG-U the information about a shared NG-U termination consists of an GTP-U TEID.

- the gNB-CU-UP may provide the gNB-CU-CP at E1 setup or configuration update about established shared NG-U terminations, indicated by one or several MBS Session IDs.

- at establishment of the MC bearer context in the gNB-CU-UP, the gNB-CU-UP may overwrite the QoS flow mapping indicated by the gNB-CU-CP, if the gNB-CU-CP provides its consent to do so at MC bearer context setup.

***--------------------------------End of the Changes-----------------------------***