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# Foreword

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

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

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document specifies architectural enhancements to the 5G system using NR to support multicast and broadcast communication services, complying to the requirements in TS 22.146 [2], TS 22.246 [3] and TS 22.261 [4]. This document encompasses support for functions such as how to deliver multicast and broadcast communications including support within certain location areas, mobility, MBS session management and QoS.

The present document also covers interworking with E-UTRAN and EPC based eMBMS for Public Safety (e.g. MCX services).

# 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 22.146: "Multimedia Broadcast/Multicast Service (MBMS); Stage 1".

[3] 3GPP TS 22.246: "Multimedia Broadcast/Multicast Service (MBMS) user services; Stage 1".

[4] 3GPP TS 22.261: "Service requirements for the 5G system".

[5] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[6] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[7] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

[8] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".

[9] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[10] 3GPP TS 23.468: "Group Communication System Enablers for LTE (GCSE\_LTE)".

[11] 3GPP TS 26.348: "Northbound Application Programming Interface (API) for Multimedia Broadcast/Multicast Service (MBMS) at the xMB reference point".

[12] 3GPP TS 23.003: "Numbering, Addressing and Identification".

[13] 3GPP TS 26.346: "MBMS: Protocols and Codecs".

[14] 3GPP TR 23.757: "Study on architectural enhancements for 5G multicast-broadcast services".

[15] 3GPP TS 38.413: "NG Application Protocol (NGAP)".

[16] 3GPP TS 38.401: "NG-RAN; Architecture description".

[17] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane Nodes; Stage 3".

[18] 3GPP TS 26.502: "5G Multicast-Broadcast User Service Architecture".

# 3 Definitions of terms and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms and definitions defined in TR 21.905 [1] and the following apply:

**5GC Individual MBS traffic delivery**: 5G CN receives a single copy of MBS data packets and delivers separate copies of those MBS data packets to individual UEs via per-UE PDU sessions, hence for each such UE one PDU session is required to be associated with a multicast session.

**5GC shared MBS traffic delivery**: 5G CN receives a single copy of MBS data packets and delivers a single copy of those MBS data packets to a RAN node.

**Area Session Identifier:** A unique identifier within an MBS Session used for an MBS session with location dependent content. When present the Area Session ID, together with the TMGI, is used to uniquely identify the data flow of an MBS Session in a specific MBS service area.

**Associated PDU Session:** A PDU Session associated to a multicast session that is used for 5GC Individual MBS traffic delivery method and for signalling related to a user's participation in a multicast session such as join and leave requests.

**Associated QoS Flow:** A unicast QoS Flow that belongs to the associated PDU Session and is used for 5GC Individual MBS traffic delivery method. The associated QoS Flow is mapped from a multicast QoS Flow in a multicast MBS session.

**Broadcast communication service:** A 5GS communication service in which the same service and the same specific content data are provided simultaneously to all UEs in a geographical area (i.e., all UEs in the broadcast coverage area are authorized to receive the data).

NOTE 1: For the broadcast communication service, the content provider and network may not be aware whether the authorized UEs are actually receiving the data being delivered.

**Broadcast MBS session:** An MBS session to deliver the broadcast communication service. A broadcast MBS session is characterised by the content to send and the geographical area where to distribute it.

**Broadcast service area:** The area within which data of one or multiple Broadcast session(s) are sent.

**MBS QoS Flow**: The finest granularity for QoS forwarding treatment for MBS data. Providing different QoS forwarding treatment requires separate MBS QoS Flows in 5GS supporting MBS.

**MBS Service Announcement:** Mechanism to allow users to be informed about the available MBS services.

**MBS session:** A multicast session or a broadcast session.

**Multicast communication service:** A 5GS communication service in which the same service and the same specific content data are provided simultaneously to a dedicated set of UEs (i.e., not all UEs in the multicast coverage are authorized to receive the data).

NOTE 2: For multicast communication service, the content provider and network can be aware whether the authorized UEs are actually receiving the data being delivered.

**Multicast MBS session:** An MBS session to deliver the multicast communication service. A multicast MBS session is characterised by the content to send, by the list of UEs that may receive the service and optionally by a multicast area where to distribute it.

**MBS service area:** The area within which data of one Multicast or Broadcast MBS session may be sent. For location dependent MBS, the MBS service area is uniquely identified by the combination of Area Session ID and MBS Session ID and corresponds to the location dependent content data of the MBS Session ID.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], TS 23.501 [5] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

FEC Forward Error Correction

CDN Content Delivery Network

LL MC Lower Layer Multicast

MBMS Multimedia Broadcast/Multicast Service

MBS Multicast/Broadcast Service.

MB-SMF Multicast/Broadcast Session Management Function.

MBSF Multicast/Broadcast Service Function.

MBSTF Multicast/Broadcast Service Transport Function.

MB-UPF Multicast/Broadcast User Plane Function

PTM Point To Multipoint

PTP Point To Point

SSM Source Specific Multicast address.

TMGI Temporary Mobile Group Identity

# 4 General Concept

## 4.1 Overview of multicast and broadcast communication

Multicast and Broadcast Service (MBS) is a point-to-multipoint service in which data is transmitted from a single source entity to multiple recipients, either to all users in a broadcast service area, or to users in a multicast group as defined in TS 22.146 [2]. The corresponding types of MBS session are:

- Broadcast session

- Multicast session.

The MBS architecture defined in clause 5 follows the 5G System architectural principles as defined in TS 23.501 [5], enabling distribution of the MBS data from the 5GS ingress to NG-RAN node(s) and then to the UE. The MBS architecture provides:

- Efficient usage of RAN and CN resources, with an emphasis on radio interface efficiency;

- Efficient transport for a variety of multicast and broadcast services.

Multicast-broadcast service for roaming is not supported in this release.

Interaction between multicast-broadcast service and support of deployments topologies with specific SMF Service Areas is not specified in this release.

The 5G MBS also provides functionalities such as local MBS service, authorization of multicast MBS and QoS differentiation. Refer to clause 6 for more details.

MBS traffic is delivered from a single data source (e.g. Application Service Provider) to multiple UEs. Depending on many factors, there are several delivery methods which may be used to deliver the MBS traffic in the 5GS.

NOTE 1: For clarity, delivery methods are not referred to as unicast/multicast/broadcast but as described below. The term "unicast delivery" refers to a mechanism by which application data and signalling between the UE and the application server are delivered using PDU Session within the 3GPP network and using individual UE and application server addresses (e.g. IP addresses) between the 3GPP network and the application server. It is not equivalent to 5GC Individual MBS traffic delivery method defined in this clause.

Between 5GC and NG-RAN, there are two possible delivery methods to transmit the MBS data:

- 5GC Individual MBS traffic delivery method: This method is only applied for multicast MBS session. 5GC receives a single copy of MBS data packets and delivers separate copies of those MBS data packets to individual UEs via per-UE PDU sessions, hence for each such UE one PDU session is required to be associated with a multicast session.

- 5GC Shared MBS traffic delivery method: This method is applied for both broadcast and multicast MBS session. 5GC receives a single copy of MBS data packets and delivers a single copy of those MBS packets to an NG-RAN node, which then delivers the packets to one or multiple UEs.

The 5GC Shared MBS traffic delivery method is required in all 5G MBS deployments. The 5GC Individual MBS traffic delivery method is required to enable mobility when there is an NG-RAN deployment with non-homogeneous support of 5G MBS.

For the multicast session, a single copy of MBS data packets received by the CN may be delivered via 5GC Individual MBS traffic delivery method for some UE(s) and via 5GC Shared MBS traffic delivery method for other UEs.

Between the NG-RAN and the UE, two delivery methods are available for the transmission of MBS data packets over radio interface:

- Point-to-Point (PTP) delivery method: NG-RAN delivers separate copies of MBS data packets over radio interface to individual UE(s).

- Point-to-Multipoint (PTM) delivery method: NG-RAN delivers a single copy of MBS data packets over radio interface to multiple UEs.

NG-RAN may use a combination of PTP/PTM to deliver an MBS data packets to UEs.

NOTE 2: The PTP and PTM delivery methods are defined in RAN WGs.

As depicted in the following figure, 5GC Shared MBS traffic delivery method (with PTP or PTM delivery) and 5GC Individual MBS traffic delivery method may be used at the same time for a multicast MBS session.



Figure 4.1‑1: Delivery methods

For MBS broadcast communication, only 5GC Shared MBS traffic delivery method with PTM delivery is applicable.

For MBS multicast communication, if the NG-RAN node supports 5G MBS, the network shall use the 5GC Shared MBS traffic delivery method for MBS data transmission.

NOTE 3: The exception is when the UE moves between NG-RAN node not supporting MBS (with 5GC Individual MBS traffic delivery method) and NG-RAN node supporting MBS, there is temporary co-existence between 5GC Shared MBS traffic delivery method and 5GC Individual MBS traffic delivery method. Refer to clause 6.3 for details.

For MBS multicast communication, the switching between 5GC Shared MBS traffic delivery method and 5GC Individual MBS traffic delivery method is supported. The UE mobility between RAN nodes both supporting MBS, and between a RAN node supporting MBS and a RAN node not supporting MBS is supported, for details see clause 6.3.

For MBS multicast communication, the switching between PTP and PTM delivery methods for 5GC Shared MBS traffic delivery shall be supported. NG-RAN is the decision point for switching between PTP and PTM delivery methods.

## 4.2 MB service provisioning

### 4.2.1 Multicast data provisioning

An example for the sequence of phases for multicast data provisioning is described in the figure below:

**MBS Session Configuration & Service Announcement**

**UE Session Join & Session Establishment**

**Data Transfer**

**UE Session Leave & Session Release**

**MBS Session De-configuration**

Figure 4.2.1-1: Phases of Multicast data provisioning example.

The following phases are performed for a specific UE:

- UE Session Join: UE Session Join is the process by which a UE joins an MBS Session, i.e. the UE indicates to 5GC that such UE wants to receive Multicast data identified by a specific MBS Session ID.

- UE Session Leave: UE Session Leave is the process by which a UE leaves a MBS Session, i.e. the UE no longer wants to receive Multicast data identified by a specific MBS Session ID.

The following phases are performed for a specific service:

- MBS Session Configuration: It is the phase that the information of multicast session begin to exist as described in clause 4.3. This step is optional.

- Service announcement: Service announcement is used to distribute information toward UEs about the service required for service reception (e.g., IP multicast address(es)) and possibly other service related parameters (e.g. service start time). This step is optional.

- Session Establishment: It is the phase that multicast session is established as described in clause 4.3.

- No data receiving: It is the phase when no multicast data is received by 5GC. This step is optional.

- Data transfer: It is the phase when Multicast data are transferred to the UEs.

- Session Release: It is the phase that the resources for multicast session is released as described in clause 4.3.

- Session De-configuration: It is the phase that multicast session will no longer exist as described in clause 4.3.

NOTE: After configuration, multicast session state could be switched between Active and Inactive several times, triggered by AF or User Plane event, see clause 7.2.5. 5GC further updates multicast session state towards NG-RAN nodes after Session Establishment.

The phase of Multicast data provisioning is illustrated with the following example of timeline:



Figure 4.2.1-2: Multicast service timeline example

### 4.2.2 Broadcast data provisioning

An example for the phases of broadcast data provisioning is described in the figure below:



Figure 4.2.2-1: Phases of Broadcast data provisioning

The following phases are performed for a specific service:

- MBS Session Configuration: MBS Session Configuration is used by the AF to configure the MBS Session towards 5GC. MBSC session configuration can occur in several steps (e.g. TMGI allocation, provisioning information about MBS session, request to activate the MBS session). The last step of the MBS session configuration triggers resource establishment for transmitting the DL Broadcast data between 5GC and NG-RAN.

NOTE: For broadcast communication, after MBS Session Configuration and Session Establishment, the established resources are not only between 5GC and NG-RAN, but also between the AF to 5GC.

- Service announcement: Service announcement is used to distribute information towards UEs about the service required for service reception (e.g., IP multicast address(es)) and possibly other service related parameters (e.g. service start time). This step can occur in parallel or after the MBS session configuration. However, TMGI allocation is required before. The information of the service announcement could be pre-configured at the UE side, see clause 7.3.1.

- Data transfer: It is the phase when broadcast data are transferred in the air interface.

- Session Release: It is the point at which there will be no more need to transmit Broadcast data. At Session Release, the resources in 5GS are released.

- Session De-configuration: It is the phase that broadcast session will no longer exist.

The phase of Broadcast data provisioning is illustrated with the following example of timeline:



Figure 4.2.2-2: Broadcast service timeline

4.3 Multicast session state model

The following illustrate the states for the multicast session:

**- Configured state**: Information about the multicast session (e.g. QoS information) is configured in 5GC NFs (e.g. MB-SMF) serving the multicast session, but no User Plane resources towards NG-RAN are reserved and no MBS data can be transmitted. Only resources at MB-SMF, NEF and MB-UPF are reserved and no multicast data are transmitted. A TMGI can be allocated for the multicast session. UEs may be allowed to join (subject to authorization check and configuration), but the first accepted UE join request will trigger the multicast session establishment towards the NG-RAN and the UE, see clause 7.2.1.

NOTE 1: The SMF is not involved in the multicast session while the multicast session is in configured state.

NOTE 2: There may be several interim states in the configured state, e.g. TMGI requested, or information about the multicast session provided, but these interim states will not be specified in this release.

- **Active state**: Multicast session is established and MBS data can be transmitted to the UEs that have joined the multicast session. Radio resources for the multicast session are established. To receive multicast MBS session data, UEs that joined the multicast session shall be in CM-CONNECTED state for receiving data of the multicast session. UEs are allowed to join the multicast session (subject to authorization check). 5GC resources and radio resources for the multicast session are reserved for UEs that joined the multicast session.

- **Inactive state**: Multicast session is established but no MBS data is transmitted to the UEs that have joined the multicast session. Radio resources for the multicast session are released, and the UEs that joined the multicast session may be in CM-CONNECTED or CM-IDLE state. UEs are allowed to join the multicast session (subject to authorization check).

The following procedures are defined which result in transition of the multicast session state:

**Multicast Session Configuration**: The AF provides information about the multicast session and optionally request the allocation of a TMGI, see clause 7.1.1.2 and 7.1.1.3. Alternatively, the information about the multicast session can be pre-configured in the network. The configuration may indicate whether the multicast session may be established in active or inactive state and when a multicast session can become active. The AF may provide configuration in several steps, e.g. to first request TMGI and then provide full information about the multicast session and allow it to be established, or to update the information whether the multicast session is to be in active or inactive state after establishment. Multicast session state transitions from NULL to Configured state.

NOTE 3: A multicast session can also be configured by the operator via OAM or be established without prior configuration.

Editor’s Note: How the procedure works if multicast session is configured by the operator or established without prior configuration is FFS.

- **Multicast Session Establishment**: When the join request of the first UE for the multicast session is accepted, the multicast session is established towards the NG-RAN node and the UE, see clause 7.2.1. Multicast session state transitions from NULL or Configured state to either Inactive or Active state.

- **Multicast Session Activation**: See clause 7.2.5.2, Triggered by the 5GC, the radio resources for the multicast session are established and multicast session data starts to be transmitted to the UE. UEs in CM-IDLE state and CM-CONNECTED with RRC Inactive state that joined the multicast session are notified. Activation can be triggered by AF request or data notification from the MB-UPF. Multicast session state transitions from Inactive state to Active state.

NOTE 4: The AF could not be aware, and the NEF will not be aware, whether a session is in configured or established state. An AF may therefore update the session configuration to request the activation of a session prior to the establishment of the session, and this will determine that the session is subsequently established in active state when the first UE joins, but will not trigger the Multicast Session Activation state transition.

- **Multicast Session Deactivation**: See clause 7.2.5.3. Triggered by the 5GC, the radio resources for the multicast session are released and multicast session data stops to be transmitted to the UE. Deactivation can be triggered by AF request or no reception of multicast data by the MB-UPF. Multicast session state transitions from Active to Inactive state.

- **Multicast Session Release**: Triggered by the last UE leaving the multicast session (see clause 7.2.2.2), or Multicast Session De-configuration procedure (7.1.1.6 or 7.1.1.7), the resources for the multicast session are released in both 5GC nodes and RAN nodes, see clause 7.2.2. Multicast session state transitions from Active or Inactive state to Configured.

- **Multicast Session De-configuration**: All information about the multicast session is removed from the 5GC, and the TMGI for the multicast session (if allocated during Multicast Session Configuration) is deallocated, see clause 7.1.1.4 or 7.1.1.5. The deconfiguration may be triggered by an AF request. Multicast session state transitions from Configured, Active or Inactive state to NULL.

****

**Figure 4.3-1: Multicast session states and state transitions**



**Figure 4.3-2: Multicast session states and state transitions in MB-SMF**

****

**Figure 4.3-4: Multicast session states and state transitions in NG-RAN**

NOTE 5: Multicast session states and state transitions in NG-RAN is for illustration purpose, the final decision will be made by RAN WGs.

****

**Figure 4.3-5: Multicast session states and state transitions in SMF**

5.1 General architecture

Figure 5.1-1 depicts the 5G MBS reference architecture. Service-based interfaces are used within the Control Plane.

****

**Figure 5.1-1: 5G System architecture for Multicast and Broadcast Service.**

NOTE 1: The MBSF is optional and may be collocated with the NEF or AF/AS, and the MBSTF is an optional network function.

NOTE 2: The existing service based interfaces of Nnrf, Nudm, and Nsmf are enhanced to support 5G MBS. The existing service based interfaces of Npcf and Nnef are enhanced to support 5G MBS.

NOTE 3: xMB-C/MB2-C and xMB-U/MB2-U are intended for legacy AS. A 5G MBS enabled AF uses either Nmbsf or Nnef to interact with the MBSF.

Editor's note: Which NF is used to store service parameters, including serving MB-SMF information will be updated in future versions.

Figure 5.1-2 depicts the 5G system architecture for MBS using the reference point representation.

**Figure 5.1-2: 5G System architecture for Multicast and Broadcast Service in reference point representation.**

NOTE 4: The existing reference points of N1, N2, N4, N10, N11, N30 and N33 are enhanced to support 5G MBS.

## 5.2 General architecture for interworking with LTE

Interworking between MBS and eMBMS at service layer functionality applies in cases where the same Multicast/Broadcast service is provided via eMBMS and 5MBS. Figure 5.2-1 depicts the system architecture for interworking between E-UTRAN/EPC eMBMS and MBS at service layer, with collocated BM-SC and MBSF/MBSTF functionalities.

**Figure 5.2-1: MBS-eMBMS interworking system architecture at service layer**

The BM-SC+MBSF/MBSTF exposes common Nmb3/Nmb6/xMB-C/MB2-C and Nmb4/xMB-U/MB2-U reference points to the NEF and/or AF/AS. A common TMGI is used towards the AF/AS. The TMGI is also used as identifier for transport over E-UTRAN/EPC.

NOTE: MB2-C/U are both legacy reference points and 5GS reference points.

5.3 Reference point and functional entities

5.3.1 Reference point

The 5G System Architecture for MBS contains the following new reference points:

**N3mb:** Reference point between the RAN and the MB-UPF.

**N4mb:** Reference point between the MB-SMF and the MB-UPF.

**N6mb:** Reference point between the MB-UPF and the AF/AS.

**N7mb:** Reference point between the MB-SMF and the PCF.

**N11mb:** Reference point between the AMF and the MB-SMF.

**N16mb:** Reference point between the SMF and the MB-SMF.

**N19mb:** Reference Point between the UPF and the MB-UPF.

**N29mb:** Reference point between the MB-SMF and the NEF.

**Nmb1:** Reference point between the MB-SMF and the MBSF.

**Nmb2:** Reference point between the MBSF and the MBSTF.

**Nmb5:** Reference point between the MBSF and the NEF.

**Nmb8:** Reference point between the MBSTF and the AF.

**Nmb9:** Reference point between the MB-UPF and the MBSTF.

**Nmb10:** Reference point between the MBSF and the AF.

**Nmb12:** Reference point between the MBSF and the PCF.

**Nmb13:** Reference point between the MB-SMF and the AF.

5G System Architecture for MBS reuses the existing reference points of N1, N2, N4, N10, N11, N30 and N33 with enhancement to support MBS.

5.3.2 Functional entities

5.3.2.1 PCF

In addition to the functions defined in TS 23.501 [5], the PCF performs the following functions to support MBS if dynamic PCC for 5MBS is needed:

- Supporting QoS handling for MBS Session.

- Providing policy information regarding the MBS Session to MB-SMF for authorizing the related QoS profiles.

- Interacting with UDR for QoS information retrieval.

- The PCF can receive MBS information from AF, NEF or MBSF, e.g. based on the different configuration options in Annex A.

5.3.2.2 MB-SMF

The MB-SMF performs the following functions to support MBS:

- General for multicast and broadcast sessions:

- Supporting MBS session management (including QoS control).

- Configuring the MB-UPF for multicast and broadcast flows transport based on the policy rules for multicast and broadcast services from PCF or local policy.

- Allocating and de-allocating TMGIs.

- Specific for broadcast sessions:

- Interacting with RAN (via AMF) to control data transport using 5GC Shared MBS traffic delivery method.

- Specific for multicast sessions:

- Interacting with SMF to modify PDU Session associated with MBS session.

- Interacting with RAN (via AMF and SMF) to establish data transmission resources between MB-UPF and RAN nodes for 5GC Shared MBS traffic delivery method.

- Controlling multicast data transport using 5GC Individual MBS traffic delivery method.

5.3.2.3 SMF

In addition to the functions defined in TS 23.501 [5], the SMF performs the following functions to support MBS:

- Discovering MB-SMF for a multicast session.

- Authorizing multicast session join operation if needed.

- Interacting with MB-SMF to obtain and manage multicast session context.

- Interacting with RAN for shared data transmission resource establishment.

NOTE: SMF and MB-SMF may be co-located or deployed separately.

5.3.2.4 MB-UPF

The MB-UPF performs the following functions to support MBS:

- General for multicast and broadcast sessions:

- Packet filtering of incoming downlink packets for multicast and broadcast flows.

- QoS enforcement (MFBR) and counting/reporting based on existing means.

- Interaction with MB-SMF for receiving multicast and broadcast data.

- Delivery of multicast and broadcast data to RAN nodes for 5GC Shared MBS traffic delivery method.

- Specific for multicast sessions:

- Delivery of multicast data to UPF for 5GC Individual MBS traffic delivery method.

5.3.2.5 UPF

In addition to the functions defined in TS 23.501 [5], the UPF performs the following functions to support MBS:

- Interacting with SMF for receiving multicast data from MB-UPF for 5GC Individual MBS traffic delivery method.

- Delivering multicast data to UEs via PDU Session for 5GC Individual MBS traffic delivery method.

NOTE: UPF and MB-UPF may be co-located or deployed separately.

5.3.2.6 AMF

In addition to the functions defined in TS 23.501 [5], the AMF performs the following functions to support MBS:

- Signalling with NG-RAN and MB-SMF for MBS Session management.

- Selection of NG-RANs for notification of multicast session activation toward UEs in CM-IDLE state.

- Selection of NG-RANs for broadcast traffic distribution.

Additionally, AMF being aware of NG-RAN 5G MBS capability.

5.3.2.7 NG-RAN

In addition to the functions defined in TS 23.501 [5], the NG-RAN performs the following functions to support MBS:

- Management of MBS QoS flows via N2.

- Delivery of MBS data packets from 5GC shared for multiple UEs over radio using PTM or PTP.

- Configuration of UE for MBS QoS flow reception at AS layer.

- Control switching between PTM and PTP delivery per UE.

- Support for multicast sessions continuity during Xn Handover and N2 Handover.

- Support notification of multicast session activation over radio toward UEs in CM-IDLE state and CM-CONNECTED with RRC Inactive state.

5.3.2.8 UE

In addition to the functions defined in TS 23.501 [5], the UE may perform the following functions to support MBS:

- Reception of multicast data using PTM/PTP.

- Reception of broadcast data using PTM.

- Handling of incoming MBS QoS flows.

- Support of signalling for joining and leaving multicast MBS session.

- MBS resource management support at AS layer.

- Reception of notification in CM-IDLE state and CM-CONNECTED with RRC Inactive state for multicast data transmission.

5.3.2.9 AF

The AF performs the following functions to support MBS:

- Requesting multicast or broadcast service from the 5GC by providing service information including QoS requirement to 5GC.

- Instructing MBS session operation towards 5GC if needed.

- Interacting with NEF for MBS related service exposure.

5.3.2.10 NEF

In addition to the functions defined in TS 23.501 [5], the NEF performs the following functions to support MBS:

- Providing an interface to AFs for MBS procedures including service provisioning, MBS session and QoS management.

- Interacting with AF and NFs in 5GC, e.g., MB-SMF for MBS session operations, determination of transport parameters.

- Selection of MB-SMF to serve an MBS Session.

5.3.2.11 MBSF

The MBSF performs the following functions to support MBS:

- Service level functionality to support MBS, and interworking with LTE MBMS

- Interacting with AF and MB-SMF for MBS session operations, determination of transport parameters, and session transport.

- Selection of MB-SMF to serve an MBS Session.

- Controlling MBSTF if the MBSTF is used.

- Determination of sender IP multicast address for the MBS session if IP multicast address is sourced by MBSTF.

NOTE: MBSF functionality related to service and MBS data handling (e.g. encoding) is to be determined with SA WG4.

5.3.2.12 MBSTF

The MBSTF performs the following functions to support MBS if deployed:

- Media anchor for MBS data traffic if needed.

- Sourcing of IP Multicast if needed.

- Generic packet transport functionalities available to any IP multicast enabled application such as framing, multiple flows, packet FEC (encoding).

- Multicast/broadcast delivery of input files as objects or object flows.

NOTE: MBSTF functionality related to MBS data handling (e.g. encoding) is to be determined with SA4.

5.3.2.13 UDM

In addition to the functions defined in TS 23.501 [5], the UDM performs the following functions to support MBS:

- Support management of subscription for authorization for multicast MBS sessions.

5.3.2.14 UDR

In addition to the functions defined in TS 23.501 [5], the UDR performs the following functions to support MBS if deployed:

- Support management of UE authorization information for multicast MBS session.

- Support management of policy information for multicast or broadcast MBS session

#### 5.3.2.15 NRF

##### 5.3.2.15.1 General

In addition to the functions defined in TS 23.501 [5], the NRF performs the following functions to support 5G MBS:

- Support of new NF types MB-SMF and MBSF and their corresponding NF profiles.

- For both multicast and broadcast MBS Session, support of MB-SMF discovery based on parameters such as DNN, S-NSSAI and MB service area, at MBS Session creation.

- For multicast MBS Session, support of MB-SMF discovery based on MBS Session ID by SMF serving the multicast Session at UE join.

##### 5.3.2.15.2 Extensions to NF profile at NRF

In addition to the NF profile contents defined in clause 6.2.6.2 of TS 23.501 [5], the NF profile in the NRF contains the following content:

- For MB-SMF, the NF profile may include MBS Session ID(s), Area Session ID(s) and corresponding MBS service area(s) if available.

# 6 Functionalities and features

## 6.1 Authorization to MBS service

6.1.1 AF authorization to the service for multicast and broadcast

The AF should be authorized by the 5GC for delivering MBS data to the 5GC and/or interacting with the 5GC. For signalling exchange with the 5GC, the NEF perform authorization to the external AF for determination of whether the interaction with the 5GC is allowed or not.

6.1.2 UE authorization to the service for multicast

The following authorizations are defined:

1. Whether the UE is authorized to use the Multicast service in the PLMN.
2. The authorization for a UE of receiving the content of a specific multicast MBS session.

A Multicast MBS session may be open to any UEs and no authorization is needed;

NOTE 1: UE authorization for a specific Multicast MBS session can be implicitly performed when UE is configured for a specific Multicast MBS session, e.g. via Service Announcement for public safety use case.

NOTE 2: The authorization mentioned by a) is required even if an authorization according to b) is available. If the UE is not authorized to use the Multicast service by the PLMN, the UE is not authorized to join any multicast MBS Session even if the Multicast MBS session is open to any UEs.

A Multicast MBS session may require the 5GS to authorize the UE based on authorization information, e.g. preconfigured, or provided by the AF (see clause 7.1.1).

The procedure for UE authorization is a part of UE join procedure and is described in clause 7.2.1.

## 6.2 Local MBS service and Location dependent MBS service

### 6.2.1 General

A Local MBS service is an MBS service provided in one MBS service area. A location dependent MBS service is an MBS service provided in several MBS service area(s). An MBS service area is identified by a cell list or a tracking area list. The MBS service area could be geographical area information or civic address information, and NEF/MBSF translates the location information to Cell ID list or TAI list as MBS service area, see clause 7.1.1.2.

If the multicast session relates to a Local MBS service or a location dependent MBS service and the SMF configures 5GC Individual MBS traffic delivery, the SMF subscribes at the AMF to notifications about the "UE location" or UE moving in or out of a subscribed "Area Of Interest"" event using the Namf\_EventExposure service.

For multicast communication, local MBS and location dependent MBS services may be supported via 5GC Individual MBS traffic delivery towards RAN nodes not supporting MBS. If the SMF obtains a notification about the UE location, it checks whether the UE is still in the MBS service area of the multicast session. For a local MBS service, if the UE is no longer in the MBS service area, the SMF terminates the 5GC Individual MBS traffic delivery towards the UE. For a location dependent MBS service, if the UE is no longer in the current MBS service area, the SMF determines whether the UE is in another MBS service area of the multicast session; if so, the SMF configures the UPF to send multicast data relating to the new MBS service area towards the UE. If the SMF terminates the 5GC Individual MBS traffic delivery towards the UE, it unsubscribes at the AMF from the notifications about the UE location or "UE moving in or out of a subscribed "Area Of Interest" event using the Namf\_EventExposure service.

### 6.2.2 Local MBS service

For a local MBS service, only UEs within the MBS service area may receive content data, while UEs outside the MBS service area are not allowed to receive location specific content. For multicast MBS service, UEs outside the MBS service area are not allowed to join the MBS service, and the network shall not deliver location specific content anymore to the UEs moved out of the MBS service area. The UE shall be able to obtain service area information of the local multicast service via MBS service announcement or via NAS signalling (UE Session Join Accept/Reject including Cell ID list or TAI list). If the UE Session Join procedure fails due to the UE being outside the MBS service area, the UE does not attempt to join the multicast session again until the UE moves inside the MBS service area. When the UE Session Join succeeds and if the multicast session is deactivated, the UE does not perform monitoring the session activation notification and any other information related to the multicast session identified by an MBS Session ID over the radio if outside the MBS service area.

NOTE: Broadcast communication service is the service provided simultaneously to all UEs in a geographical area, therefore for broadcast it is naturally a local MBS service.

### 6.2.3 Location dependent MBS service

A location dependent MBS is identified by MBS Session ID, and provided in several MBS service areas. The location dependent MBS service enables distribution of different content data to different MBS service areas. The same MBS Session ID is used but a different Area Session ID is used for each MBS service area. The Area Session ID is used, in combination with MBS Session ID, to uniquely identify the service area specific part of the content data of the MBS service within 5GS. The network supports the location-dependent content distribution for the location dependent MBS services, while UEs are only aware of the MBS Session ID (i.e. UEs are not required to be aware of the Area Session IDs). When UE moves to a new MBS service area, content data from the new MBS service area shall be delivered to the UE, and the network ceases to deliver the content data from the old MBS service areas to the UE. When UE moves out of an MBS service area and there is no other MBS service area for the MBS session, the network ceases to deliver the content data to the UE.

Information about different MBS service areas for a location dependent MBS service may be provided by one or several AFs or may be configured. Different ingress points for location dependent points for the MBS session are supported for different MBS service area dependent content of the MBS session; different MB-SMFs and/or MB-UPF may be assigned for different MBS service areas in an MBS session. When the different MB-SMFs are assigned for different MBS service areas in an MBS session, the same TMGI is allocated for this MBS session.

The Area Session ID is allocated by MB-SMF in MBS Session configuration procedure. MB-SMF allocates Area Session ID for each MBS services area which is unique within the MBS session. MB-SMF needs to further ensure there is no MBS service area overlapping with other MBS service areas that share the same MBS session ID.

NOTE 1: In this release, deployments topologies with specific SMF Service Areas are not supported, as a result, location dependent service using multicast communication is not supported when a UE moves outside its SMF service area.

NOTE 2: For location dependent service provided in different MBS service areas within the same SMF service area, it is assumed that one MB-SMF is used for an MBS Session.

NOTE 3: An example of Location-dependent MBS is a nationwide weather forecast service with local weather reports.

NOTE 4: Area Session ID is equivalent to Flow ID as specified in TS 23.246 [8].

### 6.2.4 Update of broadcast local MBS service and location dependent MBS service

If an MBS service area is updated via configuration for broadcast communication, the MB-SMF provides the updated MBS service area to AMFs, and the AMFs provide it to NG-RAN node(s) affected by the previous or updated service area. The RAN nodes terminate transmission of MBS data towards cells that were in the previous service area but are outside the new service area. The NG-RAN nodes start transmission of MBS data towards cells that were outside the previous service area but are inside the new service area.

### 6.2.5 Update of multicast local MBS service and location dependent MBS service

If an MBS service area is updated via configuration for multicast communication, the MB-SMF provides the updated MBS service area to:

- SMFs,

- and AMF(s), and the AMF(s) forward this information to the relevant NG-RAN(s) that update the MBS service area.

NG-RAN node configures the UE not to receive the MBS data over air interface if it detects the UE was in the previous service area but is outside the updated MBS service area NG-RAN node may release the tunnel for the shared delivery if none of the cells/TAs of the NG-RAN node belongs to the MBS service area any more. NG-RAN node configures the UE to receive the MBS data over air interface if it detects the UE was outside the previous service area but is inside the updated MBS service area, if part of cells/TAs of the NG-RAN node belongs to MBS service area and others outside the MBS service area.

## 6.3 Mobility support of MBS service

### 6.3.1 Mobility of Multicast MBS session

The mobility of multicast MBS service is supported when:

- The UE moves from a NG-RAN node that supports MBS to a target NG-RAN node that supports MBS; or

- The UE moves from a NG-RAN node that supports MBS to a target NG-RAN node that does not support MBS and vice versa.

During the mobility from a NG-RAN node that supports MBS to a target NG-RAN node that supports MBS, or from a NG-RAN node that supports MBS to a target NG-RAN node that does not support MBS, minimization of data loss should be supported, see clause 7.2.3.5 for details.

To support Handover from NG-RAN node that supports MBS to a target NG-RAN node that supports MBS:

- If the shared delivery for the MBS session has not been established towards target NG-RAN, the target NG-RAN establishes the shared delivery for the MBS Session with MB-SMF and MB-UPF.

To support Handover from NG-RAN node that supports MBS to a target NG-RAN node that does not support MBS:

- mapping information about unicast QoS flows for multicast data transmission and the information of associated multicast QoS flows are provided to the NG-RAN node. This is already performed during the PDU session modification procedure for the PDU session associated with the MBS session when the UE Joins into the MBS Session;

- during the handover procedure, the delivery method is switched from 5GC Shared MBS traffic delivery method to 5GC Individual MBS traffic delivery method, i.e. the N3 tunnel of the PDU Session for 5GC Individual MBS traffic delivery needs to be activated towards the target NG-RAN node. The SMF realizes that the target NG-RAN node does not support MBS.

- the SMF and the MB-SMF shall activate the GTP tunnel between the UPF and the MB-UPF for 5GC Individual MBS traffic delivery method, if needed.

To support Handover from a NG-RAN node that does not support MBS to a target NG-RAN node that supports MBS:

- The PDU sessions, including the one associated with the MBS session and used for 5GC Individual MBS traffic delivery, are handed over to the target NG-RAN node.

- SMF triggers mode switch, i.e. from 5GC Individual MBS traffic delivery method to 5GC shared MBS traffic delivery method.

- When the MBS session context is given to the target NG-RAN node by the SMF, if the shared delivery for the MBS session has not been established towards target NG-RAN, the target NG-RAN establishes the shared delivery for the MBS Session with MB-SMF and MB-UPF.

- The 5GC terminates the 5GC Individual MBS traffic delivery and changes to the 5GC shared MBS traffic delivery.

### 6.3.2 Mobility of Broadcast MBS session

The UE receives the same Broadcast MBS service in the target NG-RAN if the same MBS session is established with 5GC Shared MBS traffic delivery method in the target NG-RAN node.

NOTE: When the UE moves into NG-RAN node not supporting 5MBS within the Broadcast MBS service area, how the UE get the same content via application level is out scope of this specification.

## 6.4 Subscription to multicast services

### 6.4.1 General

The UDM stores the subscription information to give the user permission to use multicast services, which include the MBS subscription data for a UE in UE subscription data.

At any time, the operator may change the subscription for multicast services in the UDM.

The MBS subscription data in UE subscription data contains the following information:

- Indication of whether the UE is authorized to receive any multicast MBS session data at all.

- MBS Session ID(s) of the multicast session(s) that the UE is allowed to join.

NOTE: The MBS session IDs only apply for MBS sessions which are not open to any UE. The SMF only takes this information in consideration for the authorization of a UE to join an MBS session when being informed by the MB-SMF that the MBS session is not open to any UE.

The MBS subscription data is provided by the UDM to the SMF during or after the establishment procedure of PDU Session associated with multicast session(s) using Nudm\_SDM service for subscription data type "MBS subscription data" as defined in clause 7.2.1.2.

During multicast session join procedure, the SMF retrieves MBS Session information from the MB-SMF, and authorizes the MBS Session join request for the UE based on MBS subscription data of the UE and the MBS Session information as described in clause 7.2.1.

The UDR is updated by the UDM and stores the MBS data (as specified in clause 4.15.6.2 of TS 23.502), i.e. authorization information by the AF and/or the 5GC per MBS Session, which contains the following information:

- MBS Session ID(s);

- For each MBS Session ID:

- Internal Group Identifier, SUPI list or Any UE indication which indicates which UEs are entitled to join the MBS Session identified by the MBS Session ID;

### 6.4.2 MBS subscription data in UDM

The information stored in the UDM as defined in clause 5.2.3.3.1 of TS 23.502 [6] is extended as follows:

* MBS subscription data for a UE as part of UE subscription data, as defined in Table 6.4.2-1, with keys defined in Table 6.4.2-2.

Table 6.4.2-1: MBS subscription data type in UE subscription data

| Subscription data type | Field | Description |
| --- | --- | --- |
| MBS subscription data | MBS allowed | Indicates whether the UE is authorized to receive any multicast MBS session data at all. |
| MBS Session ID(s) | Identifies the MBS Session(s) that the UE are allowed to join. |

Table 6.4.2-2: MBS subscription data type keys

|  |  |  |
| --- | --- | --- |
| Subscription Data Types | Data Key | Data Sub Key |
| MBS Subscription data | SUPI | MBS Session ID |

### 6.4.3 MBS information in UDR

The information stored in the UDR as defined in clause 5.2.12.2.1 of TS 23.502 [6] is extended as follows:

1. MBS data as defined in Tables 6.4.3-1 with keys defined in Table 6.4.3-2.

Table 6.4.3-1: MBS data type

| data type | Field | Description |
| --- | --- | --- |
| MBS data | MBS Session ID | MBS Session ID as defined in Clause 6.5.1 |
| Internal Group Identifier (NOTE 1) | Identifies internal group of UEs that are entitled to join a multicast session |
| SUPI list (NOTE 1) | Identifies UEs that are entitled to join a multicast session |
| Any UE indication (NOTE 1) | Indicates that any UE that is entitled to use multicast may join multicast session. |
| NOTE 1: For multicast groups, one of "Internal Group Identifier", "SUPI list", or "Any UE indication" is present. | | |

Table 6.4.3-2: MBS data type keys

|  |  |  |
| --- | --- | --- |
| Subscription Data Types | Data Key | Data Sub Key |
| MBS data | MBS session ID | Internal Group Identifier or SUPI |

6.5 Identifiers

6.5.1 MBS Session ID

The MBS session ID is used to identify a Multicast/Broadcast MBS Session by the 5G system on external interface towards AF and between AF and UE, and towards the UE.

MBS Session ID may have the following types:

- TMGI (for MBS broadcast and multicast MBS Session);

- source specific IP multicast address (for multicast MBS Session).

If a multicast MBS session is provided within an SNPN, the multicast MBS session can still be identified by a (globally unique) source specific IP multicast address or TMGI. In 5GS internal signalling the PLMN ID, included in TMGI, is complemented with the NID to identify an SNPN.

Source specific IP multicast address or TMGI may be used as MBS Session ID in NAS messages exchange between a UE and a CN when the UE requests to join/leave a multicast session. For multicast MBS sessions that the UE joined with a source specific IP multicast address, a TMGI is also allocated by 5GC and is sent to the UE and used in other signalling messages between RAN, CN and UE. Details see clause 7.2.1.3.

The UE shall be able to obtain at least one MBS Session ID via MBS service announcement.

For multicast MBS Session, a source specific IP multicast address can be assigned by external AFs.

6.5.2 Temporary Mobile Group Identity

TMGI (Temporary Mobile Group Identity) is defined in TS 23.003 [12] and is used to be able to identify a broadcast MBS Session or a multicast MBS Session.

In SNPN (Stand-alone Non-Public Network), TMGI is used together with NID (Network Identifier) defined in TS 23.003 [12] to identify an MBS Session.

6.5.3 Source Specific IP Multicast Address

The source specific IP multicast address is used to identify an Multicast MBS Session and consists of two IP addresses, one is an IP unicast address used as source address in IP packets for identifying the source of the multicast service (e.g. AF/AS), the other is an IP multicast address used as destination address in related IP packets for identifying a multicast communication service associated with the source.

6.6 QoS Handling for Multicast and Broadcast services

For MBS services, the network shall support QoS control per MBS session.

The 5G QoS model and parameters as defined in TS 23.501 [5] clause 5.7 also apply to multicast/broadcast communication services with the following differences:

- Reflective QoS is not applicable;

- Wireline access network specific 5G QoS parameters do not apply to MBS services;

- Alternative QoS Profile is not applicable;

- QoS Notification Control is not applicable;

- UE-AMBR is not applicable;

NOTE 1: For multicast communication service, the UE-AMBR applies for associated PDU Session.

- Session-AMBR if provided is enforced at MB-UPF but not communicated to NG-RAN.

NOTE 2: Whether Session-AMBR is required in addition to the MBS service data flow bit rate is determined by operator policy and/or agreement with the service provider.

- For broadcast MBS session, the QoS rule and QoS Flow level QoS parameters are not provided to UE.

NOTE 3: For broadcast MBS session, the associated QoS Flow(s) are not applicable.

Editor’s Note: For multicast MBS Session, whether UE needs to be aware that a QoS Flow within the PDU Session is mapped from MBS QoS Flow is FFS.

- For multicast MBS session, the handling of QoS rule and QoS Flow level QoS parameters of the associated QoS Flow(s) is the same as for other QoS Flow without UL in a PDU Session.

The network shall support one or multiple QoS flows, which can be either GBR or non-GBR, for an MBS session.

If 5GC Individual MBS traffic delivery method is used to deliver multicast data packets, the network may use dedicated QoS Flows for multicast data packets in a PDU session.

NOTE 4: When there is a need to apply 5GC individual MBS traffic delivery, the Session-AMBR of the associated PDU Session can be configured with a sufficiently high value to cater for MBS Session-AMBR.

Editor´s Note: Whether any policy control at the SMF for individual delivery QoS flows is required is FFS.

The MB-SMF may obtain QoS information for multicast and broadcast MBS session in different ways depending on the deployment and use cases.

If dynamic PCC is not deployed:

- When an MBS session is started, the MB-SMF is provided with service requirements including QoS information. If MBSF is not used, the service requirement is provided to the MB-SMF by the AF (directly or via the NEF). If the MBSF is used, the MBSF receives request from the AF (or via the NEF) and decides the related QoS requirements (e.g. considering support for FEC) and provides them to the MB-SMF. The MB-SMF determines the QoS profiles and QoS for N4 rules for the MBS session with QoS parameters of the MBS QoS flows, and provides related information to the RAN and the MB-UPF respectively.

NOTE 5: What information is included in the request from AF to MBSF requires collaboration with SA WG4.

If dynamic PCC is deployed:

Editor’s note: The following description depends on the ongoing PCF discussion and needs revisit

- It is the PCF that generates policy rules for MBS Session based on the received service requirement and provides the policy rules to the MB-SMF. The MB-SMF, based on the policy rules from the PCF, determines to create, and/or modify MBS QoS Flow(s) including providing QoS information to NG-RAN and MB-UPF, and providing packet detection and forwarding information to MB-UPF.

6.7 User plane management

The MB-UPF acts as the MBS Session Anchor of an MBS session, and if the MBSTF is involved in the MBS session, then the MBSTF acts as the media anchor of the MBS traffic. The MB-UPF receives only one copy of MBS data packets from AF or MBSTF.

The user plane between MBSTF and MB-UPF, or between MB-UPF and AF, may use either multicast transport or unicast tunnel for the MBS session (depending on application and capabilities of control interface). If the transport network does not support multicast transport, the user plane uses unicast tunnel for the MBS Session. The user plane between MBSTF and AF may use unicast tunnel, multicast transport or other means (e.g., HTTP download from external CDN). Unicast is used for the MBS Session, after receiving the downlink MBS data, the MB-UPF forwards the downlink MBS data without the outer IP header and tunnel header information.

The user plane from the MB-UPF to NG-RAN(s) (for shared delivery) and the user plane from the MB-UPF to UPFs (for individual delivery) may use multicast transport via a common GTP-U tunnel per MBS session, or use unicast transport via separate GTP-U tunnels at NG-RAN or at UPF per MBS session. If the user plane uses unicast transport, the transport layer destination is the IP address of the NG-RAN or UPF, each NG-RAN or UPF allocates the tunnel separately and multiple GTP-U tunnels are used for the MBS Session. If the user plane uses multicast transport, a common GTP-U tunnel is used for both RAN and UPF nodes. The GTP-U tunnel is identified by a common tunnel ID and an IP multicast address as the transport layer destination, both assigned by 5GC.

The above is depicted in Figure 6.7‑1.

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**Figure 6.7‑1: Schematic showing user plane data transmission**

The MB-SMF configures the MB-UPF to receive packets related to an MBS session.

For shared delivery, if unicast transport over N3mb applies, the MB-SMF configures MB-UPF to replicate the received MBS packets and forward them towards multiple RAN nodes via separate GTP tunnel. For shared delivery, if multicast transport over N3mb applies, the MB-SMF configures the MB-UPF to replicate the received MBS data and forwards the data via a single GTP tunnel.

For individual delivery, the MBS data received by the MB-UPF is replicated towards the UPF(s) where individual delivery is performed in the following way:

- The MB-SMF configures the MB-UPF to receive packets related to an MBS session, to replicate those packets and forward them towards multiple UPFs via GTP tunnels if unicast transport over N19mb is applied, or via a single GTP tunnel if multicast transport over N19mb is applied.

- The SMF(s) configures the UPF to receive packets related to a multicast session from an MB-UPF over N19mb, to replicate those packets and to forward them in multiple PDU sessions.

For the SMF and UPF, traffic replication and forwarding for an MBS session is realized by using for each MBS session an UPF internal interface ("MBS internal") and a two-step detection and forwarding process. In the first step, the packets received from a single data source are forwarded by the UPF to the UPF internal interface (i.e. Destination Interface set to "MBS internal" and MBS session ID indicated as Network instance in an FAR). In the second step, PDRs installed at the UPF internal interface (i.e. Source Interface set to "MBS internal" and MBS session ID indicated as Network instance) detect the packets and forward them to the respective outgoing interface.

NOTE: This enables separate PFCP sessions for the related PDU sessions and for the reception of the MBS session

For the MB-SMF and MB-UPF, traffic replication and forwarding for an MBS session is realized by using for each MBS session one PDR that detects the incoming MBS packets and points to one FAR that describes the forwarding of the data towards multiple destinations (UPFs or RAN nodes):

- A PFCP session is created when the MBS Session is started, regardless of multicast or unicast transport over N3mb and N19mb.

- For Multicast transport over N3mb and N19mb, the destination in the FAR contains the MB-UPF IP Multicast Distribution Info.

- For unicast transport over N3mb and N19mb, the FAR in the PFCP session may contain multiple destinations represented by the NG-RAN N3mb Tunnel Info and UPF N19mb Tunnel Info (if applicable).

Editor's note: Whether a two-step approach for 5G VN group is needed for SMF and UPF and thus whether new source/destination source types are needed for MBS traffic is FFS and needs CT4 feedback.

## 6.8 Interworking with MBMS over E-UTRAN for public safety services

In order to minimize the interruption of services, upon mobility for MBS service from NR/5GC to E-UTRAN/EPC and vice versa, the following applies:

- If the same multicast service is provided via eMBMS in E-UTRAN and 5MBS, interworking is supported at service layer.

- The UE is always configured with a common TMGI regardless of whether the UE is discovering and joining the MBMS/MBS service via E-UTRAN or NR. When the UE camps on NR, the UE establishes an MBS session context using the MBS context ID = TMGI. When the UE camps on E-UTRAN, the UE uses procedures as defined in TS 23.246 [8] for MBMS reception for the TMGI.

- The session context for multicast service transferring is not handed over to E-UTRAN during mobility from 5GS to EPS.

6.9 MBS Session Context

6.9.1 MBS Session Context

The MBS Session Context contains all information describing a particular MBS session in the 5GS and is created in each node involved in the delivery of the MBS data.

The content of the Multicast MBS Session Context is described in Table 6.9.1-1.

**Table 6.9.1-1: Multicast MBS Session context**

| **Parameter** | **Description** | **NG-RAN** | **MB-SMF** | **SMF** | **AMF** |
| --- | --- | --- | --- | --- | --- |
| State | State of MBS session ('Active multicast session' or 'Inactive multicast session' or 'Configured multicast session') | X  (note 2) | X | X  (note 2) |  |
| SSM (source specific IP multicast address) | IP multicast address identifying the MBS session. |  | X (note 1) | X (note 1) |  |
| TMGI | Temporary Mobile Group Identity allocated to the MBS Session. | X | X | x | X |
| Area Session Identifier | Used for MBS session with location dependent content. When present, the Area Session Identifier together with the TMGI uniquely identify the MBS Session in a specific MBS service area. | X (note 1) | X (note 1) | X (note 1) | X |
| MB-SMF | The MB-SMF that handles the MBS session. | X |  | X | X |
| QoS information | QoS information of the MBS session. | X | X | X |  |
| MBS Service Area | Area over which the MBS session data is distributed (i.e. Cell ID list or TAI list). | X (note 1) | X (note 1) | X (note 1) | X |
| NG-RAN Node ID(s) | NG-RAN nodes which are involved in the multicast session |  |  |  | X |
| AMF | The AMF(s) which are selected for the MBS session | X | X |  |  |
| IP multicast and source address for data distribution | IP addresses identifying the SSM user plane transport for shared delivery between MB-UPF and NG-RAN and for individual delivery between MB-UPF and UPF when the IP multicast transport is used. | X (note 1) | X (note 1) | X (note 1) |  |
| SMF | The SMF(s) that manages the associated PDU session. |  | X |  |  |
| UE ID | ID identifying the UE that successfully join the Multicast MBS Session. For NG-RAN it is NGAP UE ID and for SMF it is SUPI. | X  (note 3) |  | X  (note 3) |  |
| IP address for distribution | The IP addresses and TEID of NG-RAN used for the user plane between NG-RAN and MB-UPF and between MB-UPF and UPF when Point to Point tunnel is used. | X (note 1) | X (note 1) | X (note 1) |  |
| TEID for data distribution | The tunnel ID used for receiving the multicast data for shared delivery by NG-RAN and for individual delivery by UPF | X | X | X |  |
| MB-PCF | The MB-PCF that provides policy control for the MBS session. |  | X (note 1) |  |  |
| NOTE 1: It is an optional parameter.  NOTE 2: The value 'Configured multicast session' is not applicable for NG-RAN and SMF.  NOTE 3: the UE ID is available within the UE Context which contains the MBS information. | | | |  | |

In Broadcast MBMS mode, an MBS Session Context is created in the NG-RAN, AMF, MB-SMF and MBSF as a result of the MBS Session Start procedure.

The content of the Broadcast MBS Session Context is described in Table 6.9.1-2.

**Table 6.9.1-2: Broadcast MBS Session context**

| **Parameter** | **Description** | **NG-RAN** | **AMF** | **MB-SMF** |
| --- | --- | --- | --- | --- |
| TMGI | Temporary Mobile Group Identity allocated to the MBS Session. | X | X | X |
| Area Session Identifier | Used for MBS session with location dependent content. When present, the Area Session Identifier together with the TMGI uniquely identify the MBS Session in a specific MBS service area. | X (note 1) | X (note 1) | X (note 1) |
| AMF | The AMF(s) which are selected for the MBS session | X |  | X |
| QoS information | QoS information for the MBS Session, including the QoS parameters of QoS flows. | X |  | X |
| MBS Service Area | Area over which the MBS session data is distributed (i.e. Cell ID list or TAI list). | X | X | X |
| NG-RAN Node ID(s) | NG-RAN nodes which are selected for the broadcast session |  | X |  |
| IP multicast address for data distribution | IP addresses identifying the user plane transport used for shared delivery between MB-UPF and NG-RAN when the IP multicast transport is used. | X (note 1) |  | X (note 1) |
| NG-RAN IP Address for data distribution | The IP address of NG-RAN used for the user plane between NG-RAN and MB-UPF when Point to Point tunnel is used. | X (note 1) |  | X (note 1) |
| TEID for data distribution | The tunnel ID used for receiving the broadcast data for shared delivery by NG-RAN | X |  | X |
| MB-PCF | The MB-PCF that provides policy control for the MBS session. |  |  | X (note 1) |
| NOTE 1: It is an optional parameter. | | | | |

## 6.10 Policy control for Multicast and Broadcast services

The policy and charging control framework as defined in TS 23.503 [7] applies to Multicast and Broadcast services in the following aspects:

- MBS Session binding: MBS Session binding is the association of an AF Session information to one and only one MBS Session. The PCF shall perform the session binding based on the MBS Session ID, i.e. TMGI or source specific IP multicast address.

- QoS Flow binding: For an MBS Session, QoS Flow binding is the association of a PCC rule to a QoS Flow within an MBS Session. The MB-SMF performs QoS Flow binding for an MBS Session in the same way as the SMF for a PDU Session.

- PCC rules for MBS Session are used to provide policy for QoS flows: The following PCC rule parameters defined in Table 6.3.1 of TS 23.503 [7] are applicable for MBS;

+ Rule identifier

+ Service data flow detection: Precedence, Service data flow template (only for IP PDU traffic)

+ Policy Control: 5G QoS Identifier (5QI), DL-maximum bitrate, DL-guaranteed bitrate, ARP, Priority Level, Averaging Window, Maximum Data Burst Volume.

- Policy information can also be applicable for an entire MBS session. The following parameters defined for a PDU session in Table 6.4.1 of TS 23.503 [7] are applicable for an entire MBS session;

+ Authorized Session-AMBR

Editor's note: It is FFS whether any other aspects or differences compared to existing PCC framework are required for MBS policy control.

6.11 Service Announcement

Service Announcement provides the UE with descriptions specifying the multicast or broadcast services to be delivered as part of MBS Session.

The Service Announcement includes the MBS Session ID(s), which is represented by TMGI or a Source Specific IP Multicast Address, for the service. When the MBS Session ID is Source Specific IP Multicast Address, the Service Announcement may include the PLMN ID of the PLMN and NID for an SNPN in which the service is delivered.

The Service Announcement includes an MBS Service Type, which indicates whether the MBS Session for the service is multicast or broadcast.

NOTE 1: A Source Specific IP Multicast Address as MBS Session ID indicates a multicast session.

For local MBS service, the Service Announcement may include the MBS service area. The MBS service area used by AF can be Cell ID list, TAI list, geographical area information or civic address information. Amongst them, Cell ID list and TAI list shall only be used by AFs who reside in trust domain, and when the AFs are aware of such information.

If the MBS Session is multicast, the Service Announcement may include the DNN and S-NSSAI of the PDU Session to indicate which PDU Session is associated with the MBS Session.

NOTE 2: For multicast, AF or MBSF provides Service Announcement only after the MBS information is available to 5GC or the start time need be included, to avoid potential rejection sent by SMF of the MBS session join request.

NOTE 3: The MBS Service related information, e.g. default PLMN ID, DNN and S-NSSAI can be pre-configured in the UE.

NOTE 4: If DNN and S-NSSAI information is not provided in the service announcement or pre-configured, how UE determines the PDU session to join the MBS Session is implementation specific.

The Service Announcement may be provided to a UE by AF or MBSF, or may be retrieved by the UE from those entities.

NOTE 5: How the UE can get the Service Announcement from other entities is not specified.

# 7 MBS procedures

## 7.1 Common procedure for Multicast and Broadcast

### 7.1.1 MBS Session Management

Editor’s Note: Term “configuration” can be revisited in the next meeting in clauses 7.1.1.2~7.1.1.7

#### 7.1.1.1 General

The call flows in Clause 7.1.1 and clause 7.3 show a "NEF/MBSF", but as detailed in Annex A, there can be different related configurations involving either only NEF, or MBSF, or both.

The interactions between "NEF/MBSF" and MB-SMF, PCF, BSF and NRF depicted in the call flows apply for NEF, MBSF or a combined NEF and MBSF, depending on configuration. They may also apply for AF in trusted domain where NEF is not mandated.

However, the interactions between AF and "NEF/MBSF" depicted in the call flows only apply for the NEF.

Interactions between AF and MBSF based on the MB2 interface follow TS 23.468 [10].

Interactions between AF and MBSF based on the xMB interface follow TS 26.348 [11].

Services offered by the MBSF and related interactions based on that service between MBSF and AF or NEF (if MBSF and NEF are split as shown in configuration 2) are specified in SA4 TS 26.502 [18].

Detailed interactions between the MBSF or NEF and the MBSTF are specified in SA4 TS 26.502 [18].

Editor's note: The reference towards the SA4’s TS xxx and yyy needs to be added when they are ready.

7.1.1.2 Initial MBS session configuration without PCC

This procedure is used by the AF to start the MBS Session towards 5GC and consist of TMGI allocation, and MBS session creation, and they apply to both multicast and broadcast communications unless otherwise stated.

For multicast, MBS session establishment procedure triggered by UE join requests may follow the initial MBS session configuration procedure to reserve resources towards NG-RAN. For broadcast, the MBS session start procedure to reserve resources towards NG-RAN is triggered by the MBS session configuration procedure.

For both broadcast and multicast communication, the TMGI allocation may be separated from the MBS Session creation request.

For multicast communication, TMGI allocation procedure is applicable if TMGI is used as MBS Session ID.

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**Figure 7.1.1.2-1: Initial Configuration for MBS Session** **without PCC**

Steps 1 to 6 are optional and only applicable if TMGI is used as MBS Session ID and required to be pre-allocated.

1. AF sends Nnef\_TMGI\_Allocate Request (TMGI number) message to NEF/MBSF to request allocation of a TMGI(s) to identify new MBS session(s).

NOTE 1: Depending on the configuration, MB-SMF may receive requests from AF directly, or via NEF, or via MBSF, or via NEF and MBSF.

2. NEF checks authorization of AF.

NOTE 2: NEF is not required if AF is in trusted domain.

3. NEF/MBSF discovers and selects an MB-SMF using NRF or based on local configuration,

4. NEF/MBSF sends an Nmbsmf\_TMGI\_Allocate Request (TMGI number) message to the MB-SMF.

5. MB-SMF allocates TMGI(s) and returns the TMGI(s) to the NEF/MBSF via the Nmbsmf\_TMGI\_Allocate response (TMGI(s), expiration time).

6. The NEF or MBSF responds to the AF by sending an Nnef\_TMGI\_Allocate Response (TMGI(s), expiration time).

7. The AF may perform a Service Announcement towards UEs. The AF informs UEs about MBS Session information with MBS Session ID, e.g., TMGI, source specific multicast address, and possibly other information e.g., MBS service area, session description information, etc.

The MBS service area information can be Cell ID list, TAI list, geographical area information or civic address information. Amongst them, Cell ID list and TAI list shall only be used by AFs who reside in trust domain, and when the AFs are aware of such information.

The UE needs to be aware if the service is broadcast or multicast to decide if JOIN is to be performed.

Editor's note: How to do service announcements requires SA WG4 /WG6 coordination.

8. AF of content provider may provide description of an for an MBS session (possibly providing information for a previously allocated TMGI to NEF via a Nnef\_MBSSession\_Create request (([MBS Session ID], service type, MBS information, [TMGI allocation indication]). If step 1-6 has not been executed before, the AF may provide a source specific multicast address or it may request that the network allocates an identifier for the MBS session (i.e., TMGI). The AF provides the service type (i.e. either multicast service or broadcast service). MBS information may further include QoS requirements, for a multicast session MBS authorization information (e.g., or an indication that any UE may join), MBS service area, start and end time of the MBS session and MBS session state (active/inactive). In addition, MBS information may also indicate whether the allocation of an ingress transport address is requested.

If geographical area information or civic address information was provided by the AF as MBS service area, NEF/MBSF translates the MBS service area to Cell ID list or TAI list.

Editor's note: What other information is to be sent by AF is FFS.

9 NEF/MBSF checks authorization of content provider.

10. NEF/MBSF discovers MB-SMF candidates and selects MB-SMF as ingress control node, possibly based on MBS service area. If a TMGI is included in step 8, NEF/MBSF finds MB-SMF based on that TMGI.

11. NEF/MBSF sends Nmbsmf\_MBSSession\_Create Request (MBS Session ID, service type, TMGI allocation indication, MBS service area information, ingress transport address request indication) to MB-SMF, to request MB-SMF to reserve ingress resources for a MBS distribution session, The NEF/MBSF provides MBS Session ID or request allocation of a TMGI, and indicate the requested service type (either multicast service or broadcast service) and MBS session state (active/inactive). It also indicates that the allocation of an ingress transport address is requested if this was requested in step 8, or if the MBSF decides to insert an MBSTF into the user plane for the MBS session. If provided in step 8, the request includes the indication that any UE may join.

The MBS service area is provided by NEF/MBSF to the MB-SMF if provided by the AF in step 8.

12. If requested to do so, or if a source specific multicast is provided as MBS Session ID in step 11, the MB-SMF allocates a TMGI.  
If a source specific multicast is provided as MBS Session ID in step 11, the MB-SMF updates its NF profile at the NRF with the serving MBS Session ID. If an MBS service area information was received in step 11, the MB-SMF updates its NF profile at the NRF with that information.

3

13. The MB-SMF derives the required QoS parameters locally.

14 MB-SMF selects the MB-UPF. If the allocation of an ingress transport address was requested in step 11, the MB-SMF requests the MB-UPF to reserve user plane ingress resources. If multicast transport of the MBS data towards RAN nodes is to be used, the MB-SMF also request the MB-UPF to reserve for the outgoing data a tunnel endpoint and the related identifiers (source IP address, source specific multicast address and GTP Tunnel ID) and to forward data received at the user plane ingress resource using that tunnel endpoint.

If the allocation of an ingress transport address was not requested in step 11, the MB-SMF provides the source specific multicast address received as MBS session ID to the MB-UPF and requests the MB-UPF to join the corresponding multicast tree from the content provider. The MB-SMF may also defer the configuration to join the corresponding multicast tree e.g. based on information that the session is inactive, QoS requirements and MBS start/end time until receiving the first query for the MBS session as part of the establishment procedure in clause 7.2.1.3, or until receiving a request to activate the MBS session via the MBS Session Update procedure in clause 7.1.1.6 or 7.1.1.7..

15. If requested, MB-UPF selects an ingress address (IP address and port) and a tunnel endpoint for the outgoing data and provides it to MB-SMF.

16. For broadcast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.3.1.

17. MB-SMF indicates the possibly allocated ingress address to the NEF/MBSF. MB-SMF may include TMGI if it is allocated in step 9. It also indicates the success or failure of reserving transmission resources.

18. [Optional] If the MBSF decides to use an MBSTF, the NEF/MBSF provides the ingress address received in step 18 towards the MBSTF as DL destination. If the allocation of an ingress transport address was requested in step 8, the MBSF requests the MBSTF to allocate the user plane ingress resources. If the allocation of an ingress transport address was not requested in step 8, the MBSF provides the source specific multicast address received as Multicast session ID in step 8 and requests the MBSTF to join the corresponding multicast tree from the content provider.

19. [Conditional on step 19] If requested, the MBSTF selects an ingress address (IP address and port) and provides it to NEF/MBSF.

20. The NEF/MBSF-C indicates the possibly allocated ingress address and other parameters (e.g. TMGI) to the AF via an Nnef\_MBSSession\_Create response ([TMGI], [Allocated ingress address])).

21. Same as step 7. The AF may also perform a service announcement at this stage.

22. For multicast communication, depending on configuration UEs can join the MBS Session as specified in clause 7.2.1

7.1.1.3 Initial MBS session configuration with PCC

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**Figure 7.1.1.3-1: Configuration for MBS Session** **with PCC**

Steps 1 to 7 are optional and only applicable if TMGI is used as MBS Session ID and required to be pre-allocated.

1. to 10: same as in Figure 7.1.1.2-1

11. Same as step 11 in Figure 7.1.1.2-1. In addition, the NEF/MBSF decides based on local configuration or based on parameters received in step 8 (e.g. whether the session comprises several data flows) whether it will invoke the Npcf\_MBSPolicy Authorization service for the MBS session. If so, the NEF/MBSF indicates to the MB-SMF that it will also provide a policy authorization for the MBS session to the PCF.

12. Same as step 12 in Figure 7.1.1.2-1

13. [Optional] If the NEF/MBSF indicated in step 11 that it will also provide a policy authorization for the broadcast session to the PCF, the MB-SMF selects a PCF and sends an Npcf\_MBSPolicyControl\_Create Request (MBS session ID) for the MBS session towards the PCF, and defers step 25 until receiving an Npcf\_MBSPolicyControl\_UpdateNotify for the MBS session. Otherwise the MB-SMF decides based on local configuration whether to invoke the Npcf\_MBSPolicyControl service.

14. [Conditional on step 13] The PCF registers at the BSF that it handles the MBS session by using Nbsf\_management\_Register Request (MBS Session ID, PCF ID).. It provides an identifier that the policy association is for MBS and the MBS Session ID, its own PCF ID and optionally its PCF set ID.

15. [Optional] The PCF may retrieve preconfigured policy information for the MBS session (e.g. applicable QoS, the MBS Session-AMBR and/or default 5QI) from the UDR.

16. [Conditional on step 13] The PCF responds with Npcf\_MBSPolicyControl\_Create Request (MBS Policy, see clause 6.10) with policies for the MBS Session ID. The MBS Policy may include the Session-AMBR for the MBS session and 5QI for the MBS QoS Flow.

Editor’s Note: How PCF determines the MBS policy for MBS QoS Flow without service requirement in this case is FFS.

17.-18 Same as steps 14-15 in Figure 7.1.1.2-1

19 Same as step 17 in Figure 7.1.1.2-1

20-21. [Optional] The NEF/MBSF uses the BSF Discovery service to discover the PCF serving the MBS session with the MBS session ID by using Nbsf\_management\_Discovery operation.

22. [Optional] The NEF/MBSF sends an Npcf\_MBSPolicy Authorization\_Create Request to PCF with the MBS session ID and MBS information,

The PCF determines whether the request is authorized.

If the request is authorized, the PCF derives the required QoS parameters based on the information provided by the NEF and determines whether this QoS is allowed (e.g. according to the policy input configuration in the UDR).

If the request is not authorized or the required QoS is not allowed, the PCF indicates so in the response to the NEF

23. [Conditional] If the PCF determined updated policies for the MBS session in step 21, it update the policy information at the MB-SMF. When obtaining a request for the creation of a policy association (signal 21) for a broadcast session, for which it already performs policy control towards an MB-SMF, the PCF always provides a policy update to the MB-SMF; if no real policy update is required, the PCF repeats previous policies or sends an empty update message.

24. [Conditional] If required by the updated policies, the MB-SMF updates the MB-UPF accordingly.

25. When obtaining an MBS policy control update from the PCF (signal 23) for a broadcast session, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.3.1 to request the allocation of resources to for the transmission of the broadcast session.

26.-30 Same as steps 18-22 in Figure 7.1.1.2-1

Editor’s Note: AF sends a create message in step 8 and get a response in step 26. How to avoid the potential procedure handling failure is FFS.

NOTE: Steps 26-27 can be executed in parallel to steps 20-25.

7.1.1.4 Removal of MBS session configuration without PCC

This procedure is used by the AF to release the MBS Session. This procedure may also include TMGI de-allocation. The procedures apply to both multicast and broadcast communications unless otherwise stated. This procedure releases the reserved resources in both 5GC and NG-RAN.

****

**Figure 7.1.1.4-1: Removal of MBS Session configuration without PCC**

1. AF of content provider may request to release the MBS session (MBS Session ID).

2/3. If an MBSTF was inserted into the user plane, the MBSF request the MBSTF to release user plane resources.

4. NEF/MBSF requests MB-SMF to release resources for the MBS session.

5. For broadcast session, the MB-SMF triggers resource release towards the AMFs as specified in clause 7.3.2. For multicast session, the MB-SMF triggers resource release towards the SMFs as specified in clause 7.2.2.3.

6/7. MB-SMF requests the MB-UPF to release user plane resources.

8. [Conditional] If MB-SMF configured the profile with an MBS session ID when the MBS session was configured, the MB-SMF updates its NF profile at NRF to release the MBS Session ID.

9. MB-SMF responds to the NEF/MBSF.

10. The NEF/MBSF responds to the AF.

11. [Optional] AF requests NEF/MBSF to de-allocate TMGI(s),

12. [Conditional on step 11] NEF/MBSF forwards request to de-allocate TMGI(s) to MB-SMF

13. [Conditional on step 12] The MB-SMF responds to the NEF or MBSF by sending a de-allocate TMGI Response message.

14. [Conditional on step 13] NEF or MBSF forwards de-allocate TMGI Response message to AF.

7.1.1.5 Removal of MBS session configuration with PCC

This procedure is used by the AF to release the MBS Session. This procedure may also include TMGI de-allocation. The procedures apply to both multicast and broadcast communications unless otherwise stated. This procedure releases the reserved resources in both 5GC and NG-RAN.

****

**Figure 7.1.1.5-1: Removal of configuration for MBS Session with PCC**

1-3 Same as in Figure 7.1.1.4-1

4. The NEF/MBSF sends an NMBSPolicyAuthorization\_Delete Request to the PCF that handles the Policy of the MBS Session.

5. The PCF sends an Npcf\_MBSPolicyControl\_UpdateNotify Request to MB-SMF to release the MBS Policy Control Association.

6-9. Same as steps 5-8 in Figure 7.1.1.4-1

10. The MB-SMF sends the Npcf\_MBSPolicyControl\_UpdateNotify Response to the PCF.

11. The PCF de-registers at the BSF that it handles the MBS session.

12. The PCF sends an NpcfMBSPolicyAuthorization\_Delete Response to the NEF/MBSF.

13-17. Same as steps 11-15 in Figure 7.1.1.4-1.

7.1.1.6 MBS Session Update without PCC

This procedure is used by the AF to update the MB service area and/or update QoS of an MBS Session. Updating QoS of an MBS Session may lead to addition of new MBS QoS Flow(s). The procedure applies to both multicast and broadcast communications unless otherwise stated.

****

**Figure 7.1.1.6-1: Update of MBS Session** **without PCC**

1. AF of content provider initiates MBS Session Update to a NEF/MBSF, e.g. to update MBS service area and/or update service requirement, or to activate or deactivate an MBS session. AF may provide updated information for an MBS session (identified by MBS session ID) by sending MBS Session update request ([MBS Session ID], MBS information, AF Identifier). MBS information may include service requirements, MBS service area information, and media information. The service requirements adjustment may lead to addition of new MBS QoS Flow(s), removal of existing MBS QoS Flow(s) or update of existing MBS QoS Flow(s).

2. NEF checks authorization of AF.

3. NEF/MBSF forward the MBS Session Update request to MB-SMF.

4. The MB-SMF derives any updated QoS parameters locally.

5-6.

7. For broadcast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.3.3. For multicast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.2.5 (for service activation/deactivation), 7.2.6 (for QoS updates) and 7.2.x (for service area updates).

8. If an MBS service area is being updated, the MB-SMF stores the new service area in its profile at the NRF.

9. MB-SMF responds to the MBS Session Update.

10. NEF/MBSF responds to the MBS Session Update.

7.1.1.7

**Figure 7.1.1.7-1: MBS session configuration update with PCC**

1-2. Same as in Figure 7.1.1.6-1.

For updates of MBS service area and/or MBS session activation/deactivation steps 3 to 6 apply

3. NEF/MBSF forward the MBS Session Update request to MB-SMF, removing any updates not related to MBS service area and/or MBS session activation/deactivation

4. For broadcast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.3.3. For multicast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.2.5 (for service activation/deactivation), and 7.2.x (for service area updates).

5. If an MBS service area is being updated, the MB-SMF stores the new service area in its profile at the NRF.

6. MB-SMF responds to the MBS Session Update.

For other updates of the service description and QoS related updates, steps 7 to 12 apply.

7. NEF/MBSF updates the MBS policy Authorization for the MBS session at the PCF and provides the input received from the AF, removing any updates related to MBS service area and/or MBS session activation/deactivation, by sending Npcf\_MBSPolicyAuthorization\_Update Request message (MBS Session ID, service requirement).

8. Based on the input received in step 7, the PCF may provide updated policy rules to the MB-SMF by issuing Npcf\_MBSPolicyControl\_UpdateNotify request message including the updated policy information about the MBS Session.

9-10. Same as steps 5-6 in Figure 7.1.1.6-1.

11. For broadcast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.3.3. For multicast communication, the MB-SMF continues the procedure towards the AMF and NG-RAN as specified in clause 7.2.6 (for QoS updates).

12. The PCF sends the Npcf\_MBSPolicyAuthorization\_Update response to the NEF/MBSF.

13. Same as step 10 in Figure 7.1.1.6-1

7.1.2 MB-SMF discovery and selection for multicast/broadcast session

To facilitate the MB-SMF discovery/selection for one multicast/broadcast MBS session, the following mechanism is used:

- The MB-SMF registers its capability related to multicast/broadcast session management (e.g. S-NSSAI(s) and the associated NSI ID(s) (if available), DNN(s), TMGI range, service area) as part of its profile to the NRF by invoking Nnrf\_NFManagement\_NFRegister. In addition, when an multicast session is configured, and the MBS session ID is not yet included in the MB-SMF profile, the MB-SMF updates its profile towards the NRF with the MB Session ID (i.e. TMGI or source specific IP multicast address).

NOTE: The operator can preconfigure MB-SMF for specific source IP multicast address range or TMGI range.

- When the UE joins the multicast MBS session via PDU session modification procedures, the SMF serving the PDU session invokes the Nnrf\_NFDiscovery\_Request Request including the MBS session ID for multicast provided by the UE and optionally other information, i.e. the S-NSSAI and the associated NSI ID (if available), DNN, etc., to query the NRF for MB-SMF information. Based on the MBS session ID and other information for query, the NRF decides whether an MB-SMF serving the MBS session exists. If so, the NRF provides in Nnrf\_NFDiscovery\_Request Response the information of the MB-SMF currently serving the MBS session. The SMF serving the PDU session selects the MB-SMF currently serving the multicast MBS session, based on the MB-SMF information provided by the NRF. For local MBS services, the SMF takes MB-SMF service area, UE location into account when selecting the MB-SMF. If no MB-SMF serving the multicast session exists, the NRF provides MB-SMF profiles based on the other query information.

- When the multicast MBS session context is deleted from the MB-SMF, e.g. due to MBS session release, the MB-SMF updates its profile towards the NRF, i.e., removing the MBS session ID which is no longer served by the MB-SMF.

- During MBS session information provisioning procedures defined in clause 7.1.1.2, unless the MB-SMF information is available by other means, e.g. locally configured in the NEF/MBSF/AF, the NEF/MBSF/AF queries the NRF with information of the multicast/broadcast session (e.g. S-NSSAI(s) and the associated NSI ID(s) (if available), DNN(s)), and selects the MB-SMF(s) based on the MB-SMF information provided by the NRF. For local MBS services, the NEF/MBSF/AF takes MB-SMF service area into account when selecting the MB-SMF(s).

### 7.1.3 MB-UPF discovery and selection for multicast/broadcast session

The selection and reselection of the MB-UPF are performed by the MB-SMF by considering MB-UPF deployment. For the local broadcast/multicast MBS session and location-dependent MBS session, the service area is taken into consideration for MB-UPF selection.

MB-SMF may be locally configured with the information about the available MB-UPFs, e.g. by OA&M system when MB-UPF is instantiated or removed.

The MB-UPF selection functionality in the MB-SMF may optionally utilize the NRF to discover MB-UPF instance(s) which is similar with UPF selection with NRF defined in the TS 23.501 [5] clause 6.3.3.2.

## 7.2 MBS procedures for multicast Session

### 7.2.1 MBS join and Session establishment procedure

#### 7.2.1.1 General

MBS Session Join procedure is used by UEs to inform the 5GC of the UE interest in joining a multicast MBS session. The first accepted UE join request will trigger the multicast MBS session establishment towards the NG-Ran and the UE.

#### 7.2.1.2 Establishment of a PDU Session that can be associated with multicast session(s)

The PDU Session associated with multicast session(s) (i.e., the associated PDU Session) is established using the procedures as specified in TS 23.502 [6] clause 4.3.2.2 with the following differences:

NOTE 1: The DNN and S-NSSAI are used to establish the PDU session which can carry the Multicast operation, i.e. join/leave, and can be associated with multicast MBS session(s).

- In step 2, based on the DNN and S-NSSAI use for establishing a PDU Session associated with multicast session(s), the AMF selects an SMF capable of handling multicast sessions based on DNN and S-NSSAI, locally configured data or a corresponding SMF profile stored in the NRF. For indirect discovery, the AMF requests the SCP to select an SMF capable of handling multicast sessions.

- In step 4, if MBS subscription data for the UE (i.e. corresponding SUPI), DNN and S-NSSAI of the HPLMN is not available, the SMF retrieves the MBS subscription data using Nudm\_SDM\_Get (SUPI, MBS subscription data, selected DNN, S-NSSAI of the HPLMN, Serving PLMN ID, [NID]) and subscribes to be notified when this subscription data is modified using Nudm\_SDM\_Subscribe (SUPI, MBS subscription data, selected DNN, S-NSSAI of the HPLMN, Serving PLMN ID, [NID]). UDM may get this information from UDR by Nudr\_DM\_Query (SUPI, MBS data, selected DNN, S-NSSAI of the HPLMN, Serving PLMN ID, [NID]) and may subscribe to notifications from UDR for the same data by Nudr\_DM\_subscribe. The MBS subscription data can also be retrieved along with the Session Management Subscription data, i.e. with additional input parameter for MBS subscription data in the Nudm\_SDM services.

NOTE 2: In this release, the roaming is not supported, i.e. HPLMN ID and Serving PLMN ID is same.

#### 7.2.1.3 Multicast session join and session establishment procedure

The following steps are executed before the UE requests to join the MBS session:

- The MBS Session may have has been configured in the 5GC (see clause 7.1.1 for details).

- The UE registers in the PLMN and establishes a PDU session.

- The UE has known at least the MBS Session ID of a multicast group that the UE can join, e.g. via service announcement.



Figure 7.2.1.3-1: PDU Session modification for UE joining multicast session

1. To join the multicast group, the UE sends a PDU Session Modification Request which additionally contains one or several MBS Session ID(s) and join request. The MBS Session ID(s) indicate the multicast group(s) that UE wants to join.

2. [Conditional] Based on the received MBS Session ID and join request, the SMF determines this is MBS Session join request. The SMF checks whether the user is authorized to use the required multicast service.

3. [Conditional] If SMF has no information about MBS Session context for the indicated MBS Session ID(s), SMF discovers and selects an MB-SMF for the MBS Session via the NRF as described in clause 7.1.2. If no MB-SMF is assigned for the MBS session ID, the SMF may select an MB-SMF and request it configure the multicast session or the SMF may reject the join request.

NOTE 1: Details how the SMF select an MB-SMF and request it configure the multicast session are left to SMF implementation.

4. Nmbsmf\_ MBSSession\_ContextStatusSubscribe request indicates the SMF want to subscribe the MBS session context. For each MBS session in step 1, by using Nmbsmf\_ MBSSession\_ContextStatusSubscribe request (MBS Session ID) with the immediately reporting flag. SMF interacts with the MB-SMF to retrieve information about the indicated multicast session context information (multicast QoS flow information (e.g., QoS profile(s) for multicast MBS session), [start time], [session status indication (active/inactive)], [MBS session authorization information (MBS session open for any user)], LL MC address]) and to subscribe to events notifications related to the multicast session.

If it is the first time for the MB-SMF to receive Nmbsmf\_ MBSSession\_ContextStatusSubscribe request of the indicated MBS Session from SMF, MB-SMF learns it is the first UE joining the multicast group. For multicast transport between MB-UPF and content provider, if it is the first UE joining the multicast group, and MB-UPF has not joined the multicast tree in the MBS configuration procedure, the MB-SMF requests the MB-UPF to join the multicast tree towards the AF/MBSF, otherwise MB-SMF will not send the request to the MB-UPF. The MB-SMF determines whether the user is authorized to join the multicast session as follows: The MB-SMF checks the user subscription data received from the UDM to determine whether the user is allowed to use any multicast service. If so, the MB-SMF checks the received indication whether the multicast session is open for any user. If the multicast session is not open to any user, the MB-SMF checks the user subscription data received from the UDM to determine whether the MBS session ID is included. If a UE joins prior to the start time of the multicast session, the SMF may accept the join request in step 8 and indicate to the UE the start time, or it may reject the join request with appropriate error cause and possible back-off time. If a UE joins while the multicast session is inactive, the SMF accepts the join request in step 8. If authorization check fails, the SMF indicates cause value in the PDU Session Modification Reject sent to the UE and proceeds with step 8.

NOTE 2: The MB-SMF can answer the Nmbsmf\_ MBSSession\_ContextStatusSubscribe request either based on information received in the configuration procedures in Clause 7.1.1 or based on preconfigured information. The pre-configuration also includes information about the MBS session stored in the NRF. If the MB-SMF uses preconfigured information, the pre-configuration also include MB-UPF configuration.

7. SMF responds to AMF through Nsmf\_PDUSession\_UpdateSMContext response (N2 SM information (PDU Session ID, MBS Session ID, [updated PDU Session information], [mapping information between unicast QoS flow(s) and multicast QoS flow (s)]), N1 SM container (PDU Session Modification Command)) to:

- create an MBS session context for the indicated MBS session in the RAN, if it does not exist in the RAN already; and

- inform the NG-RAN about the relation between the multicast context and the UE's PDU Session context by including the MBS session ID and the mapping between the multicast QoS flow(s) and associated QoS flow(s).

Based on operator policy, the SMF may prepare for 5GC individual MBS traffic delivery fall-back. The SMF maps the received QoS information of the multicast QoS Flow into PDU Session's unicast QoS Flow information, and includes the information of the QoS Flows and the mapping information about the QoS Flows in the SM information sent to RAN.

NOTE 3: Detailed information included in N2 SM information will be aligned with by RAN WG3.

NOTE 4: A PDU Session UP activation is not triggered by message 7 if it only includes information related to the multicast session and associated QoS flows and is received by an MBS capable NG RAN node.

Editor’s Note: The implication of not triggering PDU Session UP activation in NG-RAN when SMF informs the NG-RAN of UE join requires RAN collaboration.

Editor's note: Possible PCF interactions related to the multicast QoS flows are FFS.

8. The N2 message, which includes the multicast session information and PDU session modification information is sent to the NG-RAN.

If the 5G MBS is not supported by NG-RAN, 5GC individual MBS traffic delivery may be used. Otherwise if the MBS is supported by NG-RAN, 5GC shared MBS traffic delivery is adopted.

If the NG-RAN supports 5G MBS, the NG-RAN uses the MBS Session ID to determine that the PDU Session identified by the PDU Session ID is associated with the indicated multicast session.

If the multicast QoS information is received and the NG-RAN supports MBS, the associated unicast QoS flow information is not used to allocate the radio resource and CN resource.

NOTE 5: It is NG-RAN that decides whether radio resource is allocated or not, and it is NG-RAN/UPF that decides whether multicast transport or unicast transport is used between the NG-RAN/UPF and the MB-UPF.

9. [Conditional] If shared tunnel has not been established for the MBS session towards the NG-RAN node, the procedures in clause 7.2.1.4 for the Establishment of shared delivery toward RAN node are executed. Step 9 is executed separately for each MBS session.

10. The NG-RAN node performs AN specific signalling exchange with the UE to establish radio resource for the MBS session if not established yet. If the NG-RAN does not support MBS, radio resource are reconfigured for unicast transmission of the MBS data over the associated PDU session. As part of the AN specific signalling exchange, the N1 SM container (PDU Session Modification Command) is provided to the UE.

11. The NG-RAN node sends the PDU session modification response.

If the MBS is not supported by NG-RAN, the accepted unicast QoS flow is included in the N2 SM response container. If the MBS is supported by NG-RAN, the N2 SM response container includes the accepted multicast QoS flow.

12. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext request ([N2 SM container]) to the SMF.

Per the accepted unicast QoS flow information, the SMF determines the delivery mode, i.e. whether 5GC individual MBS traffic delivery is used for multicast data transmission.

NOTE 6: If the shared tunnel is used, no interaction with UPF is needed for the indicated MBS session

[Conditional] Step 13 is used for 5GC Individual MBS traffic delivery, if the related NG-RAN does not support multicast .If a shared tunnel between the UPF (PSA) and MB-UPF for 5GC individual MBS traffic delivery has not yet been established by the SMF for the multicast session, steps 13a to 13e are executed. Step 13f is executed irrespective of that.

13a. The SMF contacts the UPF to request the creation of a tunnel and provides the MBS session ID. The UPF indicates to the SMF whether the tunnel for this MBS session is newly allocated (as there can be multiple SMFs interacting with the same UPF for the same MBS Session). If the UPF determines to use unicast transport over N19mb, the UPF allocates a DL N19mb Tunnel endpoint for the MBS session if the SMF request is the first one to allocate DL N19mb Tunnel endpoint for the MBS Session in the UPF. The UPF includes the DL Tunnel Info in the response to the SMF. The DL tunnel info includes the downlink tunnel ID and the UPF address. The UPF is now ready for receiving the MBS data from the MB-UPF and forwarding the data to the PDU session.

Editor’s Notes: whether 13b to 13e can be skipped for multicast N10mb is FFS

13b. If the UPF indicates the DL N19mb Tunnel is newly allocated, the SMF invokes Nmbsmf\_MBSsession\_ ContextUpdate request (MBS Session ID, [DL tunnel info]) towards MB-SMF that includes MBS Session ID and downlink tunnel info of UPF, for establishing the multicast session transport between MB-UPF and UPF.

13c. If the DL tunnel info of the UPF is received, MB-SMF configures MB-UPF to transmit the multicast session data towards UPF using the possibly received downlink tunnel ID.

13d. MB-SMF responds to SMF through Nmbsmf\_MBSSession\_ ContextUpdate response (MBS Session ID, [multicast DL tunnel info]). If the UPF DL tunnel info for unicast transport is not received by the MB-SMF, multicast transport between MB-UPF and UPF is to be used, and the SMF includes the downlink tunnel information with the transport multicast address for the multicast session.

13e. For multicast transport between MB-UPF and UPF, SMF configures UPF to receive the multicast session data. If multicast transport over N19mb is used, the UPF joins the source specific multicast group of MB-UPF. The UPF forwards the data to the PDU session.

13f. The MB-SMF configures the MB-UPF to forward the received multicast session data within the PDU session. (This step may be combined with step 13a or 13e).

14. The SMF invokes Nsmf\_PDUSession\_UpdateSMContext response to the AMF.

15. MB-UPF receives multicast PDUs, either directly from the content provider or via the MBSTF that can manipulate the data.

Steps 16 to 18 are for 5GC shared MBS traffic delivery:

16. MB-UPF sends multicast PDUs in the N3mb tunnel associated to the multicast session to the NG-RAN. There is only one tunnel per multicast session and NG-RAN node, i.e., all the UEs which have joined the multicast session via the NG-RAN node share this tunnel for reception of the multicast session data.

17. The NG-RAN selects PTM or PTP radio bearers to deliver the multicast PDUs to the UE(s) that have joined the multicast session.

18. The NG-RAN transmits the multicast session data to the UE(s) using the selected PTM or PTP radio bearer(s).

Steps 19 to 21 are for 5GC individual MBS traffic delivery:

19. MB-UPF sends multicast PDUs in the N19mb tunnel associated to the multicast session to UPF. There is only one tunnel per multicast session and destination UPF, i.e., all associated PDU sessions share this tunnel.

20. UPF forwards the multicast data towards the NG-RAN via unicast (i.e. in the N3 tunnel of the associated PDU Session).

21. The NG-RAN forwards the multicast session data to the UE via unicast (i.e. over the radio bearer(s) corresponding to the mapped unicast QoS flow(s) of the associated PDU Session).

NOTE 7: Details of the DL MBS data transmission are described in clause 6.7.

NOTE 8: When the MBSF is involved in the multicast MBS session, the tunnel between MBSTF and MB-UPF has been established in the configuration procedure.

#### 7.2.1.4 Establishment of shared delivery toward RAN node

In the following cases, the shared tunnel for shared delivery is established between the NG-RAN and MB-UPF:

- The first UE is included in the context of the MBS session in the NG-RAN.

NOTE 1: When the MBS session is deactivated, if there is at least one UE joining the MBS session is in connected mode in the NG-RAN, the shared delivery is not released.

NOTE 2: Share delivery establishment procedures are used when MBS supporting NG-RAN node(s) get involved in the MBS session upon MBS session activation.

- Handover to the target NG-RAN when the shared delivery tunnel is not established in the target RAN node for this MBS session.

**NG-RAN**

**AMF**

**MB-SMF**

**MB-UPF**

1. Decide to establish shared delivery for a multicast session

2. N2 Message ()

3. Nmbsmf\_MBSSession\_ContextUpdate Request

4. N4mb Session Modification

6. Nmbsmf\_MBSSession\_ContextUpdate Response

7. N2 Message ()

5. Store AMF ID for the MBS session

Figure 7.2.1.4-1: Establishment of shared delivery toward NG-RAN node

1. A NG-RAN node decides to establish shared delivery for an MBS session when it serves at least one UE within the MBS session. For location dependent services, the NG-RAN node needs to establish shared delivery for the location dependent contents of an MBS session if it serves at least one UE assigned to an MBS session ID and area session ID.

2. The NG-RAN sends an N2 MBS Session request message (MBS Session ID, N2 SM information (MBS Session ID, [unicast Tunnel Info], [Area Session ID])) towards AMF.

If the NG-RAN node is configured to use unicast transport for the shared delivery, it allocates a GTP tunnel endpoint and provides the unicast Tunnel Info in the request, which includes the GTP tunnel endpoint and NG-RAN node address. For location dependent MBS services, the NG-RAN node also provides the Area Session ID.

3. The AMF selects the MB-SMF serving the multicast session using the NRF discovery service. It invokes Nmbsmf\_MBSSession\_ContextUpdate request (MBS Session ID, N2 SM information) to the MB-SMF.

The AMF stores the information for the NG-RAN nodes (e.g. NG-RAN node ID) for the subsequent signaling related to the MBS Session.

4. If the MB-SMF received unicast Tunnel Info in step 3, it configures the MB-UPF to send multicast data for the multicast session (or location dependent content of the multicast session if an area session ID was received) towards that GTP tunnel endpoint via unicast transport.

5. The MB-SMF stores the AMF in the multicast session context (or location dependent part of the multicast session context if an area session ID was received) to enable subsequent signalling towards that NG-RAN node.

6. The MB-SMF sends Nmbsmf\_MBSSession\_ContextUpdate response (MBS Session ID, N2 SM information ([TMGI], multicast QoS flow information, [transport multicast address], [multicast Tunnel Info])) to the AMF. If the MB-SMF did not receive unicast Tunnel Info in step 3, it provides the transport multicast address (e.g. a LL SSM) and a GTP tunnel endpoint for multicast transport of the shared delivery.

7. The AMF sends an N2 MBS Session response (MBS Session ID, N2 SM information) to the NG-RAN node. If the NG-RAN node receives the transport multicast address and multicast Tunnel Info of the shared delivery, it uses the transport multicast address to join the multicast transport distribution.

### 7.2.2 MBS Session leave and Session release procedure

#### 7.2.2.1 General

Session Leave procedure is used by UEs to inform the 5GC of the UE leaving an MBS Session. The user plane management is described in clause 6.7.

7.2.2.2 MBS Session Leave

When the UE determines to leave the multicast MBS Session, it shall send PDU session Modification request to inform the 5GC the leaving operation. The Fig 7.2.2.2-1 describes the procedure.



**Figure 7.2.2.2-1: UE initiated multicast MBS session leave**

1. The UE sends the PDU Session Modification Request when the UE determine to leave the multicast MBS Session. The PDU Session Modification Request carries the MBS session ID which the UE want to leave.

2. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext (N1 SM container (PDU Session Modification Request with the MBS session leaving information (i.e., leave indication, MBS session ID))) to SMF.

3a. [Conditional] If 5GC individual MBS traffic delivery is applied, the SMF sends an N4 Session Modification Request to the UPF (PSA). The SMF reconfigures UPF to terminate the distribution of multicast data via the PDU session and release the resources for the reception of the multicast data.

3b. The UPF (PSA) sends an N4 Session Modification Response to the SMF.

If there are no PDU sessions to receive the MBS session data in the UPF, and unicast transport is used over N19mb, the UPF releases the DL N19mb tunnel endpoint and informs the SMF.

If there are no PDU sessions to receive the MBS session data in the UPF, and multicast transport is used over N19mb, the UPF leaves the multicast distribution tree of MB-UPF.

4. [Conditional] If the UPF indicates the tunnel release, the SMF invokes Nmbsmf\_MBSession\_ReceptionStop Request (MBS session ID, [tunnel information]) to release the tunnel between UPF and MB-UPF for this MBS session.

NOTE 1: The service operation and the parameters need to align with the MB-SMF service definition.

If unicast transport is used, tunnel information is included to indicate the tunnel between UPF and MB-UPF.

5. [Conditional] The MB-SMF request to MB-UPF to release the tunnel between UPF and MB-UPF for the MBS session.

6. [Conditional] The MB-SMF responds to SMF for step 4.

7. The SMF invokes the Nsmf\_PDUSession\_UpdateSMContext Response (PDU Session ID, N2 SM information (MBS Session ID), N1 SM container) service operation. In the N2 SM information, the SMF informs the NG-RAN to remove the UE from this MBS session if 5GC Shared MBS traffic delivery method is used.

In the N2 SM information, the SMF also informs the NG-RAN to release the associated QoS Flow(s), which carry or intend to carry the Multicast MBS traffic for 5GC individual MBS traffic delivery.

The mapped QoS Flow(s) are released as defined in TS 23.502 [6] clause 4.3.3.2.

8. The AMF send N2 message (N2 SM information, N1 SM container) to the NG-RAN

9. The NG-RAN node performs the necessary AN-specific resource modification procedure toward the UE and transports the N1 SM container received in step 7 to the UE.

10. The NG-RAN node removes the UE from this MBS session and sends a N2 message to the AMF.

11. The AMF transfers the N2 message received in step 9 to the SMF via the Nsmf\_PDUSession\_UpdateSMContext service operation.

The SMF updates the associated PDU session SM context, e.g., remove the MBS session ID from the SM context. In addition, if dedicated QoS flow is used for the unicast transfer of the multicast data, the SMF also removes the unicast QoS flow information associated with the indicated MBS session form the UE SM context.

11a. If the UE is the last joined one of the MBS session in the SMF, The SMF also indicates that the last UE served by the SMF leaves the Multicast MBS Session, the SMF unsubscribes the MBS session updates from the MB-SMF. And the MB-SMF will no longer notify/invoke the SMF for the further updates of the MBS session (e.g., activation, deactivation, update, release, etc.). For multicast transport between MB-UPF and content provider, if it is the last remaining SMF that subscribed for MB-SMF information notify, i.e., if it is the last UE leaving the MBS session, the MB-SMF may request the MB-UPF to leave the multicast tree towards the AF/MBSF, if the MB-UPF joins the multicast tree when the first UE joins the MBS session.

NOTE 2: The service operation and the parameters need to align with the MB-SMF service definition.

12. If the UE is the last UE in this RAN node for this MBS session, the NG-RAN release shared delivery between NG-RAN and MB-UPF as described in clause 7.2.2.4.

If release of the PDU Session associated with an MBS session is triggered, corresponding procedures between UE, NG-RAN, AMF, and SMF are performed as described in clause 4.3.4 of TS 23.502 [2], and SMF triggers the UE leave the MBS session by performing steps 3-6 in Figure 7.2.2.2-1 for each MBS session(s) associated with the PDU Session, and UE considers as left the MBS session. If the UE deregistration procedure is executed, corresponding procedures between UE, NG-RAN, AMF, and SMF are performed as described in clause 4.2.2.3 of TS 23.502 [2], and SMF performs steps 3-6 in Figure 7.2.2.2-1 for all MBS sessions joined by the UE. When the PDU Session Release procedure or UE deregistration procedure is executed, according to the UE context, NG-RAN performs step 12 for each MBS session associated with the PDU Session.

#### 7.2.2.3 SMF removing joined UEs from MBS session

This procedure applies:

1. When the AF determines to release the MBS Session, the AF initiates MBS Session Release procedure towards the MB-SMF.

2. When the SMF decides to remove a UE from an MBS session.

When the SMF receives the notification indicating multicast session release from the MB-SMF, the SMF initiates procedures to remove the joined UEs from the MBS session.

For the active MBS session, to release radio resources as early as possible, the MB-SMF may trigger Multicast Session Deactivation towards the NG-RAN as specified in clause 7.2.5.3, prior to or in parallel with triggering MBS Session Release to the SMF.



Figure 7.2.2.3-1: SMF removing joined UEs from MBS session

1. The SMF receives Nmbsmf\_MBSSession\_ContextNotify (Release, MBS Session ID) from the MB-SMF with MBS Session ID. The SMF checks joined UEs.

NOTE 1: the service operation name and parameters need to align with the MB-SMF service operation definition.

2. For UEs without activated UP, the SMF may perform the same procedure as defined in step 3-7 in clause 7.2.5.2.

Alternatively, for UEs without activated UP, the SMF does not trigger message to the AMF, instead the SMF marks that the UE is to be informed of the MBS Session release.

NOTE 2: The SMF initiates PDU Session Modification to inform the UE of the MBS Session release at next UP activation of the associated PDU Session.

3. For the joined UEs with UP activated, the SMF invokes Namf\_Communicate\_N1N2MessageTransfer to the AMF. The N1 SM container indicates MBS session release. In N2 SM information, the SMF informs the NG-RAN to remove the UE from the MBS session. If there are associated QoS Flow(s) for individual delivery, the SMF also release those QoS Flow(s) as specified in TS 23.502 [6] clause 4.3.3.2.

4. The AMF sends N2 Request to the NG-RAN.

5. The NG-RAN transports the N1 SM container (PDU Session Modification Command) to the UE.

6. The NG-RAN performs radio resource modification. If no joined UEs in the MBS session, the NG-RAN release the radio resources.

7. If no joined UEs in the MBS session, for unicast transport of N3mb, the NG-RAN initiates the DL tunnel release towards MB-UPF via AMF and MB-SMF. For multicast transportation of N3mb, the NG-RAN perform IGMP/MLD Leave for the MBS session. See clause 7.2.2.4 for details.

8. The NG-RAN sends N2 Response to the AMF. If no joined UEs in the MBS session, the MBS Session context is removed from the NG-RAN.

9. The AMF transfers the N2 message received in step 8 to the SMF via the Nsmf\_PDUSession\_UpdateSMContext service operation. The SMF removes the UE from the MBS Session.

When the UP for the associated PDU Session is activated as specified in clause 4.2.3.2 and clause 4.2.3.3 of TS 23.502 [6], the SMF initiates PDU Session Modification to inform the UE of the MBS Session release, if needed.

7.2.2.4 Release of shared delivery toward RAN node

In the following case, the shared delivery tunnel may be released between NG-RAN and MB-UPF:

- The last UE is excluded from the context of the MBS session in the NG-RAN;

- Handover to the target NG-RAN when the UE is the last UE for this MBS session in the source NG-RAN node during handover preparation phase known by the source NG-RAN node;

- Handover to the target E-UTRAN when the UE is the last UE for this MBS session in the source NG-RAN;

- MBS session de-configuration.

NOTE: When the MBS session is deactivated, the shared delivery is not release if there is at least one UE is in connected mode for this MBS session.



**Figure 7.2.2.4-1: Release of shared delivery toward RAN node**

1. A RAN node decides to release shared delivery for an MBS session, e.g. because it no longer serves at least one UE within the MBS session. For location dependent services, the NG-RAN node may release shared delivery for the location dependent contents of an MBS session if it no longer serves at least one UE assigned to an MBS session ID and area session ID.

2. The NG-RAN node sends N2 MBS Session release request (MBS Session ID, [unicast GTP TEID], [Area Session ID]) to the AMF. For location dependent services, the NG-RAN node also provides the Area Session ID. The RAN node includes the unicast GTP TEID if unicast transport is used for the shared delivery.

3. The AMF invokes Nmbsmf\_MBSSession\_ReceptionEnd request (MBS Session ID, N2 SM information) to the MB-SMF corresponding to the MB-SMF ID stored in the AMF for the MBS Session ID.

4. If unicast transport was used towards the NG-RAN node, the MB-SMF sends N4mb Session Modification to the MB-UPF to release the N3mb tunnel used for the multicast session (or location dependent content of the multicast session if an area session ID was received) towards that RAN node using the received GTP tunnel endpoint information.

5. The MB-SMF responses to the AMF. If there’s no RAN node controlled by the AMF serving the multicast session, the MB-SMF also removes the AMF ID from the context of the multicast session.

6. The AMF removes the RAN node ID from storage in the context of the multicast session (or location dependent part of the multicast session if an area session ID was received).

7. The AMF sends an N2 MBS Session release response (MBS Session ID) to the RAN node. The NG-RAN node deletes the unicast GTP TEID (if unicast transport is used for the shared delivery) or sends IGMP/MLD leave message to leave the multicast transport if multicast transport is used for the shared delivery). The NG-RAN node releases local resources for the multicast session.

### 7.2.3 Mobility Procedures for MBS

#### 7.2.3.1 General

UE may move from one NG-RAN node to another NG-RAN node after UE has joined the MB Session. There are various mobility scenarios possible, depending on whether one of the involved NG-RAN nodes supports 5G MBS.

During an active MBS Session, mobility between an NG-RAN supporting 5G MBS and an NG-RAN node not supporting 5G MBS requires the mobility procedure to provide the appropriate MBS traffic delivery method at the target NG-RAN node.

7.2.3.2 Xn based handover from MBS supporting NG-RAN node

This clause describes an Xn based handover with MBS traffic delivered to the UE at the source NG-RAN node supporting 5G MBS.



**Figure 7.2.3.2-1: Xn based handover with MBS Session**

The following additions apply compared to clause 4.9.1.2 of TS 23.502 [6]:

**Before Handover:**

The source NG RAN has been provided with MBS Session Resource information (including the MBS Session ID and multicast QoS flow information) and the UE Context information contains a mapping information within the PDU Session Resource associated with the MBS Session Resource, e.g. including mapped unicast QoS Flows associated with the multicast QoS flow(s) of the MBS Session Resource.

**Handover Preparation Phase:**

At Xn handover, the target NG-RAN is provided with information by the source NG-RAN which causes:

- a 5G MBS non-supporting target NG-RAN node to prepare the unicast resources according to associated QoS flow(s) information.

‐ a 5G MBS supporting target NG-RAN node to allocate to the UE shared NG-RAN resources according to the MBS session information. If the 5GC MBS delivery for the indicated MBS Session has not been established in target NG-RAN, target NG-RAN triggers setup of the resources for the 5GC shared MBS traffic delivery, see clause 7.2.1.4 for details.

1. Target NG-RAN to AMF: the target NG-RAN sends N2 Path Switch Request to AMF.

The target NG-RAN node indicates whether it supports of MBS to SMF in N2 SM information. Per the received N2 SM information, the SMF knows whether the target NG-RAN node supports 5G MBS and determines the delivery method, i.e., whether the 5GC shared MBS traffic delivery is used for MBS data transferring.

Based on the received N2 SM message, the SMF can differentiate two cases:

Case A) The target NG-RAN supports 5G MBS. Step 3 applies and steps 4~8 are skipped.

3. SMF to UPF: The SMF invokes N4 Session Modification procedure with the UPF (PSA) only for unicast PDU Session.

Case B) The target NG-RAN does not support 5G MBS and the UPF is not yet configured to forward multicast data via unicast, steps 4 to 8 apply.

4. SMF to UPF (PSA): The SMF invokes N4 Session Modification procedure with UPF (PSA), the SMF instructs the UPF (PSA) to forward the multicast data received from the MB-UPF via the associated QoS flow(s) of the PDU Session. The SMF provides the mapping information between the multicast QFI and the corresponding unicast QFI of the multicast QFI in the PDU Session to the UPF (PSA), the UPF (PSA) forwards the multicast data via the PDU session based on the mapping information. If the delivery tunnel for the MBS session from MB-UPF to UPF is not established yet, the SMF instructs the UPF (PSA) to allocate a tunnel endpoint for the reception of multicast data from the MB-UPF.

If delivery of the multicast data from MB-UPF to UPF needs to be configured, steps 5 to 8 apply.

5. SMF to MB-SMF: The SMF invokes an Nmbsmf\_MBSSession\_Update (MBS session ID, DL tunnel info) service operation to MB-SMF to establish the shared tunnel between the UPF (PSA) and MB-UPF.

6. MB-SMF to MB-UPF: The MB-SMF configures the MB-UPF with the received DL tunnel Info and instructs the MB-UPF to forward data of the MBS session to the UPF (PSA) via the tunnel. The MB-UPF starts to forward data of the MBS session to the UPF (PSA) if unicast transport is applied. If multicast transport is applied, the MB-UPF return the endpoint information (e.g. the Common-TEID) including the transport multicast address to MB-SMF.

7. MB-SMF to SMF: The MB-SMF responds to SMF through Nmbsmf\_MBSSession\_Update response. If multicast data are transported via multicast transport, the MB-SMF provides endpoint information (e.g. the Common-TEID) including the transport multicast address.

8. SMF to UPF (PSA): The SMF invokes an N4 Session Modification procedure with the UPF (PSA). If multicast data are transported via multicast transport, the SMF provides endpoint information including the transport multicast address to the UPF (PSA) and the UPF (PSA) sends IGMP Join in order to receive data from the MB-UPF.

9.

Editor's note: Details on data forwarding, if applicable, needs to wait for RAN WGs.

11. SMF to AMF: The SMF responds to AMF through Nsmf\_PDUSession\_UpdateSMContext response.

12. AMF to target NG-RAN: The AMF sends the path switch Ack to target NG-RAN.

7.2.3.3 N2 based handover from MBS supporting NG-RAN node

This clause describes the N2 based handover with MBS traffic delivered to the UE at the source NG-RAN node supporting 5G MBS.



**Figure 7.2.3.3-1: N2 based handover with MBS Session**

The following additions apply compared to clause 4.9.1.3 of TS 23.502 [6]):

2. Source NG-RAN to S-AMF: Handover Required (RAN container (MBS Session information, associated PDU session information, associated QoS flow information and corresponding multicast QoS flow information)).

4. SMF to T-AMF: The T-AMF is provided with associated PDU Session information and the MBS session related information.

5. T-AMF to Target NG-RAN: The Target NG-RAN prepares the radio resource based on the received information:

- If the target NG-RAN does not support 5G MBS, the MBS Session information is not used. The target NG-RAN uses the associated mapping PDU Session information to allocate resource to deliver MBS data. The MBS data are transmitted via the associated QoS flows within the associated PDU Session.

- If the target NG-RAN supports 5G MBS, the target NG-RAN uses the MBS Session information to allocate resource to deliver the MBS data.

6-10. If Target NG-RAN supports 5G MBS and the MBS delivery for the indicated MBS Session has not yet been established towards target NG-RAN, the target NG-RAN initiates the shared delivery establishment towards the MB-SMF. Details is defined in the clause 7.2.1.4.7. Target NG-RAN to T-AMF: The target NG-RAN sends Handover Request Ack to T-AMF.

The target NG-RAN node indicates whether it supports of 5G MBS to SMF in N2 SM information. Per the received N2 SM information, the SMF knows whether the target NG-RAN node supports 5G MBS and determines the delivery method, i.e. whether the 5GC shared MBS traffic delivery is used for MBS data transferring.

17. T-AMF to SMF: The AMF invokes Nsmf\_PDUSession\_UpdateSMContext request towards SMF, the message includes the received N2 SM message.

Based on the received N2 SM message, the SMF can differentiate two cases:

Case A) The Target NG-RAN supports 5G MBS. Step 18 applies and steps 19~23 are skipped.

18. SMF to UPF (PSA): The SMF invokes N4 Session Modification procedure with the UPF (PSA) only for unicast PDU Session. The SMF instructs the UPF to send the end marker packet towards the source NG-RAN and to send subsequent packets towards the target NG-RAN within the unicast PDU Session.

Case B) The target NG-RAN does not support 5G MBS. If the UPF (PSA) is not yet configured to forward multicast data via unicast, steps 19 to 23 apply.

19 SMF to UPF: The SMF may invokes N4 Session Modification procedure with UPF (PSA), the SMF instructs the UPF (PSA) to forward the multicast data received from the MB-UPF via the associated QoS Flow(s) within the associated PDU Session (i.e., 5GC Individual MBS traffic delivery method will be used). The SMF provides the mapping information between the multicast QFI and the corresponding mapped associated QFI to the UPF (PSA), the UPF (PSA) forwards the multicast data via the PDU session based on the mapping information. If the delivery tunnel for the MBS session from MB-SMF to UPF is not established yet, the SMF instructs the UPF (PSA) to allocate a tunnel endpoint for the reception of multicast data from the MB-UPF.

If delivery of the multicast data from MB-UPF to UPF needs to be configured, steps 24 to 27 apply.

20. SMF to MB-SMF: The SMF invokes an Nmbsmf\_Reception\_Request (MBS session ID, SMF ID, DL tunnel info) request service operation to MB-SMF to establish the shared tunnel between the UPF (PSA) and MB-UPF.

21. MB-SMF to MB-UPF: The MB-SMF configures the MB-UPF with the received DL tunnel Info and instructs the MB-UPF to forward data of the MBS session to the UPF (PSA) via the tunnel. The MB-UPF starts to forward data of the MBS session to the UPF (PSA).

22. MB-SMF to SMF: The MB-SMF responds to SMF through Nmbsmf\_Reception\_Request response. If multicast data are transported via multicast, the MB-SMF provides endpoint information (e.g. the Common-TEID) including the transport multicast address.

23. SMF to UPF (PSA): The SMF invokes an N4 Session Modification procedure with the UPF (PSA). If multicast data are transported via multicast, the SMF provides endpoint information including the transport multicast address to the UPF (PSA) and the UPF (PSA) sends IGMP Join in order to receive data from the MB-UPF.

24./25.

Editor's note: Details on data forwarding, if applicable, needs to wait for RAN WGs.

#### 7.2.3.4 Xn/N2 based handover from non-MBS supporting NG-RAN node

When the UE has joined the MBS session and the source NG-RAN node does not support 5MBS, the 5GC Individual MBS traffic delivery method is used for the MBS session data delivery. When the Xn/N2 based handover procedure is triggered, the UE is handed over to the target NG-RAN node per existing Xn /N2 based handover procedure defined in TS 23.502 [6].

The following applies for an Xn handover from an NG-RAN node not supporting MBS to an NG-RAN node supporting MBS:

- The source NG-RAN node requests the associated QoS Flow(s) in the associated unicast PDU session to be handed over to the target NG-RAN node.

- In the Path Switch Request message, the target NG-RAN node indicates whether it supports MBS to the SMF in the N2 SM information.

- After successful handover, if the target NG-RAN node support MBS the SMF triggers modification of the PDU Session resources at NG-RAN by including the MBS related information in N2 SM Info, which includes the MBS session ID and the associated QoS flow(s) information .

- The SMF changes the MBS session data delivery method from 5GC Individual MBS traffic delivery method to 5GC shared MBS traffic delivery method, and sends N4 Session modification message to UPF to configure UPF to not forward the received multicast service data via the associated PDU Session. If there are no multicast MBS session data forwarding via the associated PDU session(s) is needed, the shared tunnel between the UPF and MB-UPF can also be released.

The following applies for an N2 handover from an NG-RAN node not supporting MBS to an NG-RAN node supporting MBS:

- During handover preparation phase, the SMF includes the MBS session related information in N2 SM Information and sends it to target NG-RAN. The target NG-RAN indicates its support of MBS to SMF in N2 SM information. The NG-RAN node adds the UE into the MBS session context.

- Based on the received N2 SM information, the SMF determines the MBS data delivery method. The SMF configures UPF to not forward the received multicast service data to the associated PDU Session via N4 Session modification message, i.e. SMF changes 5GC individual MBS traffic delivery to 5GC shared MBS traffic delivery. If there are no multicast MBS session data forwarding via the associated PDU session(s) is needed, the shared tunnel between the UPF and MB-UPF can also be released.

#### 7.2.3.5 Minimization of data loss

Editor's note: Details for how to minimize data loss between the source NG-RAN node and the target NG-RAN node should be aligned with 3GPP RAN WGs.

#### 7.2.3.6 Xn/N2 based handover for inactive MBS session

If the MBS session in "Inactive" state, comparing the handover procedure for the MBS session in "Active" state, the following additional procedures apply:

* For Xn based handover, the information that MBS session is inactive is provided from the source RAN node towards the target RAN node.
* For N2 based handover, the information that MBS session is inactive is provided from SMF towards the target RAN node.
* For the MBS supporting NG-RAN node, the target NG-RAN establishes the shared tunnel with the MB-UPF as usual. However, as the MBS session is inactive state, the NG-RAN node will not allocate related radio resource.
* After a handover to a not supporting MBS target RAN node, the SMF removes the associated QoS flow(s) information.

Editor’s Notes: RAN confirmation is required.

NOTE: Whether the associated QoS Flow(s) are removed from UE, NG-RAN, or only resource in NG-RAN is removed is up to implementation.

### 7.2.4 Support of Local multicast service

#### 7.2.4.1 General

The procedures for Local multicast service contains the ones for Local multicast service with the location-dependent content, and the ones for limited local multicast service distribution, as described in clause 6.2.

#### 7.2.4.2 Support of multicast service with location-dependent content

##### 7.2.4.2.1 UE join location dependent multicast session and establishment procedure

The local multicast session join and establishment procedure is performed as defined in clause 7.2.1 with the following additions:

- The local multicast session is configured as described in clause 7.2.4.2.2.

- If SMF has no information about the multicast MBS session context for the indicated MBS Session ID, the SMF requests MB-SMF information via Nnrf\_NFDiscovery\_Request Request (MBS Session ID, UE location), the NRF provides information about the MB-SMF(s) serving the multicast session at the indicated location and service areas and service area IDs for the multicast session, via Nnrf\_NFDiscovery\_Request Response (MB-SMF profile(Area Session ID(s), MBS service area(s)). The SMF selects the MB-SMF based on the location area where the UE is residing and interacts with MB-SMF to retrieve QoS information of the multicast QoS flow(s) for the MBS Session ID.

- SMF requests the AMF to transfer an N2 message to the RAN node using the Nsmf\_PDUSession\_UpdateSMContext response, to provide the NG-RAN with multicast session information which additionally includes the Area Session ID(s) and MBS service area(s) that the NG-RAN node belongs to. The SMF provides all MBS service areas information (Area session ID, MBS service area) to NG-RAN.

- The RAN uses the received MBS Session ID(s) and Area Session ID(s) to determine the local multicast session context and whether the user plane for the local multicast session is already established.

##### 7.2.4.2.2 Configuration for local MBS

For local MBS, the configuration procedure for the UE is optional and performed as defined in clause 7.1.1.2 with the following additions:

- Multiple AFs may start the same multicast session with different content in different MBS service areas. The NEF selects MB-SMF as ingress control node(s) for different MBS service areas.

- If presented, the NEF maps possible external identifiers for MBS service areas to network-internal identifiers (e.g. list of cells, TAIs).

- MB-SMF allocates Area Session ID, and updates its NF profile towards the NRF with the MBS Session ID, session area and Area Session ID.

NOTE: For a location dependent service provided in different MBS service areas within the same SMF service area, it is assumed that one MB-SMF is used for an MBS Session. If the MBS Session ID is TMGI, the MB-SMF updating NF profile can be skipped.

- The policy of Multicast session is determined based on the service requirements per MBS service area.

- The MB-SMF may select the MB-UPF based on the MBS service area.

- The MBS service area(s) are indicated to the UE in the Service Announcement as defined in clause 6.11.

##### 7.2.4.2.3 Handover procedure

The Handover procedure for the UE is performed as defined in clause 7.2.3 with the following additions:

- Before the Handover, The UE is camping at Source RAN and receiving multicast data corresponding to the MBS Session ID and Area Session ID.

- For the Xn Handover:

- Source RAN includes MBS Session ID, Area Session ID and MBS service area to the Target RAN.

- Target RAN determines whether to establish the resources for multicast distribution for MBS Session ID and Area Session ID provided by Source RAN, based on MBS Session ID, Area Session ID and MBS service area.

NOTE: Data forwarding issue needs the feedback of RAN WGs

- Target RAN responses to Source RAN, with the accepted MBS Session ID, Area Session ID. When Target RAN supports multicast but the UE is no longer in the location area, Target RAN rejects to handover the multicast session with a cause indication.

- For the N2 Handover:

- The SMF includes all MBS session area information (MBS Session ID, Area Session ID and MBS service area) to the Target RAN in Handover request.

- Target RAN determines whether to establish the resources for multicast distribution for MBS Session ID and Area Session ID provided by SMF, based on MBS Session ID, Area Session ID and location area. - If the target RAN determines the shared delivery is not established for the multicast session ID and area session ID, the target NG-RAN initiates the shared delivery establishment as specified in clause 7.2.1.4.

#### 7.2.4.3 Support of multicast service available within a limited area

##### 7.2.4.3.1 Local MBS service area information provided by AF

For local multicast services, the MBS service area information is provided to the UE and the 5GC as specified in clauses 7.1.1.2 and 7.1.1.3 with the following differences and clarifications:

- For the Service Announcement, MBS service area information may be included.

- When performing the MBS session request to the 5GC, the MBS service area information for a multicast session may be provided by the AF.

##### 7.2.4.3.2 Multicast session join and session establishment procedure for multicast service available within a limited area

For the case that the multicast service is only available within a limited area, the UEs outside the MBS service area are not allowed to join the multicast service.

The multicast session join and session establishment for multicast service available within a limited area are performed as specified in clause 7.2.1.3 with the following differences and clarifications:

- The local multicast session has been configured where the AF provided the MBS service area information as specified in clause 7.2.4.3.1.

- The UE may have information about local multicast service including MBS service area and local MBS service indication via Service Announcement as specified in clause 7.2.4.3.1.

- In step 1, if the UE determines that it is in the MBS service area based on the information about local multicast service e.g. obtained via Service Announcement, the UE sends the PDU Session Modification Request (MBS Session ID) as a Join Request to join the multicast group. If the UE determines that it is outside the MBS service area, the UE does not send the Join Request.

- In step 4, the SMF obtains the MBS service area (i.e. Cell ID list or TAI list) of the indicated MBS session from the MB-SMF, and the SMF determines the indicated MBS session corresponds to local multicast service based on the MBS service area.

- In step 5, the SMF checks whether the UE is inside or outside the MBS service area.

- If the SMF detects that the UE is inside the MBS service area, the SMF continues the process of multicast session join as specified in clause 7.2.1.3 with the following additions:

- The SMF sends the UE a PDU Session Modification Command indicating a Join Accept as a response to the Join Request. The Joint Accept includes the MBS service area (i.e. Cell ID list or TAI list).

- The multicast session information sent by the SMF to the NG-RAN includes the MBS service area (i.e. Cell ID list or TAI list).

- If the SMF detects that the UE is outside the MBS service area, the SMF rejects the multicast session join, so sends a Join Reject to the UE indicating that the MBS join is rejected. The Joint Reject includes the reject reason (outside of local service area) and the MBS service area (i.e. Cell ID list or TAI list).

In this case, the MBS Session establishment (i.e. resources establishment for MBS traffic delivery) for the UE is not performed.

NOTE 1: There may be the case that the UE determines that it is inside the MBS service area based on the geographical area information or civic address information as MBS service area information provided by the AF, so sends a Join Request but the UE is outside the MBS service area.

NOTE 2: Which SM NAS message is used to deliver the Join Reject (e.g. PDU Session Modification Reject) is defined in stage 3 specifications.

- If the Join Request from the UE is accepted and 5GC individual MBS traffic delivery is used, the SMF subscribes to the UE mobility event notification from the AMF (e.g. UE moving into or out of Area Of Interest, which is set by MBS service area), by invoking Namf\_EventExposure\_Subscribe service operation as specified in clause 5.2.2.3.2 of TS 23.502 [6].

- For the UE that received the Join Reject from the SMF, later, if the UE detects that it is inside the MBS service area based on the MBS service area provided in the Join Reject, the UE sends the PDU Session Modification Request (MBS Session ID) to join the multicast group.

##### 7.2.4.3.3 Handover procedure with limited area MBS session

The Handover procedure for the UE is performed as defined in clause 7.2.3 with the following additions:

- Before the Handover, the UE is camping at Source RAN and receiving multicast data corresponding to the MBS Session ID.

- For Xn based handover in clause 7.2.3.2, Source RAN includes MBS Session ID and MBS service area to the Target RAN during Handover preparation phase. For N2 based handover in clause 7.2.3.3, this step corresponds to Handover Request and Handover Required message, respectively.

- For Xn based handover in clause 7.2.3.2, target RAN responses to Source RAN, with the accepted MBS Session ID. When Target RAN supports MBS but the UE is no longer in the MBS service area, Target RAN does not allocate RAN resources for the MBS Session to the UE. For N2 based handover in clause 7.2.3.3, this step corresponds to Handover Request acknowledge message.

- For Xn handover, if the UE is handed over to a target cell outside the MBS service area, the SMF does not provide the MBS session related information in N2 SM Info to the target RAN.

- For N2 handover, if the UE is handed over to a target cell outside to the MBS service area, the SMF does not provide the MBS session related information in N2 SM Info to the target RAN.

### 7.2.5 MBS session activation and deactivation

#### 7.2.5.1 General

MBS Session activation procedure is for multicast only. MBS Session activation procedure is triggered by MB-SMF, when it receives the notification from MB-UPF for the downlink MBS DL data, or when it receives the request directly from AF or via NEF. The MBS Session activation procedure is used for activating the resources for MBS data at NG-RAN node. The multicast session state transits from inactive to active after MBS Session activation procedure, see clause 4.3.

MBS Session deactivation procedure is for multicast only. MBS Session deactivation procedure is triggered by MB-SMF, when it receives the notification from MB-UPF in the case that there is no downlink data to be transmitted for some duration, or when it receives the request directly from AF or via NEF. The MBS Session deactivation procedure is used for deactivating the resources for MBS data at NG-RAN node. The multicast session state transits from active to inactive after MBS Session deactivation procedure, see clause 4.3.

#### 7.2.5.2 MBS session activation procedure

The following can trigger the MBS session activation procedure:

- AF requests MB-SMF to activate the MBS session;

- MB-UPF receives the multicast data and notifies MB-SMF.

**UE**

**RAN**

**AMF**

**SMF**

**MB-SMF**

3. Namf\_MT\_EnableGroupReachability request ()

5. AMF pages idle mode UEs

6. Service request ()

8. Namf\_Communication\_N1N2MessageTransfer ()

9. N2 request (N2 SM)

12. NGAP activation message (TMGI)

4. Namf\_MT\_EnableGroupReachability response ()

13. NGAP activation message (TMGI)

**UPF**

15. N4mb Session Modification

**MB-UPF**

10a. Establishment of 5GC shared MBS traffic delivery in clause 7.2.1.4

10b. Steps 9 to 12 as defined in clause 7.2.1.3

1. MB-SMF triggers session activation

11. Namf\_MBSCommunication\_N2MessageTransfer Request (TMGI)

14. Namf\_MBSCommunication\_N2MessageTransfer Response ()

2. Nmbsmf\_MBSSession\_ContextStatusNotify ()

7. UE reachability notification

Figure 7.2.5.2-1: MBS session activation procedure

In this procedure, steps 2 to 10 and steps 11 to 14 can be executed in parallel.

1. The procedure may be triggered by the following events:

- When MB-UPF receives downlink data for a MBS session, based on the instruction from MB-SMF (as described in clause 7.2.5.3), MB-UPF sends N4mb Notification (N4 Session ID) to the MB-SMF for indicating the arrival of DL MBS data.

- AF sends MBS Activation request (TMGI) to the MB-SMF directly or via NEF.

2. MB-SMF sends Nmbsmf\_MBSSession\_ContextStatusNotify (subscription correlation information) to SMF(s).

Based on the received subscription correlation information, SMF set the related MBS session state as "Active" state and finds the list of UEs that joined the MBS session identified by the related TMGI. If SMF determines the user plane of the associated PDU session(s) of the UE(s) with respect to TMGI are activated already, steps 3-7 will be skipped for those UE.

3. SMF sends Namf\_MT\_EnableGroupReachability Request to AMF, including (UE list, TMGI, associated information). When later UE is reachable, the associated information is used by the AMF to identify and notify the related SMF to activate the associated PDU Session.

After receiving the request, for each UE in the list, the AMF determines CM state of the UE: see steps 4 - 7.

4. [Optional] If the UE involved in the MBS Session is in CM-CONNECTED state, the AMF responds the list of the UE involved in the MBS Session and in CM-CONNECTED state, using Namf\_MT\_EnableGroupReachability Response (UE list). Step 5-6 will not be executed for that UEs in the list.

5. [Optional] If AMF determines that there are any UEs in CM-IDLE state and involved in the MBS Session, and AMF figures out the paging area considering all the UE(s), which need be paged. The AMF sends a paging request message to the NG-RAN node(s) belonging to this Paging Area with the TMGI as the identifier to be paged if the related NG-RAN node(s) support the MBS session. If the NG-RAN node(s) does not support MBS, the AMF sends Paging message to the NG-RAN node(s) per UE without using the MBS Session ID as described in step 4b in clause 4.2.3.3 of TS 23.502 [6].

NOTE 1: The details of the paging are specified by the RAN WGs.

6. The UE(s) in CM-IDLE state sends Service Request message to AMF, see clause 4.2.3 of TS 23.502 [6].

7. After receiving the Service Request sent by the UE(s), based on the received associated information in step 3 the AMF identifies and notifies the related SMF of the UE(s), which are reachable now.

8. For those UE(s), which the associated PDU Session is activated before step 2 and if the associated QoS flow information has been provided to RAN before, step 8-9 are skipped.

After receiving MBS\_Session\_Notification Response message, SMF determines the related UE is in CM- CONNECTED state and sends Namf\_Communication\_N1N2MessageTransfer (N2 SM message (MBS Session identifier, associated QoS profiles, mapping information between the unicast QoS flow and multicast QoS flow)) to AMF for the UE which is identified in step 3. The mapping information between the unicast QoS flow and multicast QoS flow is included to support the 5GC Individual MBS traffic delivery.

NOTE 2: N2 SM message is included in which message depends on what associated information is included in step 3.

9. AMF sends N2 request message (N2 SM message (MBS Session identifier, associated QoS profiles, mapping information between the unicast QoS flow and multicast QoS flow) to the RAN node.

10a. If the shared tunnel has not been established before, the shared tunnel is established at this step, as defined in clause 7.2.1.4. The NG-RAN configures UE with RRC messages if needed.

10b. NG-RAN responses to SMF as steps 9 to 12 defined in clause 7.2.1.3. If 5GC Individual MBS traffic delivery is used, the SMF configures the UPF for individual delivery and if necessary requests the MB-SMF to configure the MB-UPF to send multicast data to the UPF.

11. If the MB-SMF finds there are shared tunnel established, step11-15 are performed. The MB-SMF sends Namf\_MBSCommunication\_N2MessageTransfer Request (Activation, TMGI) to the AMF for those NG-RAN nodes, which have shared tunnel with MB-UPF. This step can be performed in parallel with step 2.

NOTE 3: The messages in step 11 and 12 is MBS-specific messages and it is possible that the AMF(s) in step 10 are not associate to any UEs involved in the MBS Session.

12. AMF sends NGAP activation message (TMGI) to the RAN nodes.

13. RAN nodes responses to AMF by NGAP activation response message. Steps 8 of clause 7.2.1.3 are performed to establish RAN resources to transmit multicast session data to the UE(s). The NG-RAN shall not release the radio connection of a UE that has joined into the multicast session only because no unicast traffic is received for the UE.

14. AMF to MB-SMF: Namf\_MBSCommunication\_N2MessageTransfer Response ().

15. MB-SMF may send N4mb Session Modification Request to MB-UPF. MB-UPF responses to MB-SMF with N4mb Session Modification Response acknowledging the MB-SMF request. See clause 4.4 for more details.

#### 7.2.5.3 MBS session deactivation procedure

**UE**

**RAN**

**AMF**

**SMF**

**MB-SMF**

5. Namf\_MBSCommunication\_N2MessageTransfer request (TMGI)

7. RAN node sets the MBS session state to inactive

8. NGAP deactivation response message (TMGI)

6. NGAP deactivation request message (TMGI)

9. Namf\_MBSCommunication\_N2MessageTransfer response (TMGI)

3. Nmbsmf\_MBSSession\_ContextStatusNotify ()

**UPF**

2. N4mb Session Modification request/response

**MB-UPF**

4. Step 3a and steps 4~8 in clause 4.3.3.2 of TS 23.502 are performed

1. MB-SMF triggers session deactivation

Figure 7.2.5.3-1: MBS session deactivation procedure.

In this procedure, steps 3 to 4 and steps 5 to 9 are executed in parallel.

Editor's note: Service operation of messages are FFS.

1. The procedure may be triggered by the following events:

- When MB-UPF detects there is no data receives for the MBS Session, MB-UPF sends MB-N4 Notification (N4 Session ID) to the MB-SMF for deactivating the MBS session.

- AF sends MBS Deactivation request (TMGI) to the MB-SMF directly or via NEF.

2. MB-SMF send N4mb Session Modification Request to MB-UPF (TMGI, indication for buffering and notifying MB-SMF). See clause 4.4 of TS 23.502 [6] for more details.

MB-UPF to MB-SMF: N4mb Session Modification Response acknowledging the MB-SMF request.

The MB-SMF also indicate to MB-UPF to remove the shared tunnel between UPF and MB-UPF, which is used for Individual MBS traffic delivery.

3. The MB-SMF sends Nmbsmf\_MBSSsession ContextStatusNotify request (subscription correlation ID) to the SMFs.

Based on the received subscription correlation ID, the SMF set the indicated MBS session state to "Inactive" state.

* If SMF find there exist UE(s) that joined the indicated MBS session and use 5GC Individual MBS traffic delivery, step 4 is performed for those UE(s).
* If SMF find there are no UE(s) that joined the indicated MBS session and use 5GC Individual MBS traffic delivery, no further operation for SMF is required.

4. For those UE(s) which the 5GC individual delivery is used, step 3a and steps 4-8 in clause 4.3.3.2 of TS 23.502 [6] are performed to remove the associated QoS flow(s).

NOTE: Whether the associated QoS Flow(s) are removed from UE, NG-RAN, or only resource in NG-RAN is removed is up to implementation.

5. If the MB-SMF finds there are shared tunnel established, the MB-SMF sends Namf\_MBSCommunication\_N2MessageTransfer Request (Deactivation, TMGI) to the AMFs.

6. The AMF sends NGAP deactivation request message (TMGI) to the RAN nodes.

7. NG-RAN keeps the MBS session context and N3mb tunnel for the MBS session.

If no UE(s) is in the MBS session context (e.g., due to UE becomes CM-IDLE state), the NG-RAN triggers release of the shared delivery as described in clause 7.2.2.4.

8. NG-RAN acknowledges the NGAP deactivation Response message.

9. The AMF invokes Namf\_MBSCommunication\_N2MessageTransfer Response to acknowledge the service for MB-SMF.

When the MBS session is "Inactive" state and handover procedure is triggered, it is defined in clause 7.2.3.6.

7.2.6 Multicast session update procedure

Multicast session update procedure is invoked by the AF to update the ARP for an ongoing multicast session. For the interaction between AF and MB-SMF, see clause 7.1.1.6 and 7.1.1.7.



**Figure 7.2.6-1: Multicast session QoS update procedure.**

1. This procedure is triggered by the MB-SMF receiving the updated policy for MBS, see clauses 7.1.1.6 and 7.1.1.7.

2. The MB-SMF generates the QoS profile for the multicast MBS session, and invokes Namf\_MBSCommunication\_N2MessageTransfer service operation (MBS Session ID, N2 SM information (TMGI, QoS profiles for multicast)) to the AMF(s).

3. The involved AMF sends N2 MBS session request (N2 SM information) to NG-RAN nodes based on the TMGI and RAN node IDs stored in the AMF for the MBS session.

4. NG-RAN updates the MBS session context, and if only the ARP of QoS parameters is updated, NG-RAN node also updates the QoS parameters of the associating PDU Sessions.

5. The NG-RAN(s) acknowledges N2 MBS session request by sending an N2 MBS session Response message to the AMF.

6. The AMF uses the Nmbsmf\_MBSSession\_ContextUpdate to the MB-SMF.

7. MB-SMF sends Nmbsmf\_MBSSession\_ContextStatusNotify request (TMGI, QoS profiles for multicast) to the SMFs.

8. SMF determines the UE list regarding the TMGI included in the message. If the individual delivery is used, or the QoS parameters other than ARP needs to be updated, SMF triggers PDU Session Modification procedure for each UE as defined in TS 23.502 [6].

7.2.7 Multicast session service area update procedure

Editor´s note: Whether this procedure can be combined with 7.2.6 will be addressed in the next meeting

9. Determine affected UEs

For each affected UE

Optional

**RAN**

**AMF**

**SMF**

**MB-SMF**

3. Namf\_MBSCommunication\_N2MessageTransfer

4. NGAP Session update Request (TMGI, service area)

8. Nmbsmf\_MBSSession\_ContextStatusNotify Notify

6. NGAP Session update Response

7. Nmbsmf\_ MBSSession\_ContextUpdate

**UE**

5. RAN updates service area

2. AF informs UE about updated service area for multicast session

10. UE location inquiry

11. N1 signalling towards UE via AMF and RAN (service area)

12. PDU Session Modification procedure (service area)

**AF**

1. AF informs MB-SMF about updated service area for multicast session

Figure 7.2.7-1: MBS service area update procedure for multicast.

1. This procedure is triggered by the MB-SMF receiving the updated service area for MBS, see clauses 7.1.1.6 and 7.1.1.7.
2. The AF providing the updated service area may also inform UEs at application level about the new service area via a service announcement. If a UE is located in a radio cell which was previously outside the service area and is now inside the updated service area, the UE may join the multicast service.

Steps 3 to 7 are optional and can be omitted. However, they allow to terminate data transmission towards cells served by the RAN node previously in the multicast service area and now outside the updated multicast service area as quickly as possible.

1. The MB-SMF may send Namf\_MBSCommunication\_N2MessageTransfer request (N2 SM message (TMGI, MBS service area, [Area Session ID]) to the AMF(s) handling NG-RAN nodes within the multicast session (and for multicast session with location dependent content within the same location area). The MB-SMF may alternatively inform only NG-RAN nodes handling the multicast session but where the MBS service area was restricted in such a way that some or all cells served by the RAN node previously in the multicast service area are now outside the updated MBS service area.

4. The involved AMF forwards the N2 SM information received from MB-SMF to the RAN nodes via NGAP Session update Request (N2 SM message (TMGI, MBS service area, [Area Session ID])) message.

5. NG-RAN node updates the MBS session context with the new MBS service area. If an NG-RAN node is informed via MB-SMF about an updated MBS service area of the multicast session and some cells it serves previously within the service area are now outside the updated service area it ends transmission of the related multicast data towards those cells. If the RAN node no longer serves any cells within the service area with users inside the multicast session, it requests (via AMF) from the MB-SMF that the distribution of the multicast data towards the NG-RAN node is terminated, see clause 7.2.2.4.

6. The NG-RAN acknowledges NGAP Session update Request by sending an NGAP Session update Response message to the AMF.

7. The AMF sends Nmbsmf\_ MBSSession\_ContextUpdate to the MB-SMF.

8. MB-SMF sends Nmbsmf\_MBSSession\_ContextStatusNotify Notify (subscription correlation info, Event ID, MBS service area, [Area Session ID]) to each SMF with a related subscription. It is assumed that each SMF serving UEs within the multicast session performs a related subscription for the multicast session at the MB-SMF when the first such UE joins.

9. SMF determines the affected UEs it serves based on the subscription correlation identifying the multicast session and Area Session ID (if exists) included in the message 8.

The subsequent steps 10 to 12 are executed separately for each affected UE. Signaling related to steps 11 and 12 may be combined in the same messages between SMF and AMF, and between AMF and NG-RAN, e.g. as NGAP PDU session modify request/response. In an alternative implementation, step 10 is executed for a list of UEs and only step 11 and 12 are executed separately for each affected UE.

10. The SMF may query AMF or NG-RAN for the current location of the UE (e.g. cell ID and/or TAI) to determine whether the UE is within the updated service area.

11. For a multicast local MBS service, the SMF informs each UE involved in the multicast session that it serves about the changed service area by providing information about the multicast session ID and updated service area in a N1 container. For a UE previously inside the MBS service area but now outside the updated MBS service area of the multicast session, the SMF may also signal towards the UE that it has been removed from the multicast session to trigger UE resources for the reception of multicast data to be released and/or a related notification towards the user.

12. The SMF also updates the PDU session resources associated to the multicast session with the new MBS service area.

7.2.8 Service request procedure

When the UE go to CM-IDLE and next time user plane of the associated PDU session is activated again, the SMF sends the MBS session information to NG-RAN. The MBS session information indicate that this MBS session is "Inactive" state:

* For the MBS supporting NG-RAN node, the NG-RAN establish the shared tunnel with the MB-UPF as usual. However, as the MBS session is inactive state, the NG-RAN node will not allocate related radio resource.
* For the non-MBS supporting NG-RAN node, the unicast QoS flow associated with the MBS session are not established.

7.3 MBS procedures for broadcast Session

Editor's note: The interactions between the MBSF, the MBSTF and the AF for file delivery and HTTP adaptive streaming requires input from SA4, which are FFS.

7.3.1 MBS Session Start for Broadcast

The Broadcast Session Start follows the common procedure specified in clause 7.1.1.2, which consist of TMGI Allocation and MBS Session Create. It is possible for AF to allocate TMGI once but create the MBS Session for multiple times. A combined procedure to perform both TMGI allocation and MBS Session Create is available.

The TMGI Allocation is used by AF to obtain the TMGI as MBS Session ID (i.e. TMGI) and perform service announcement towards UEs.

The MBS Session Create (with MBS service type set to broadcast service) is used by the AF to indicate the impending start of the transmission of MBS data, and to provide the session attributes , so that resources for the MBS Session are set up in the MB-UPF and in the NG-RAN for 5GC shared MBS traffic delivery. The MBS Session Create can be used if TMGI has not been allocated. In this case, MB-SMF will allocate a unique TMGI for the AF and then start the MBS Session.

NOTE 1: When the multicast transport between NG-RAN and MB-UPF is described below, source specific multicasting is assumed. That is, the parameter "LL MC address" is assumed to be accompanied by a "Source host address" parameter in the descriptions below.

To receive the data of broadcast communication service, the UE is either preconfigured with needed configuration (e.g. USD as defined in TS 26.346 [13]) for the UE to receive MBS service, or provisioned with the configuration of broadcast session on application level (service announcement; the configuration may for instance be performed using SIP signalling, or methods described in TS 26.346 [13]). If the needed configuration is pre-configured, the UE does not need to interact with network.

**UE**

**NG-RAN**

**AMF**

**MB-SMF**

**MB-UPF**

**PCF**

**NEF/MBSF**

**AF**

2. Namf\_MBSBroadcast\_ContextCreate Request (TMGI, LL SSM, 5G Authorized QoS Profile, MBS service area)

5. IGMP/MLD join

1. TMGI allocation and MBS Session Create: see clause 7.1.1.2 or 7.1.1.3

3. N2 message Request (TMGI, LL SSM, QoS Profile, MBS service area)

4. MBS Session context created

6. N2 message Response (TMGI, N3mb DL Tunnel info)

7. Namf\_MBSBroadcast\_ContextCreate Response ()

9. NG-RAN advertises TMGI

10. Media stream

11. Media stream

12. PTM transmission

8. N4mb Session Update (TMGI, N3mb DL Tunnel Info)

**Figure 7.3.1-1: MBS Session Establishment for Broadcast**

Editor's note: The services and messages used in this procedure are FFS.

1. To establish broadcast MBS session, the AF performs TMGI allocation and MBS session creation as specified in clause 7.1.1.2 or 7.1.1.3. The MBS service type indicates to be broadcast service.

2. The MB-SMF may use NRF to discover the AMF(s) based on the MBS service area and select the appropriate one(s). Then the MB-SMF sends the MBS Session Resource Setup Request (TMGI, LL MC Address and source host address, 5G QoS Profile, MBS service area) messages to the selected AMF(s) in parallel if the service type is broadcast service.

3. The AMF transfers the Namf\_MBSBroadcast\_ContextCreate Request (TMGI, LL MC and source host address, N2 SM information (5G QoS Profile)) message to all NG-RANs which support MBS in the MBS service area. The AMF may include the MBS service area.

4. NG-RAN creates a Broadcast MBS Session Context, stores the TMGI, the QoS Profile in the MBS Session Context. The LL MC Address and Source Host Address are optional parameters and only provided by MB-SMF to NG-RAN if N3mb multicast transport is configured to be used in the 5GC.5. If NG-RAN prefers to use N3mb multicast transport (and if LL MC Address is available in NG-RAN), the NG-RAN joins the multicast group (i.e. LL MC Address).

If NG-RAN prefers to use N3mb point-to-point transport (or if the LL MC Address is not available in NG-RAN) between the NG-RAN and MB-UPF, NG-RAN provides its N3mb DL Tunnel Info.

6. The NG-RAN reports successful establishment of the MBS Session resources (which may include multiple MBS QoS Flows) by sending MBS Session Resource Setup Response (TMGI, N2 SM information (N3mb DL Tunnel Info)) message(s) to the AMF. N3mb DL Tunnel Info is only available when point-to-point transport applies between MB-UPF and NG-RAN.

7. The AMF transfers the Namf\_MBSBroadcast\_ContextCreate Response () to the MB-SMF. The AMF should respond success when it receives the first success response from the NG-RAN(s). And if all NG-RAN(s) report failure, the AMF should respond failure. The MB-SMF store the AMF(s) which responds success in the MBS Session Context as the downstream nodes.

8. If N3mb point-to-point transport is to be used (i.e. N3mb DL Tunnel Info is present in the MBS Session Start Response message from AMF), the MB-SMF sends an N4mb Session Modification Request to the MB-UPF to allocate the N3mb point-to-point transport tunnel for a replicated MBS stream for the MBS Session. Otherwise, step 8 can be skipped.

9. NG-RAN advertises the TMGI representing the MBS service over radio interface. Step 9 can take place in parallel with step 6.

10. The AF starts transmitting the DL media stream to MB-UPF using the N6mb Tunnel, or optionally un-tunnelled i.e. as an IP multicast stream using the HL MC address.

11. The MB-UPF transmits the media stream to NG-RAN via N3mb multicast transport or point-to-point transport.

12. The NG-RAN transmits the received DL media stream using DL PTM resources.

NOTE 2: Step 6-8 and 2-4 are comparable to step 2-5 and 6-7 in clause 7.2.1.4, respectively.

### 7.3.2 MBS Session Release for Broadcast

The MBS Session Release for broadcast follows the removal of MBS Session Configuration (e.g. TMGI De-allocation and MBS Session Stop) so that resource for shared MBS delivery is released. It is possible for AF to stop MBS Session but keep TMGI allocated.



Figure 7.3.2-1: MBS Session Release for Broadcast

1. The AF/AS may stop the media stream before sending the MBS Session Release Request (TMGI) message to the 3GPP network.

2. The AF/AS performs MBS Session Stop procedure to request release of MBS Session (step 1 ~7 in the figure 7.1.1.4-1).

3. MB-SMF sends Namf\_MBSBroadcast\_ContextRelease request (TMGI) to the AMF(s) that has been involved in the MBS Session.

4. The AMF sends an MBS Session Resource Release Request (TMGI) message to all RAN nodes that have been involved. If a NG-RAN node receives multiple MBS Session Resource Release Request messages for the same TMGI (e.g. from several AMFs the NG-RAN is connected to), NG-RAN only performs step 5 and step 6 once.

5. The NG-RAN stops the PTM transmission.

6. If N3mb multicast transport has been used, the NG-RAN sends a Leave message (LL MC Address) to stop the media stream to this NG-RAN node. If N3mb point-to-point transport has been used, the NG-RAN release its N3mb Tunnel Info. NG-RAN deletes its MBS Session Context.

7. The NG-RAN reports successful release of resources for the MBS Session by sending MBS Session Resource Release Response (TMGI) message(s) to the AMF(s).

8. The AMF sends Namf\_MBSBroadcast\_ContextRelease response (TMGI) to the MB-SMF.

9. The AF may start a TMGI de-allocation procedure (step 8~11 in the figure 7.1.1.4-1).

### 7.3.3 MBS Session Update for Broadcast

The MBS Session Update for broadcast is used by the AF to update the broadcast area or service requirements of the MBS Session which may lead to addition of new MBS QoS Flow(s), removal of existing MBS QoS Flow(s) or update of existing MBS QoS Flow(s).

Editor's note: The services and messages used in this procedure are FFS.



Figure 7.3.3-1: MBS Session Update for Broadcast

1. The AF starts MBS session update procedure by sending Modify MBS Session Request to the NEF/MBSF with TMGI (steps 1~7 in the figure 7.1.1-3). The AF may adjust service requirement and/or broadcast area. The service requirements adjustment may lead to addition of new MBS QoS Flow(s), removal of existing MBS QoS Flow(s) or update of existing MBS QoS Flow(s).

Editor´s note: There are dependence on S2-2104190/S2-2104309 which introduce the MBS session update procedure in clause 7.1.1

2. The MB-SMF sends Namf\_MBSBroadcast\_ContextUpdate Request to the AMFs with TMGI, the updated 5G QoS Profile and the updated MBS service area. If the broadcast area is updated, the MB-SMF may use NRF to discover the AMF(s) based on the new broadcast area and select the appropriate one(s).

Depending on the change of the MBS service area, the MB-SMF may send Namf\_MBSBroadcast\_ContextCreate to some AMFs in the new MBS service area, Namf\_MBSBroadcast\_ContextRelease to some other AMFs in the old MBS service area.

3. The AMF sends MBS Session Resource Update to NG-RANs with TMGI, the updated 5G QoS Profile and the updated MBS service area.

Depending on the change of the MBS service area, the AMF may send MBS Session Resource Setup to some NG-RANs in new MBS service area and MBS Session Resource Release to some other NG-RANs in old MBS service area.

4. The NG-RAN updates MBS Session Context.

5. The NG-RAN sends MBS Session Resource Update Response to the AMF.

6. The AMF sends Namf\_MBSBraodcast\_ContextUpdate Response to the MB-SMF.

7. The NG-RAN updates the MBS Session. It takes place in parallel with step 5 to step 6.

### 7.3.4 Support for Local Broadcast Service

The procedures for Local broadcast service contains the ones for local broadcast service with the location-dependent content as described in clause 6.2.

The configuration procedure is performed as defined in clause 7.1.1.2 with the following additions:

- Multiple AFs may start the same broadcast session with different content in different MBS service areas. The NEF selects MB-SMF as ingress control node(s) for different MBS service areas.

- If presented, the NEF maps possible external identifiers for MBS service areas to network-internal identifiers (e.g. list of cells, TAIs).

- MB-SMF allocates Area Session ID, and updates its NF profile towards the NRF with the TMGI and Area Session ID.

NOTE: For a location dependent service provided in different MBS service areas within the same SMF service area, it is assumed that one MB-SMF is used for an MBS Session.

- The policy of broadcast session is determined based on the service requirements per MBS service area.

- The MB-SMF may select the MB-UPF based on the MBS service area.

- The MBS service area(s) are indicated to the UE in the Service Announcement as defined in clause 6.11.

The MBS session establishment procedure is performed as defined in clause 7.3.1 with the following additions:

- MB-SMF requests the AMF to transfer an N2 message (i.e. MBS Session Resource Setup Request) to the NG-RAN nodes of the MBS service area with broadcast session information which additionally includes the Area Session ID and MBS service area.

- The NG-RAN uses the received MBS Session ID and Area Session ID to determine the local broadcast session context.

### 7.3.5 MBS Session Delivery Status Indication for Broadcast

The MBS Session Delivery Status Indication for broadcast is used by the MB-SMF to notify the AF/AS of conditions affecting the delivery of the MBS session (e.g. MBS session activated, MBS session terminated, etc.). The occurrence of the indicated condition may have been detected at the MB-SMF or may have been reported to the MB-SMF by other entities involved in the MBS session delivery.



Figure 7.3.5-1: MBS Session Delivery Status Indication for Broadcast

1. The external AF subscribes event for delivery status towards the NEF, and the NEF subscribes corresponding event towards the MB-SMF (step 1a), or the legacy AS request status report towards the MBSF, and the MBSF subscribes event for delivery status towards the MB-SMF (step 1b), or the internal AF subscribes event for delivery status towards the MB-SMF (step 1c).

2. The MB-SMF notifies the TMGI and the event towards the NEF, and the NEF notifies the TMGI and corresponding event towards the external AF (step 2a), or the MB-SMF notifies the TMGI and the event towards the MBSF, and the MBSF sends Delivery Status Indication to legacy AS with the TMGI and the corresponding event (step 2b), or the MB-SMF notifies the TMGI and the event towards the internal AF (step 2c).

Editor's note: Whether more events are needed in the delivery status notification are FFS.

## 7.4 MBS procedures for inter System Mobility

### 7.4.1 Inter-system mobility with interworking at service layer

For inter-system mobility with interworking at service layer, i.e., the same multicast service is provided via eMBMS in E-UTRAN and 5MBS, the UE is instructed to switch between 5MBS and eMBMS:

NOTE 1: The source network can be configured with the frequencies where the same service is provided in the target network, i.e., the EPC network neighbouring the 5GC network support the same eMBMS service.

NOTE 2: The UE can be configured, per TMGI, to know that the same service is provided over 5MBS and eMBMS.

- Mobility from 5MBS to eMBMS.

When moving to E-UTRAN/EPC, the UE initiates procedures as defined in TS 23.246 [8] to receive MBMS service for the TMGI(s).

If the UE has one or more unicast PDU Sessions (including, but not limited to, the PDU Session used for MBS and for another service (e.g., Public Safety service) with the QoS Flow(s) for the other service) moving to EPS, and if the handover procedure from 5GS to EPS using N26 interface described in clause 4.11.1.2.1 of TS 23.502 [6] is used:

- For the PDU Session used also for MBS, the SMF+PGW-C removes the UE from the multicast session context(s), if it exists, upon receiving a Modify Bearer Request of the PDU Session from the SGW (i.e., step 14a of clause 4.11.1.2.1 of TS 23.502 [6]).

For 5GS to EPS Idle mode mobility with no N26, when the UE moves to the EPS and performs E-UTRAN EPS attach, according to TS 23.502 [6] clause 4.11.2.4.1, step 8, if the UE does not maintain registration in 5GC, upon reachability time-out, the AMF may implicitly detach the UE and release the possible remaining PDU Session(s) in 5GC. The SMF/PGW-C removes the UE from the multicast session context(s), if it exists, upon receiving a tracking area update from the UE.

- Mobility from eMBMS to 5MBS.

When the UE has moved to NR/5GC it triggers the multicast context and multicast flow setup/modification via PDU Session Modification procedures as defined in clause 6.8 to receive 5G MBS transport for the TMGI(s).

# 8 Control and user plane stacks

## 8.1 Control plane for Multicast and Broadcast services

The control plane protocol stacks for Multicast and Broadcast service between NG-RAN and MB-SMF is defined in the subclause 8.1.1 and the other control plane protocol stacks for Multicast and Broadcast service are defined in the TS 23.501 [5] clause 8.2.

The control plane protocols for N4mb reference point between MB-SMF and MB-UPF are defined in TS 29.244 [17].

NOTE: The control plane protocols for reference point Nmb2 between MBSF and MBSTF require collaboration with SA4, SA6 and CT groups.

#### 8.1.1 NG-RAN – MB-SMF



**Legend:**

- **N2 SM information:** This is the subset of NG-AP information that the AMF transparently relays between the NG-RAN and the MB-SMF, and is included in the NG-AP messages and the N11mb related messages, where in this Release the NG-RAN is a 3GPP NR.

Figure 8.1.1-1: Control Plane between the NG-RAN and the MB-SMF

## 8.2 User plane for Multicast and Broadcast services

The User plane protocol stack for PDU session which handles the multicast operation is same with the PDU session user plane Protocol Stack defined in the TS 23.501 [5] clause 8.3.1.

The user plane protocol stack for MBS session in case of shared delivery is described in Figure 8.2-1 and Figure 8.2-2. In Figure 8.2-1, the UDP tunnel applies to N6mb and Nmb9, while in Figure 8.2-2, the plain IP multicast applies to N6mb and Nmb9. The user plane protocol stack for MBS session in case of individual delivery is described in Figure 8.2-3.



Figure 8.2-1: User Plane Protocol Stack for MBS session (UDP Tunnel)



**Figure 8.2-2: User Plane Protocol Stack for MBS session (plain IP multicast)**

- **5G-AN Protocol Layers**: This set of protocols/layers depends on the AN:

- in this Release, the 5G-AN is a 3GPP NR, these protocols/layers are defined in TS 38.401 [16]. The radio protocol between the UE and the 5G-AN node (gNodeB) is specified in TS 38.300 [9].

Figure 8.2-3: User Plane Protocol Stack for MBS session in case of Individual delivery

**Legend:**

- **5G-AN Protocol Layers**: This set of protocols/layers depends on the AN:

in this Release, the 5G-AN is a 3GPP NR, these protocols/layers are defined in TS 38.401 [16]. The radio protocol between the UE and the 5G-AN node (gNodeB) is specified in TS 38.300 [9].

NOTE: In Figure 8.2-3, the User Plane Protocol Stack between MB-UPF and AF/MBSTF is shown in Figure 8.2-1 and Figure 8.2-2.

# 9 Network Function Services

Editor's note: The NF and associating services are FFS.

9.1 MB-SMF Services

9.1.1 General

The following table illustrates the MB-SMF Services for MBS.

**Table 9.1.1-1: NF services provided by MB-SMF**

|  |  |  |  |
| --- | --- | --- | --- |
| **Service Name** | **Service Operations** | **Operation**  **Semantics** | **Example Consumer (s)** |
| **Nmbsmf\_TMGI** | Allocate | Request/Response | NEF, MBSF, AF |
| Deallocate | Request/Response | NEF, MBSF, AF |
| **Nmbsmf\_ MBSSession** | ContextStatusSubscribe | Subscribe/Notify | SMF |
| ContextStatusUnsubscribe | SMF |
| ContextStatusNotify | SMF |
| ContextUpdate | Request/Response | AMF, SMF |
| StatusSubscribe | Subscribe/Notify | MBSF, NEF, AF |
| StatusUnsubscribe | MBSF, NEF, AF |
| StatusNotify | MBSF, NEF, AF |
| Create | Request/Response | MBSF, NEF, AF |
|  | Update | Request/Response | MBSF, NEF, AF |
|  | Delete | Request/Response | MBSF, NEF, AF |



9.1.2 Nmbsmf\_TMGI service

9.1.2.1 General

**Service description:** NF Service Consumer can use this service to request the allocation of TMGIs and release allocated TMGIs.

Editor's note: Parameters of the service operations are FFS.

9.1.2.2 Nmbsmf\_TMGI\_Allocate service operation

**Service operation name:** Nmbsmf\_ TMGI\_Allocate.

**Description:** This service is used by the NF Service Consumer to request the allocation of TMGI(s) or request to refresh previously allocated TMGI(s).

**Inputs, Required:** Number of TMGIs

**Inputs, Optional:** None

**Outputs, Required:** TMGI(s), Expiry Time

**Outputs, Optional:** None.

9.1.2.3 Nmbsmf\_TMGI\_Deallocate service operation

**Service operation name:** Nmbsmf\_TMGI\_Deallocate.

**Description:** NF Service Consumer can use this service to request the release of TMGI(s).

**Inputs, Required:** TMGI(s).

**Inputs, Optional:** None.

**Outputs, Required:** Success or not.

**Outputs, Optional:** None.

### 9.1.3 Nmbsmf\_MBSSession service

#### 9.1.3.1 General

**Service description:** The following are the key functionalities of this NF service:

- (between AMF or SMF and MB-SMF) For multicast, NF Service Consumer can use this service to request the reception of MBS data or to terminate the reception of MBS data.

- (between SMF and MB-SMF) For multicast, allow consumer NFs to query information (e.g. QoS information) about MBS Session(s). This service will be invoked by SMF for UE join event;

- (between SMF (only for multicast) or MBSF/NEF and MB-SMF) Allow consumer NFs to subscribe and unsubscribe for an Event ID on MBS Session(s);

- (between SMF (only for multicast) or MBSF/NEF and MB-SMF) Notifying events on the MBS Session to the subscribed NFs;

- (between MBSF/NEF or SMF and MB-SMF) Creation/Modification/Activation/Deactivation/Release of multicast sessions; and

- (between MBSF/NEF and MB-SMF) Creation/Modification/Start/Stop/Release of broadcast sessions.

The following events related to MBS session context can be subscribed by SMF as consumer NF:

- (between SMF and MB-SMF, only for multicast) QoS change: The event notification is sent when QoS within a multicast session changes, e.g. adding/removing QoS flow(s).

- (between SMF and MB-SMF only for multicast) multicast session status (activated, deactivated).

- (between SMF and MB-SMF only for multicast) multicast session service area change.

- (between SMF and MB-SMF only for multicast) multicast session release

The following events related to MBS session can be subscribed by NBSF, NEF, or AF as consumer NF:

(between MBSF/NEF/AF and MB-SMF) MBS session release due to TMGI expiry.

- (between MBSF/NEF/AF and MB-SMF) Broadcast delivery status.

NOTE: Whether event IDs are needed can be determined by stage 3.

#### 9.1.3.2 Nmbsmf\_ MBSSession\_ContextUpdate service operation

**Service operation name:** Nmbsmf\_MBSSession\_ContextUpdate.

**Description:** NF Service Consumer can use this service to request or terminate the reception of data of a multicast session

**Inputs, Required:** if consumer is AMF: N2 container (Establishment or Release, MBS session ID, Possible Area session ID, Possible GTP Tunnel info for unicast transport), AMF ID, if consumer is SMF: SMF ID, MBS session ID, Action(Establishment or Release)

**Inputs, Optional:** if consumer is SMF: Area Session ID, Unicast GTP Tunnel info of the UPF

**Outputs, Required:** Success or not

**Outputs, Optional:** if consumer is AMF: N2 container (MBS session ID, Possible Multicast DL tunnel info); if consumer is SMF: Possible Multicast DL tunnel info.

#### 9.1.3.3 Nmbsmf\_ MBSSession\_ContextStatusSubscribe service operation

**Service operation name:** Nmbsmf\_ MBSSession\_ContextStatusSubscribe.

**Description:** Service Consumer NF can use this service operation to request information (e.g. QoS information) about a multicast session and to subscribe to notification of events about the multicast session context.

**Inputs, Required:** Multicast Session ID, notification target address, Events ID(s).

**Inputs, Optional:** immediate reporting indication.

**Outputs, Required:** When the subscription is accepted: Subscription Correlation ID.

**Outputs, Optional:** If immediate reporting indication is set: Event information (e.g. QoS information for multicast session, multicast session status (activated, deactivated), multicast session service area for local multicast service), Start time of multicast session, if consumer is SMF: indication that the MBS session allows any UE to join.

#### 9.1.3.4 Nmbsmf\_MBSSession\_ContextStatusNotify service operation

**Service operation name:** Nmbsmf\_ MBSSession\_ContextStatusNotify

**Description:** This service operation, which is applicable to multicast MBS session, is used by the MB-SMF to notify its consumers about events of an MBS Session.

**Inputs, Required:** MBS Session ID, Event ID, Notification Correlation Information.

**Inputs, Optional:** Event information (QoS information of MBS Session, MB service area).

**Outputs, Required:** Operation execution result indication.

**Outputs, Optional:** Cause.

#### 9.1.3.5 Nmbsmf\_ MBSSession \_ ContextStatusUnsubscribe service operation

**Service operation name:** Nmbsmf\_MBSSession\_ContextStatusUnsubscribe

**Description:** This service operation, which is applicable to multicast MBS session, is used by the consumer to unsubscribe to notifications about MBS context events.

**Inputs, Required:** Subscription Correlation ID.

**Inputs, Optional:** None.

**Outputs, Required:** Operation execution result indication.

**Outputs, Optional:** None*.*

#### 9.1.3.6 Nmbsmf\_MBSSession\_Create service operation

**Service operation name:** Nmbsmf\_MBSSession\_Create.

**Description:** Create a new multicast session or broadcast session during MBS session configuration. Optionally subscribe to notifications for this MBS session.

**Input, Required:** MBS Session ID (source specific multicast address or TMGI) or TMGI request

**Input, Optional:** DNN, S-NSSAI, , MBS service area, MBS activation time, MBS termination time, service description, , QoS flow information, Input Transport Address Request, session activity status (active/inactive). For a multicast session, indication that any UE may join. For subscription to notifications event ID(s), notification target address.

**Output, Required:** Result Indication.

**Output, Optional:** TMGI, Cause, MB-UPF tunnel info.

#### 9.1.3.7 Nmbsmf\_MBSSession\_Update service operation

**Service operation name:** Nmbsmf\_MBSSession\_Update.

**Description:** Update the established multicast session or broadcast session, e.g. QoS update.

**Input, Required:** MBS Session ID.

**Input, Optional:** QoS flow information, MBS service area, session activity status (active/inactive).

**Output, Required:** Result Indication.

**Output, Optional:** Cause.

#### 9.1.3.8 Nmbsmf\_MBSSession\_ Delete service operation

**Service operation name:** Nmbsmf\_MBSSession\_Delete.

**Description:** Release the multicast session or broadcast session. The session is deleted and a possible subscription to notifications is terminated.

**Input, Required:** MBS Session ID.

**Input, Optional:** None.

**Output, Required:** Result Indication.

**Output, Optional:** Cause.

#### 9.1.3.9 Nmbsmf\_MBSSession\_StatusNotify service operation

**Service operation name:** Nmbsmf\_MBSSession\_StatusNotify

**Description:** This service operation is used by the MB-SMF to notify its consumers about the status change of the MBS session.

**Input, Required:** MBS Session ID, Event ID

**Input, Optional:** Event information-

**Output, Required:** Result Indication.

#### 9.1.3.10 Nmbsmf\_MBSSession\_StatusSubscribe service operation

**Service operation name:** Nmbsmf\_MBSSession\_StatusSubscribe

**Description:** This service operation is used by the NF service consumer to subscribe notification about events related to the status of the MBS session.

**Input, Required:** MBS Session ID, event ID(s), notification target address

**Output, Required:** When the subscription is accepted: Subscription Correlation ID.

#### 9.1.3.11 Nmbsmf\_MBSSession\_StatusUnsubscribe service operation

**Service operation name:** Nmbsmf\_MBSSession\_StatusUnsubscribe

**Description:** This service operation, which is applicable for broadcast MBS session, is used by the NF service consumer to notification about events related to the status of the MBS session.

**Input, Required:** Subscription Correlation ID

**Output, Required:** Result Indication.

## 9.2 PCF Services

### 9.2.1 General

The following table illustrates the PCF Services for MBS.

Table 9.2.1-1: NF services provided by PCF for MBS

|  |  |  |  |
| --- | --- | --- | --- |
| Service Name | Service Operations | Operation  Semantics | Example Consumer (s) |
| **Npcf\_MBSPolicyControl** | Create | Request/Response | MB-SMF |
|  | UpdateNotify | Subscribe/Notify | MB-SMF |
|  | Delete | Request/Response | MB-SMF |
| **Npcf\_MBSPolicy Authorization** | Create | Request/Response | AF, NEF, MBSF |
|  | Update | Request/Response | AF, NEF, MBSF |
|  | Delete | Request/Response | AF, NEF |

### 9.2.2 Npcf\_MBSPolicyControl service

#### 9.2.2.1 General

**Service description:** NF Service Consumer, e.g. MB-SMF can create and manage a MBS Policy Association in the PCF through which the NF Service Consumer receives policy information for a MBS Session.

As part of this service, the PCF may provide the NF Service Consumer, e.g. MB-SMF with policy information about the MBS Session that may contain:

- MBS Session related policy information.

- PCC rule information.

- Policy Control Request Trigger information. When a Policy Control Request Trigger condition is met the NF Service Consumer, e.g. MB\_SMF shall contact the PCF and provide information on the Policy Control Request Trigger condition that has been met.

Editor's note: Details of MBS Session related policy information, PCC rule information, and Policy Control Request Trigger information need to be defined in an appropriate location of the TS and referenced.

At MBS Session establishment the NF Service Consumer, e.g. MB-SMF requests the creation of a corresponding MBS Policy Association with the PCF (Npcf\_MBSSMPolicyControl\_Create) and provides relevant parameters about the MBS Session to the PCF.

- When the PCF has created the "MBS Policy Association", the PCF may provide policy information as defined above.

When a Policy Control Request Trigger condition is met the NF Service Consumer, e.g. MB-SMF requests the update (Npcf\_MBSPolicyControl\_Update) of the MBS Policy Association by providing information on the condition(s) that have been met. The PCF may provide updated policy information to the NF Service Consumer.

The PCF may at any time provide updated policy information (Npcf\_MBSPolicyControl\_UpdateNotify).

At MBS Session Release the NF Service Consumer, e.g. MB\_SMF requests the deletion of the corresponding MBS Policy Association.

Editor's note: Parameters of the service operations are FFS.

#### 9.2.2.2 Npcf\_MBSPolicyControl\_Create service operation

**Service operation name:** Npcf\_MBSPolicyControl\_Create.

**Description:** The NF Service Consumer can request the creation of a MBS Policy Association and provide relevant parameters about the MBS Session to the PCF.

**Inputs, Required:** MBS session ID, DNN, S-NSSAI.

**Inputs, Optional:** None.

**Outputs, Required:** Success or Failure. For Success MBS Policy Association ID.

**Outputs, Optional:** Policy information for the MBS.

#### 9.2.2.3 Npcf\_MBSPolicyControl\_UpdateNotify service operation

**Service operation name:** Npcf\_MBSPolicyControl\_UpdateNotify

**Description:** Provides to the NF Service Consumer, e.g. MB-SMF updated Policy information for the MBS Session.

**Inputs, Required:** MBS Policy Association ID.

**Inputs, Optional:** Policy information for the MBS Session.

**Outputs, Required:** Success or Failure.

**Outputs, Optional:** None.

#### 9.2.2.4 Npcf\_MBSPolicyControl\_Delete service operation

Editor's note: whether this service operation is needed or not is FFS.

**Service operation name:** Npcf\_MBSPolicyControl\_Delete

**Description:** The NF Service Consumer can request the deletion of the MBS Policy Association and of the associated resources.

**Inputs, Required:** MBS Policy Association ID.

**Inputs, Optional: None**.

**Outputs, Required:** Success or Failure.

**Outputs, Optional:** None.

### 9.2.3 Npcf\_MBSPolicyAuthorization Service

#### 9.2.3.1 General

**Service description:** This service is to authorise an AF / NEF / MBSF request for an MBS service and to create policies as requested by the authorized AF for the MBS Service. This service also allows the NF consumer to subscribe/unsubscribe the notification of events.

Editor's note: The Notify, Subscribe and Unsubscribe service operations and related events are FFS.

Editor's note: The parameters of the service operations are FFS.

#### 9.2.3.2 Npcf\_MBSPolicyAuthorization\_Create service operation

**Service operation name:** Npcf\_MBSPolicyAuthorization\_Create

**Description:** Authorize the request, and optionally determines and installs MBS Policy Control Data according to the information provided by the NF Consumer.

**Inputs, Required:** MBS session ID, identification of the application session context.

**Inputs, Optional:** DNN if available, S-NSSAI if available, Media type, Media format, bandwidth requirements, flow description, Application Identifier, AF Communication Service Identifier, Flow status, Priority indicator, emergency indicator Application service provider.

**Outputs, Required:** Success (application session context) or Failure (reason for failure).

**Outputs, Optional:** The service information that can be accepted by the PCF.

#### 9.2.3.3 Npcf\_MBSPolicyAuthorization\_Update service operation

**Service operation name:** Npcf\_MBSPolicyAuthorization\_Update

**Description:** Provides updated information to the PCF.

**Inputs, Required:** Identification of the application session context.

**Inputs, Optional:** Media type, Media format, bandwidth requirements, flow description, Application Identifier, AF Communication Service Identifier, Flow status, Priority indicator, Application service provider.

**Outputs, Required:** Success or Failure (reason for failure).

**Outputs, Optional:** The service information that can be accepted by the PCF.

Provides updated application level information and communicates with Npcf\_MBSPolicyControl service to determine and install the policy according to the information provided by the NF Consumer. Updates an application context in the PCF.

#### 9.2.3.4 Npcf\_MBSPolicyAuthorization\_Delete service operation

**Service operation name:** Npcf\_MBSPolicyAuthorization\_Delete

**Description:** Provides means for the NF Consumer to delete the context of application level session information.

**Inputs, Required:** Identification of the application session context.

**Inputs, Optional:** None.

**Outputs, Required:** None.

**Outputs, Optional:** None.

## 9.3 AMF Services

### 9.3.1 General

The Namf\_MT\_EnableGroupReachability service operation is defined in TS 23.502 [6]

The following table illustrates the new AMF Service for broadcast communication.

Table 9.3.1-1: NF services provided by AMF

|  |  |  |  |
| --- | --- | --- | --- |
| Service Name | Service Operations | Operation  Semantics | Example Consumer (s) |
| **Namf\_MBSBroadcast** | ContextCreate | Request/Response | MB-SMF |
|  | ContextUpdate | Request/Response | MB-SMF |
|  | ContextRelease | Request/Response | MB-SMF |
|  | ContextStatusNotify | Subscribe/Notify | MB-SMF |
| **Namf\_MBSCommunication** | N2MessageTransfer | Request/Response | MB-SMF |

### 9.3.2 Namf\_MBSBroadcast service

#### 9.3.2.1 General

**Service description:** This service is used by the consumer for broadcast communication.

Editor's note: Parameters of the service operations are FFS.

#### 9.3.2.2 Namf\_MBSBroadcast\_ContextCreate service operation

**Service operation name:** Namf\_MBSBroadcast\_ContextCreate

**Description:** This service operation is used to create the broadcast session context towards the AMF.

**Inputs, Required:** MBS Session ID, Broadcast service area, N2 container (MBS Session ID, MBS QoS profile, Broadcast service area).

**Inputs, Optional:** Area Session ID, Optional parameters in the N2 container: MBS IP Multicast Tunnel Info, Area Session ID.

**Outputs, Required:** Result Indication.

**Outputs, Optional:** N2 container (NG-RAN MBS Tunnel Info).

#### 9.3.2.3 Namf\_MBSBroadcast\_ContextUpdate service operation

**Service operation name:** Namf\_MBSBroadcast\_ContextUpdate

**Description:** This service operation is used to update the broadcast session context towards the AMF.

**Inputs, Required:** MBS Session ID.

**Inputs, Optional:** Broadcast service area, N2 container (MBS Session ID, Possible MBS QoS profile, Possible Broadcast service area, Possible Area Session ID, Possible MBS IP Multicast Tunnel Info).

**Outputs, Required:** Result Indication.

**Outputs, Optional:** N2 container (MBS Session ID, NG-RAN MBS Tunnel Info).

#### 9.3.2.4 Namf\_MBSBroadcast\_ContextRelease service operation

**Service operation name:** Namf\_MBSBroadcast\_ContextRelease

**Description:** This service operation is used to release the broadcast session context towards the AMF.

**Inputs, Required:** MBS Session ID, N2 container (MBS Session ID).

**Inputs, Optional:** None.

**Outputs, Required:** Result Indication.

**Outputs, Optional:** None.

#### 9.3.2.5 Namf\_MBSBroadcast\_ContextStatusNotify service operation

**Service operation name:** Namf\_MBSBroadcast\_ContextStatusNotify

**Description:** This service operation is used to notify its consumers about the status change of a broadcast session context.

**Inputs, Required:** MBS Session ID.

**Inputs, Optional:** Event ID (e.g. change of NG-RAN MBS Tunnel Info).

**Outputs, Required:** Result Indication.

**Outputs, Optional:** None.

### 9.3.3 Namf\_MBSCommunication Service

#### 9.3.3.1 General

**Service description:** This service enables MBS multicast related N2 message transfer towards the NG-RAN via the AMF, during multicast session activation/deactivation/update/release.

#### 9.3.3.2 Namf\_MBSCommunication\_N2MessageTransfer service operation

**Service operation name:** Namf\_MBS\_N2MessageTransfer.

**Description:** This service operation is used by the NF Consumer to request the AMF to transfer the MBS related N2 message to the NG-RAN nodes serving the MBS multicast session.

**Input, Required:** MBS Session ID, N2 SM information.

**Input, Optional:** MBS area session ID

**Output, Required:** Result Indication.

**Output, Optional:** Cause.

9.4 NEF Services

9.4.1 General

The following table illustrates the NEF Services for MBS.

**Table 9.4.1-1: NF services provided by NEF**

|  |  |  |  |
| --- | --- | --- | --- |
| **Service Name** | **Service Operations** | **Operation**  **Semantics** | **Example Consumer (s)** |
| **Nnef\_MBSTMGI** | Allocation | Request/Response | AF |
| Deallocation | Request/Response | AF |
| ExpiryNotify | Subscribe/Notify | AF |
| **Nnef\_MBSSession** | Create | Request/Response | AF |
| Update | Request/Response | AF |
| Delete | Request/Response | AF |
| StatusNotify | Subscribe/Notify | AF |
| StatusSubscribe | AF |
| StatusUnsubscribe | AF |

9.4.2 Nnef\_MBSTMGI service

9.4.2.1 General

**Service description:** NF Service Consumer can use this service to request the allocation of TMGIs and deallocate TMGIs previously allocated.

9.4.2.2 Nnef\_MBSTMGI\_Allocation service operation

**Service operation name:** Nnef\_ MBSTMGI\_Allocation.

**Description:** This service is used by the NF Service Consumer to request allocation of TMGI(s), or to refresh the expiry time for already allocated TMGI(s).

**Inputs, Required:** Number of TMGIs (may be zero if only a refresh of expiry time is requested)

**Inputs, Optional:** TMGI(s) to be refreshed.

**Outputs, Required:** TMGIs, Expiry Time, Success or not.

**Outputs, Optional:** None.

9.4.2.3 Nnef\_MBSTMGI\_Deallocation service operation

**Service operation name:** Nnef\_MBSTMGI\_Deallocation.

**Description:** This service is used by the NF Service Consumer to request deallocation the TMGI(s).

**Inputs, Required:** TMGI(s)

**Inputs, Optional:** None.

**Outputs, Required:** Success or not.

**Outputs, Optional:** None.

9.4.2.4 Nnef\_MBSTMGI\_ExpiryNotify service operation

**Service operation name:** Nnef\_MBSTMGI\_ ExpiryNotify.

**Description:** This service is used by the NEF to notify the NF service consumer of the timer expiry for TMGI(s)

**Inputs, Required:** TMGI(s)

**Inputs, Optional:** None.

**Outputs, Required:** None.

**Outputs, Optional:** None.

9.4.3 Nnef\_MBSSession Service

9.4.3.1 General

**Service description:** This service operates on the multicast and broadcast MBS sessions. The following are the key functionalities of this NF service:

- Create/Update Delete for both multicast and broadcast MBS sessions;

- Provide a Notification about subscribed events. The following events are supported:

+ MBS session release due to TMGI expiry

+ Broadcast delivery status

Editor's note: Parameters of the service operations are FFS.

9.4.3.2 Nnef\_MBSSession\_Create service operation

**Service operation name:** Nnef\_MBSSession\_Create.

**Description:** Create a new multicast session or broadcast session. Optionally implicitly subscribe to notifications for this MBS session.

**Input, Required:** MBS Session ID (source specific multicast address or TMGI) or TMGI request, Service Type (broadcast or multicast)

**Input, Optional:** MBS service area (mandatory for broadcast. Can be Cell ID list and/or TAI list, or geographical area information, or civic address information), MBS start time, MBS stop time, service requirement (e.g. Flow Description, QoS), Input Transport Address Request, session activity status (active/inactive), for subscription to notifications notification target address, For a multicast session, indication that any UE may join the multicast session.

**Output, Required:** Result Indication.

**Output, Optional:** TMGI, Cause, MB-UPF tunnel info.

9.4.3.3 Nnef\_MBSSession\_Update service operation

**Service operation name:** Nnef\_MBSSession\_Update.

**Description:** This service is used by the NF service consumer to update the established multicast session or broadcast session, e.g. QoS update. For multicast MBS Session, this service is also used to activate or deactivate the MBS Session.

**Input, Required:** MBS Session ID.

**Input, Optional:** Service requirement, MBS service area, session activity status (active/inactive).

**Output, Required:** Result Indication.

**Output, Optional:** Cause.

9.4.3.4 Nnef\_MBSSession\_Delete service operation

**Service operation name:** Nnef\_MBSSession\_Delete.

**Description:** This service is used **to** delete the multicast or broadcast MBS session.

**Input, Required:** MBS Session ID.

**Input, Optional:** None.

**Output, Required:** Result Indication.

**Output, Optional:** Cause.

9.4.3.5 Nnef\_ MBSSession\_StatusNotify service operation

**Service operation name:** Nnef\_ MBSSession\_StatusNotify

**Description:** This service is used by the MB-SMF to notify the NF service consumers of the subscribed events.

**Inputs, Required:** Status Information, Multicast Session ID.

**Inputs, Optional:** None.

**Outputs, Required:** None.

**Outputs, Optional:** None.

9.4.3.6 Nnef\_ MBSSession\_StatusSubscribe service operation

**Service operation name:** Nnef\_ MBSSession\_StatusSubscribe

**Description:** This service is used by the NF service consumers to subscribe to the MBS Session status information.

**Inputs, Required:** Status Information, Multicast Session ID.

**Inputs, Optional:** None.

**Outputs, Required:** None.

**Outputs, Optional:** None.

9.4.3.7 Nnef\_ MBSSession\_StatusUnsubscribe service operation

**Service operation name:** Nnef\_ MBSSession\_StatusUnsubscribe

**Description:** This service is used by the NF service consumers to unsubscribe to the MBS Session status information.

**Inputs, Required:** Status Information, Multicast Session ID.

**Inputs, Optional:** None.

**Outputs, Required:** None.

**Outputs, Optional:** None.

## 9.5 MBSF Services

MBSF services are defined in TS 26.502 [18].

Annex A (normative):  
Configuration options at Service and/or Application for MBS

Figure A-1 provides the reference architecture with all configuration variants for Application Function interaction with 5G Core Network, usage of NEF or MBSF in the control plane, and usage of N6, MB2-U or xMB-U in user plane.



Figure A-1: Configuration options at Service and/or Application

The following characteristics describe each of the Configuration options:

- Configuration Option 1: No MBSF:

- This configuration is used for Transport Only Mode, when the Multicast service or Broadcast service does not require service layer interworking with LTE MBMS.

- The control plane entry point for the Application Function outside the trusted domain towards 5GC to request establishment of an MBS session is the NEF via N33.

- An application function within the trusted domain can directly use the N30 and N29mb service based interfaces. In this case some NEF functionality related to PCF and MB-SMF interaction is incorporated in AF.

NOTE 1: Application function within the trusted domain selects MB-SMF based on e.g. its local configuration, or query NRF based on location, etc.

- The user plane entry point for the Application Function towards 5GC is the MB-UPF via N6.

- Configuration Option 2: MBSF, N33 towards AF:

- This configuration may be used for Service Mode, or when interworking with LTE MBMS is required.

- The control plane entry point from the Application Function to request establishment of an MBS session is the NEF via N33.

- The user plane entry point for the Application Function towards 5GC is the MBSTF via MB2-U, xMB-U or Nmb8.

- The NEF and MBSF may be collocated.

- If the MBSF is not collocated with the NEF, the reference point between the NEF and MBSF is Nmb5.

- An application function within the trusted domain may be collocated with MBSF.

- Configuration Option 3: MBSF, MB2-C/xMB-C/Nmb10 towards AF:

- This configuration may be used for Service Mode (xMB-C or Nmb10), or when interworking with LTE MBMS is required (MB2-C or xMB-C).

- The control plane entry point from the Application Function to request establishment of an MBS session is the MBSF via MB2-C, xMB-C or Nmb10.

- The user plane entry point for the Application Function is the MBSTF via MB2-U, xMB-U or Nmb8.

For service mode, MBSF shall be used, i.e. either Configuration 2 or Configuration 3 shall be used. The MBSF may decide to service/transport layer changes on the MBS data (e.g. including the FEC or MBS data transcoding).

For Transport Only mode:

- If interworking with LTE MBMS at 5GC is required for the service, MBSF and MBSTF shall be used, i.e. either Configuration 2 or Configuration 3 shall be used.

NOTE 2: Interworking providing by AF is out of scope of this specification.

- If interworking with LTE MBMS is not required for the service, MBSF and MBSTF are optional.

MBSTF shall be used when MBSF is used.

Any particular deployment may support any combination of these configurations.

Annex B (informative): Service levels for multicast communication service

The following service levels for the multicast communication service are defined:

NOTE 1: Transport Only mode and Full-Service mode of operation as defined in TS 23.246 [8] differ from the service levels defined here.

- **Basic service level**. The following requirements are defined:

- Media transported transparently through the 5GS.

- Interactions between UE and network for receiving the multicast communication service.

- Packet distribution from the 5GS ingress to NG-RAN node(s).

- Data delivery from NG-RAN node(s) to the UE.

- **Enhanced service level**, with additional requirements on top of basic service level. Different requirements out of the set below may be necessary to address each use case:

- Local MBS service.

- User authentication and authorization for multicast session.

NOTE 2: User authentication and authorization is an optional feature in 5GS.

- Explicit configuration of multicast session by AF, including group member information.

- Enhanced QoS support. E.g., to differentiate MBS data flow with different QoS over 5GS.

Annex C (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-03 | SA2#143E | S2-2101423 | - | - | - | TS skeleton approved at S2#143E | 0.0.0 |
| 2021-03 | SA2#143E |  |  |  |  | Inclusion of documents agreed in SA2#143E:  S2-2101424, S2-2101425, S2-2101426, S2-2101427, S2-2101113, S2-2101428, S2-2100381, S2-2101429, S2-2101430, S2-2101118, S2-2101431, S2-2101432, S2-2101433, S2-2101114, S2-2101120, S2-2101434, S2-2101435, S2-2101115 | 0.1.0 |
| 2021-04 | SA2#144E |  |  |  |  | Inclusion of documents agreed in SA2#144E:  S2-2103526, S2-2103527, S2-2103071, S2-2103529, S2-2103530, S2-2103531, S2-2103556, S2-2103532, S2-2103533, S2-2103557, S2-2103534, S2-2103535, S2-2103072, S2-2103538, S2-2103539, S2-2103540, S2-2103541, S2-2103073, S2-2103543, S2-2103544, S2-2102339, S2-2102388, S2-2103545, S2-2103546, S2-2103547, S2-2103548, S2-2102729, S2-2102730 | 0.2.0 |
| 2021-05 | SA2#145E |  |  |  |  | Inclusion of documents agreed in SA2#145E:  S2-2104200, S2-2104966, S2-2104967, S2-2104968, S2-2104969, S2-2104970, S2-2103949, S2-2105176, S2-2104971, S2-2104972, S2-2104973, S2-2104057, S2-2105212, S2-2104974, S2-2104975, S2-2104976, S2-2104977, S2-2104978, S2-2104179, S2-2104979, S2-2104980, S2-2104981, S2-2104982, S2-2104983, S2-2104984, S2-2104985, S2-2105191, S2-2104986, S2-2104987, S2-2104988, S2-2104989, S2-2104990, S2-2104991, S2-2104992, S2-2104993, S2-2105162, S2-2103955, S2-2105192, S2-2105163, S2-2105193, S2-2105164, S2-2105165, S2-2104426, S2-2105166, S2-2105167, S2-2105168, S2-2105169, S2-2105170, S2-2105171 | 0.3.0 |
| 2021-06 | SA#92E | SP-210368 | - | - | - | MCC editorial update for presentation to TSG SA#92E for information | 1.0.0 |
| 2021-08 | SA2#146E |  |  |  |  | Inclusion of documents agreed in SA2#146E:  S2-2106914, S2-2106915, S2-2106916, S2-2106917, S2-2106918, S2-2106919, S2-2106920, S2-2106921, S2-2106922, S2-2106923, S2-2105630, S2-2106924, S2-2106925, S2-2106926, S2-2106927, S2-2106928, S2-2106929, S2-2106930, S2-2106665, S2-2106931, S2-2106932, S2-2106933, S2-2106934, S2-2106935, S2-2106936, S2-2105905, S2-2106937, S2-2106938, S2-2106939, S2-2106940, S2-2106941, S2-2106942, S2-2106943, S2-2106944, S2-2106945, S2-2106946, S2-2106947, S2-2106948, S2-2106949, S2-2106950, S2-2105906, S2-2106666, S2-2106667, S2-2106951, S2-2106952, S2-2106953, S2-2106954, S2-2106956, S2-2106957, S2-2106958, S2-2106959, S2-2106960 | 1.1.0 |