**Agenda item:** 9.8

**Source:** Qualcomm Incorporated, Telus, Ericsson, BBC

**Title:** [5MBUSA] Agreements from offline

**Document for** Discussion andAgreement

# Introduction

In several offline sessions, the following 5MBSUSA related document were asked to be reviewed.

|  |  |  |
| --- | --- | --- |
| [**S4-211005**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211005.zip) | [5MBUSA] Architecture and Service Model | Qualcomm Incorporated |
| [**S4-211006**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211006.zip) | [5MBUSA] Re-use of MBMS | Qualcomm Incorporated |
| [**S4-211007**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211007.zip) | [5MBUSA] 5GMS via eMBMS | Qualcomm Incorporated |
| [**S4-211008**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211008.zip) | [5MBUSA] Low-latency Broadcast | Qualcomm Incorporated |
| [**S4-211009**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211009.zip) | [5MBUSA] Hybrid Services | Qualcomm Incorporated |
| [**S4-211010**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211010.zip) | [5MBUSA] Security Aspects | Qualcomm Incorporated |
| [**S4-211143**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211143.zip) | pCR to TS 26.502 on reference architecture | TELUS |

This document captures:

* Some relevant background from other specifications in section 2.
* the agreements from these offline discussions in remaining sections.

This version includes agreements from the following documents:

|  |  |  |
| --- | --- | --- |
| **[S4-211005](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211005.zip)** | [5MBUSA] Architecture and Service Model | Qualcomm Incorporated |
| **[S4-211006](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211006.zip)** | [5MBUSA] Re-use of MBMS | Qualcomm Incorporated |
| [S4-211143](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211143.zip) | pCR to TS 26.502 on reference architecture | TELUS |

# Relevant Background Definitions from TS 23.247v1.0.0 and elsewhere

## 2.1 Principles 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.

There are two types of MBS session:

- Broadcast session;

- Multicast session.

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 packet to a RAN node, which then delivers them to one or multiple UEs

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

- Point-to-Point (PTP) delivery method: a RAN node delivers separate copies of MBS data packet over radio to individual UE.

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

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: Schematic showing delivery methods**

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

## 2.2 Multicast data provisioning

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



Figure 4.2.1-1: Phases of Multicast data provisioning

## 2.3 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

## 2.4 Relevant Phases

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, which may also include TMGI allocation procedure.

- 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 is optional.

- Session Establishment: Session Establishment is the point at which the transmission resources need to be established for transmitting the DL Broadcast data between 5GC and NG-RAN. Session Establishment follows Session Start, which is triggered by the request from AF.

- 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.

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

****

**Figure 4.2.2-2: Broadcast service timeline**

## 2.5 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. 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.

NOTE 1: The SMF is not involved in the multicast session while the multicast session is in configured state, but this state affects the MB-SMF.

NOTE 2: There may be several sub-states in the configured state, e.g. TMGI requested, or information about the multicast session provided.

- **Active state**: Multicast session is established and MBS data can be transmitted to the UEs that have joined 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 are transmitted to the UEs that have joined the multicast session. 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. Alternatively, there is network-internal configuration of the multicast session. Only resources at MB-SMF, NEF and MB-UPF are reserved and no multicast data are transmitted. 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. 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. Multicast session state transitions from NULL or Configured state to either Inactive or Active state.

- **Multicast Session Activation**: 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.

- **Multicast Session Deactivation**: 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, the resources for the multicast session are released in both 5GC nodes and RAN nodes. Multicast session state transitions from Active or Inactive state to Configured.

- **Multicast Session Deconfiguration**: 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. The deconfiguration may be triggered by an AF request. Multicast session state transitions from Configured, Active or Inactive state to NULL.

Editor's note: It is FFS when the multicast session is in configured state, whether AF can trigger Activation request or Deactivation request. And if AF is not allowed, it is FFS about the implications towards the AF.

****

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

## 2.6 General Architecture

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

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.

Editor's note: It is FFS whether to document those limitations of this release in the scope or general clause instead.

****

**Figure 5.1-1: 5G MBS system architecture**

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; their usage depends on deployment.

NOTE 3: xMB-C/MB2-C and xMB-U/MB2-U are intended for legacy AS. A 5G MBS 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 MBS system architecture using the reference point representation showing how various network functions interact with each other.

****

**Figure 5.1-2: 5G MBS system architecture in reference point representation**

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

## 2.6 Reference Points

The MBS System Architecture contains the following new reference points:

**N3mb**: Reference point between the (R)AN 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.

Editor's note: The Nmb7 reference point is FFS.

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

The reference points for which SA4 is expected to provide specifications (as part of the 5MBS User service) are marked in yellow.

The reference points for which SA4 is expected to be a user of as part of the 5MBS User service description, are marked in green.

## 2.6 Functional Entities

The entities for which SA4 is expected to provide specifications (as part of the 5MBS User service) are marked in yellow.

The entities for which SA4 is expected to be a user of as part of the 5MBS User service description, are marked in green.

5.3.2.1 PCF

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 MB service 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.

- 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

The SMF performs the following functions to support MBS:

- Discovering MB-SMF for 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

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

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.

- Signalling with NG-RAN for NG-RAN MBS capability, or.

- May be configured with NG-RAN MBS capability.

5.3.2.7 NG-RAN

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.

- May report the MBS capability to AMF in NGAP setup procedure defined in TS 38.413 [15].

5.3.2.8 UE

The UE may perform the following functions to support MBS:

- Reception of multicast data using PTM/PTP.

- Reception of multicast and broadcast data using PTM.

- Handling of incoming MBS QoS flows.

- Support of signalling for joining and leaving multicast 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

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

- Selection of serving MB-SMF for 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 serving MB-SMF for 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

The UDM performs the following functions to support MBS:

- Support management of subscription for authorization for multicast sessions.

5.3.2.14 UDR

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

- Support management of UE authorization information for multicast session.

5.3.2.15 NRF

The NRF performs the following functions to support MBS:

- Support management of MB-SMF information serving multicast sessions.

## 2.7 Identifiers

6.5.1 MBS Session ID

The MBS session ID is used to identify a MBS Multicast/Broadcast Session throughout the 5G system transport 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 MBS multicast Session);

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

If an MBS multicast session is provided within an SNPN, the MBS multicast 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 MBS multicast 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.

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

For MBS multicast Session, a source specific IP multicast address can be assigned by 5GC or an external network.

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) in TS 23.003 [12] together identify an MBS Session.

6.5.3 Source Specific IP Multicast Address

The source specific IP multicast address is used to identify an MBS Multicast 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 service associated with the source.

2.8 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 in which the service is delivered.

The Service Announcement includes an MBS Session 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 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.

Editor's note: Other means to provide MBS session related information to UE, e.g. pre-configuration of default PLMN ID, DNN and S-NSSAI and possible additional information are FFS.

Editor's note: 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 FFS.

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

Editor's note: Other entities that can send Service Announcement to UE is FFS.

Editor's note: The details of Service Announcement will be defined with coordination with SA4/SA6, including which information is aware by UE.

2.9 Existing Service and Session Terminology

According to TS 23.247, clause 3, on service definition:

**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.

**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.

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

**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.

According to TS 23.247, clause 3, on session definition:

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

**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.

**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.

According to TS 26.346, clause 3, on service definition:

**Application Service**: An end-user service for which the entry point document is contained in the User Service Description and whereby all associated content components are delivered through one or more MBMS User Services via broadcast and/or unicast bearers.

**MBMS User Service:** The transport-level service, comprising one or more application content components, delivered by the MBMS bearer service across one or more Broadcast and/or Multicast sessions, and/or delivered by the unicast bearer service. The application content components of the MBMS User Service, in part or in whole, are provided to the MBMS application.

See 3GPP TS 22.246 [3].

According to TS 23.346, clause 3, on session definition:

**MBMS download session:** time, protocols and protocol state (i.e. parameters) which define sender and receiver configuration for the download of content files.

**MBMS streaming session:** time, protocols and protocol state (i.e. parameters) which define sender and receiver configuration for the streaming of content.

**MBMS Transparent session:** time, area, protocols, and protocol state (i.e. parameters) which define sender and receiver configuration for the transparent delivery of application data flows.

**RTP Session**: The RTP and RTCP traffic sent to a specific IP multicast address and port pair (one port each for RTP and RTCP) during the time period the session is specified to exist. An RTP session is used to transport a single media type (e.g. audio, video, or text). An RTP session may contain several different streams of RTP packets using different SSRCs.

In addition, TS 26.346 makes very extensive use of the term FLUTE Session, but it is not defined. It is mapped to a MBMS download session. The Session parameter semantics include

- The sender IP address.

- The number of channels in the session => only one FLUTE channel is allowed.

- The destination IP address and port number for each channel in the session per media.

- The Transport Session Identifier (TSI) of the session: together sender IP addresses defines session.

- The start time and end time of the session.

- The protocol ID (i.e. FLUTE/UDP).

- Media type(s) and fmt-list.

- Data rate using existing SDP bandwidth modifiers.

- Mode of MBMS bearer per media.

- FEC capabilities and related parameters.

- Service-language(s) per media.

- QoE Metrics (as defined in sub-clauses 8.3.2.1 and 8.4).

- Alternative TMGI

According to TS 23.347, clause 3, on service definition:

**MBMS Application User Service**: An end-user service for which all associated resources are delivered through an MBMS User Service via broadcast and/or unicast bearers and which is accessible through the MBMS-API.

According to TS 26.348, clause 5.3.1

*The service management procedures allow the content provider to create, modify and delete services on the BM-SC. Each service may contain multiple sequential sessions.*

# TS 26.502 Structure

It is agreed that we need to get a good overview on the bigger picture to properly structure the outline of the specification.

1. Reference Architecture
	1. General System Description
		1. Network
		2. User Service
	2. Functional Entities
	3. Reference Points and Interfaces
	4. Domain / Service and Session Model
	5. Life-cycle model
	6. Delivery Method Principle
2. Procedures
	1. High-level Baseline Procedures
	2. Procedures for specific phases
3. Delivery Methods
	1. Object Delivery
	2. Packet Delivery

# MBS Architectures

Figure 3.1-1 updates Figure 5.1-2 from TS 23.247 to provide a more user service centric view. It also provides an update to Figure 4.4.3-1 from TR 26.802. The red highlights provide the main scope for User Service Specification from a northbound interface.



Figure 3.1-1 User Service Centric 5G MBS system architecture in reference point representation

In Figure 3.1-2, a proposed update to the 5MBS User Service Architecture is proposed that addresses the different interfaces defined in the work item description.



Figure 3.1-2 5G Multicast Broadcast User Service (5MBUS) Architecture

In the architecture above, MBS-specific functions such as the MBS AS and MBSF are shown as independent and standalone. In deployments, they may be co-located on physical devices with other functions. As an example, the MBS AS may be hosted in the Application Provider domain, or it may be hosted in a 5GMS AS.

Reference points already defined in TS 23.247 that are of relevance for the User Service architecture are:

* **Nmb1:** Reference point between the MB-SMF and the MBSF.
* **Nmb2**: Reference point between the MBSF and the MBSTF (may be MBS-3).
* **Nmb8**: Reference point between the MBSTF and the AF (may be named MBS-2).
* **Nmb9:** Reference point between the MB-UPF and the MBSTF.
* **Nmb10**: Reference point between the MBSF and the AF (may be named MBS-1).
* **Nmb12:** Reference point between the MBSF and the PCF.

The following additional reference points are defined:

* **MBS-5:** API from the MBS Client to the MBSF for the purpose of 5MBS control plane and service handling referred to as interface MBS-5. It is expected that this API has similar functionalities to those of the User Service Description as defined in TS 26.346.
* **MBS-4-MC:** dealing with unidirectional and multicast delivery from the MBSTF to the MBS Client. It is expected that this interface has similar functionalities as defined in the delivery methods defined in TS 26.346.
* **MBS-4-UC:** dealing with unicast delivery from the MBSTF to the MBS Client. It is expected that this interface has similar functionalities as defined in the delivery methods defined in TS 26.346 provided for unicast.
* **MBS-6:** API-based interface exposed by the MBS Client and used by the MBS-Aware Application to manage and control MBS User Services. It is expected that this API has similar functionalities to the control interfaces defined in clause 6 of TS 26.347.
* **MBS-7:** API-based interface MBS‑7 exposed by the MBS Client and used by the MBS-Aware Application to receive user data information about MBS User Services. It is expected that this API has similar functionalities as the data interfaces defined in clause 7 of TS 26.347.
* **MBS-8:** Interface between the 5MBS Application Provider and the MBS-Aware Application in order to announce MBS User Services.

There are no reference points defined for MBS AS at this stage.

Editor’s Note: The above figure and text needs to be combined.

Figure 4.4.1-1 depicts the MBS network architecture, showing relevant entities involved in providing MBS User Service delivery and control.



Figure 4.4.1-1: Network Architecture for MBS User Service Delivery and Control

The AF and MBSF interact at reference point Nmb10 to support MBS session operations and transport in the control plane. The legacy interfaces xMB-C and MB2-C are supported at this reference point.

The AS and MBSTF interact at reference point Nmb8 to support MBS data handling (e.g. encoding) in the user plane. The legacy interfaces xMB-U and MB2-U are supported at this reference point. The MBSTF performs generic packet transport functions available to any IP multicast-enabled application, such as framing, multiple flows and packet FEC (encoding). It also performs multicast/broadcast delivery of input files as objects or object flows. If needed, the MBSTF provides a media anchor point for MBS data traffic and sourcing of IP multicast.

MBS User Services enable high-level applications to make use of the low-level features of the MBS System. The MBS User Service is provided by the MBSF and MBSTF working in combination. It presents a complete service offering to an end-user, via a set of APIs that allows the 5MBS Client to activate or deactivate reception of the service.

Figure 4.4.1-2 depicts the functional entities in MBSF and MBSTF to support MBS User Service.



Figure 4.4.1-2: MBS user service functional entities

The User Service Discovery/Announcement function of the MBSF provides session access information, which is consumed by the MBS Client and subsequently used to initiate the reception of a MBS User Service. The session access information may contain information for presentation to the end-user, as well as application parameters used in generating service content to the MBS Client.

# Session and Service concepts – Baseline Procedures

Based on the above discussion, the following definitions are proposed:

**MBS Application Service**: An end-user service for which parts or all of the data are accessible by joining an MBS User Service.

**MBS User Service:** A transport-level service configured by the MBSF and using one or more MBS Delivery Sessions, possibly in combination with unicast delivery methods to deliver an Application Service.

**MBS Delivery Session:** time, protocols and protocol state (i.e. parameters) which define sender and receiver configuration and use an MBS Session (either an MBS Broadcast Session or an MBS Multicast Session as defined in TS 23.247) for the delivery of an application data session. (NEEDS UPDATE)

**MBS Application data session:** time, protocols and protocol state (i.e. parameters) provided by an 5MBS application provider for delivery over 5MBS and provided to the 5MBS aware application.

This concept is now also presented in the below figure.



Figure X: Service and Session Oriented Architecture

Initial session and service procedures are provided in Figure 6-1.



Figure 6-1 5MB User Service Workflow (add parallel workflows)

Editor’s Note: This diagram needs some updates to express parallel workflows and so on.

In this case

1. The MBS Application Service is provisioned though Nmb10.
2. The MBSF provisions the MBS Delivery Session(s) in the MBSTF.
3. The MBS User Service announcement is prepared for being accessed by the MBSF Client.
4. The MBS Applicarion Service is announced to the MBS-Aware Application.
5. Application data is ingested as part of an MBS Application Data Session.

NOTE: The actual data ingest (Step 5) may happen after the session announcement (Step 7) or even after the session join (step 9) in case of multicast sessions.

1. The MBS-Aware Application requests to join an MBS User Service.
2. The MBSF Client discovers the service.

NOTE: The MBSF Client may have already discovered the MBS User Service at an earlier point.

1. The MBSF Client provides the session information to the MBSTF Client.
2. The MBSTF Client based on this information joins the service.

NOTE: In broadcast the joining is not sent to the MBSTF, but only happens on the device

1. Ongoing handling of the MBS User Services session between the MBSF Client and the MBSF..
2. The MBS Delivery Session is in place.
3. The MBSTF provides the information about the MBS User Services session to the MBS-Aware Application through MBS-7.
4. The MBS User Services session is controlled by the MBS-Aware Application.

# Detailed Functions and Interfaces

## 6.1 Introduction

This section addresses the following aspects identified in S4-210975 aspects:

10. Any new specification will take into consideration the need to maximize the reuse of components already specified in MBMS.

This relates to the objective documented in clause 4 of the TR:

1. Specify the 5MBS User Service architecture, including the following reference points/interfaces and entities:

1. New entities MBSF, MBSTF, 5MBS Client, and 5MBS AS.
2. The northbound reference points Nmb6 and Nmb4.
3. The reference point Nmb2 between the MBSF and the MBSTF.
4. The interfaces between the 5MBS Client and 5MBS network functions: MBS-4-UC, MBS-4-MC and MBS‑5.
5. The 5MBS Client reference points MBS-6 and MBS-7.

Also it takes into account the conclusions in TR 26.802, the following re-use aspects are proposed:

1. The following “user service” functionalities (as defined in TS 26.346) with proper mapping to 5G MBS architecture (as to be defined in Rel-17, TS 23.247) are proposed to be reused and extended if needed. The combination with 5G Media Streaming is one deployment scenario.

a) Service Announcement and Discovery as defined in TS 26.346 based on userServiceDescription. Stage-3 aspects may be reconsidered, for example to align with 5GS design principles.

NOTE: the delivery of service announcement and discovery may be done using MBS delivery sessions or may be done independently from MBS.

b) Object delivery Method that includes:

- Download delivery method, File Delivery as defined in TS 26.346, clause 7.

- DASH/HLS over MBMS as defined in TS 26.346, clause 5.6 and 5.7, including Low-Latency CMAF as defined in 5GMS.

c) A common packet delivery method that includes the relevant delivery aspects of transparent delivery method, group communication delivery method and streaming delivery method as defined in TS 26.346, clause 8B, 8A and 8 respectively.

d) The relevant functions as now defined as Associated Delivery Procedures in TS 26.346, clause 9, and aligning with 5GMS.

2. Define the necessary extensions of relevant “MBMS Service Layer” functionalities to support 5GS and 5G MBS Sessions (as to be defined in Rel-17, TS 23.247). This pre-dominantly includes the definition or proper delivery method establishment.

3. Provide the relevant functions and protocols for northbound interfaces based on the xMB API defined in TS 26.348.

4. Define the separation of the User Plane and Control Plane Functionalities of “BM-SC” (now MBSF and MBSTF) and define the API between MBSF and MBSTF (named 'Nmb2').

5. Define the User Plane and Control Plane Functionalities/APIs of the 5MBS Client based on the MBMS Client functions as defined in TS 26.347 (Clause 6 is control, clause 7 is user-plane).

## 6.2 Service Announcement

This section deals with

1. Service Announcement and Discovery as defined in TS 26.346 based on userServiceDescription. Stage-3 aspects may be reconsidered, for example to align with 5GS design principles.

The MBMS user service description is provided in Figure 5 of TS 26.346.



The user service model from MBMS is used as a baseline.

This following modifications to the MBMS User Service model is considered:

1. The user service bundle is renamed to User Service Bouquet, modelling a collection of (possibly related) MBS User Services that can be announced jointly. FEC Repair Stream bundling is not supported for User Service Bouquets.
2. An MBS User Service may consist of multiple MBS Delivery Sessions.
3. A Session Description describes all MBS Delivery Sessions that are carried on an MBS Session. An MBS Session may offer different flows.
	1. One c= line.
	2. Scheduling and sessions of delivery methods (t lines present in MBMS).
	3. LCT/TSI (for application differentiation, MBS user service layer).
	4. UDP port (for QoS flow differentiation, to be checked).
	5. IP address (ptm and ptp).
4. Each MBS Delivery Session may be mapped to the same flow or to different flows
5. Based on this, there are four hierarchies
	1. User Service Bouquet.
	2. 1 .. P MBS User Service.
	3. 1 .. M MBS Delivery Session (could be several over time in a service), but MBU User Service is only creating one session.
	4. 1 .. N flows.
6. The appService is simplified and the explicit DASH service is removed.
7. Reporting is excluded for now and assumed to be an application function.

Based on this approach, the following data structure is proposed:

* User Service Bouquet Description
	+ Bouquet Parameters
	+ User Service 1 … N
		- User Service Parameters
		- MBS Delivery Sessions 1 … N
			* Delivery Session Parameters
		- MBS Session Description
			* Session Description parameters
			* Flows
				+ MBS Delivery Session mapping
				+ Flow Parameters
				+ QoS Parameters
		- App Service
			* App Service Parameters
		- Schedule

A profile that is “backward-compatible” to current MBMS may be defined.

From a stage-3 perspective, no decisions need to be taken yet. The concept of in-band and fragments does not have to be solved yet. Preference is a modern approach based on service-based APIs.

## 6.3 Object Delivery/Transfer Method

This section deals with

b) Object delivery Method that includes:

- Download delivery method, File Delivery as defined in TS 26.346, clause 7.

- DASH/HLS over MBMS as defined in TS 26.346, clause 5.6 and 5.7, including Low-Latency CMAF as defined in 5GMS.

For the object delivery method, it is proposed to differentiate two different cases.

1. Non-real-time file delivery including Carouselling
	1. Selected properties of this mode include
		1. Scheduled delivery
		2. File repair
		3. Carousel
		4. Post-delivery reporting
		5. File delivery QoS
		6. Usage of FEC for file delivery
	2. On stage-3 it is expected that we use FLUTE as defined in TS 26.346 with the following questions and comments:
		1. Upgrade to the latest version of ALC, FLUTE and LCT? (stage 3 decision, what is the value? do we need a legacy mode?)
		2. Profile/remove any non-used functionalities based on MBMS Download Profile in TS 26.346, Annex L.4 (stage 3 decision, legacy?)
2. Object Streaming addressing DASH/HLS
	1. Selected properties of this mode include
		1. Timed delivery
			1. Object deadline that is relevant for proper application operation.
		2. Concurrent metrics reporting
		3. Usage of FEC for object delivery
		4. Sequence of multiple objects
		5. Possibly multiple flows
		6. Limited size
		7. Partial objects
	2. Excluded at least in Rel-17 are
		1. Unicast such as fast startup, service continuity, unicast repair? At this stage no, it is deferred to the application (e.g. as part of 5GMS). This holds for Rel-17, may be revisited later.
	3. On stage 3, it is expected that enhancements are needed beyond the existing FLUTE.
		1. Resolve and address object timing model (stage-3).
		2. Address real-time and low-latency streaming, e.g. ROUTE or FLUTE extensions, but stage-3 discussion?

It is agreed that:

* It is beneficial to create two distinct object delivery methods: object carouselling and object streaming.
* Does not imply that we need two different protocols.
* We should clearly define two different call flows for the different delivery modes. The may be common procedures, but also distinct ones.

Develop at least one call flow for each of the above.

* For object carouselling:
	+ Single file, possibly with schedule.
	+ Carousel.
* For object streaming:
	+ Regular-latency object streaming.
	+ (Low-latency streaming if any substantial differences would be observed and there is sufficient time).

## 6.4 Packet Delivery/Transfer Method

Editor’s Note: The name of this delivery method is pending to further discussion

This section deals with

c) A common packet delivery method that includes the relevant delivery aspects of transparent delivery method, group communication delivery method and streaming delivery method as defined in TS 26.346, clause 8B, 8A and 8 respectively.

For the packet delivery method, it is proposed to only support the Transparent Delivery Method as defined in clause 8B, both the proxy and the forward-only mode. This includes RTP-based delivery as a special case.

The following functions are expected to be included:

* Packet sequencing.
* FEC.
* QoS, bit rates.
* Multiple flows?
* Specific protocol support such as RTP/AVP.

The following functions are expected *not* to be included:

* Metrics – this is considered to be an application function.
* Unicast is not supported.
* Codecs will not be addressed. It is an assumption that an SDP is available with RTP/AVP.

At least the following call flows are expected to created:

* Packet delivery in proxy-mode.
* Packet delivery in forward-only mode.

## 6.5 Associated Delivery Procedures

This section deals with:

d) The relevant functions as now defined as Associated Delivery Procedures in TS 26.346, clause 9, and aligning with 5GMS.

For the associated delivery procedures as defined in clause 9 of TS 26.346, the following is agreed:

* We do not maintain this generic concept in MBS User Services.
* There may instead be specific functions that are added to individual delivery methods.
* Today we consider reusing only byte range file repair, as defined in 9.3.6.2, in connection with the Object deliver/transfer method. No repair mechanism for the Packet delivery/transfer method is contemplated.
* No grouping of functions is needed.

## 6.5 Northbound Interfaces

This section deals with:

3. Provide the relevant functions and protocols for northbound interfaces based on the xMB API defined in TS 26.348.

For the northbound interfaces the following is agreed:

* Reuse to the most extent the definitions from TS 26.348.
* Modify TS 26.348 with the following functionalities:
	+ An MBS User Service may consist of multiple flows.
	+ Provide the ability to configure all defined MBS Delivery Methods.
	+ Simplify and remove any unnecessary functionalities.
	+ Take the concepts from xMB-C and to re-cast them as a more modern API design.
* Separate Nmb10 (xMB-C) and Nmb8 (xMB-U) as they are quite different.

## 6.6 Nmb2

This section deals with:

4. Define the separation of the User Plane and Control Plane Functionalities of “BM-SC” (now MBSF and MBSTF) and define the API between MBSF and MBSTF (named 'Nmb2').

For Nmb2, it is agreed:

* To reuse the findings in TR 26.802, Table 5.3.1.5-2, as the baseline.
* Identify the configuration parameters for each delivery method and use those to configure MBSTF. It is expected that MBSF:
	+ Generates the MBS Delivery Session information.
	+ Generates the MBS Session information.
	+ Provides this to the MBSTF for configuration of the delivery method.
	+ “Translates” generic service requirements into exact MBSTF Delivery Method parameters.
* Create a binding of MBS Application Data sessions to MBS Delivery Sessions.
	+ Configure the Nmb8 ingest session.

## 6.7 Client APIs

This section deals with:

5. Define the User Plane and Control Plane Functionalities/APIs of the 5MBS Client based on the MBMS Client functions as defined in TS 26.347 (Clause 6 is control, clause 7 is user-plane).

For client APIs, it is agreed:

* Reuse TS 26.347 as is, but update the mapping description between user service parameters and APIs.
* Generalize the service APIs across different MBS Delivery Methods,
* Add low-latency streaming to the user plane interface, supporting:
	+ Chunked HTTP delivery.
	+ Possibly partial access to data.
* Create signalling and APIs that make the application as “unaware” as possible of specific 5MBS delivery. Expected that there are two options:
	+ *MBMS-Aware mode:* MBS-Aaware Application wakes up the MBS Client based on MBS Application-Service announcement information it has received via MBS-8.
	+ *Transparent mode:* MBSF Client is a background service that monitors service announcements and intercepts application requests for unicast to include MBS delivery.
* Service announcement aspects of the client APIs follow a subscribe–notify design pattern similar to those of the 5GMS Media Session Handler.

# Combination with 5G Media Streaming

It was agreed to:

* Focus on the completion of MBS Architecture and procedures in TS 26.502.
* Create a new clause in TS 26.501 that provides functions and procedures for 5GMS via MBS.

# Proposal

It is proposed to:

* Use these offline agreements as the basis for future work.
* Generate appropriate pCRs to TS 26.502 during the *ad hoc* group period.
* Continue to discuss the following documents in an offline on Aug 27 and possibly add additional agreements to a revision of this document.

|  |  |  |
| --- | --- | --- |
| **[S4-211007](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211007.zip)** | [5MBUSA] 5GMS via eMBMS | Qualcomm Incorporated |
| **[S4-211008](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211008.zip)** | [5MBUSA] Low-latency Broadcast | Qualcomm Incorporated |
| **[S4-211009](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211009.zip)** | [5MBUSA] Hybrid Services | Qualcomm Incorporated |
| **[S4-211010](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_115-e/Docs/S4-211010.zip)** | [5MBUSA] Security Aspects | Qualcomm Incorporated |