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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 defines an architecture and high-level procedures for User Services conveyed using the 5G multicast–broadcast capabilities of the 5G System defined in TS 23.501 [2], TS 23.502 [3] and TS 23.247 [5].

# 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 23.501: "System architecture for the 5G System (5GS)".

[3] 3GPP TS 23.502: "Procedures for the 5G System (5GS)".

[4] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

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

[6] 3GPP TS 26.348: "Northbound Application Programming Interface (API) for Multimedia Broadcast/Multicast Service (MBMS) at the xMB reference point".

[7] 3GPP TS 26.501: "5G Media Streaming (5GMS); General description and architecture".

[8] IETF RFC 3500: "RTP: A Transport Protocol for Real-Time Applications".

[9] IETF RFC 2250: "RTP Payload Format for MPEG1/MPEG2 Video".

[10] 3GPP TS 26.247: Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH).

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1], TS 23.501 [2], TS 23.502 [3], TS 23.247 [5] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Broadcast MBS session:** an MBS session to deliver the broadcast communication service, as defined in TS 23.247 [4].

**distribution method:** a mechanism used by the MBSTF to deliver data as part of a User Service to the MBS Client.

**MBS Application Data Session:** time, protocols and protocol state (i.e. parameters) provided by the MBSTF Client to the MBS-Aware Application.

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

**MBS-Aware Application:** A UE-based application that consumes User Services by invoking with MBS Client APIs.

**MBS Client:** the UE function that consumes User Services defined in the present document.

**MBS Distribution Session:**

**MBS session:** a multicast session or a broadcast session, as defined in TS 23.247 [4].

**MBS User Service:** An abstract transport-level service configured by the MBSF and using one or more MBS Distribution Sessions, possibly in combination with unicast, for the purpose of supporting an MBS-Aware Application via a set of APIs that allows the MBS Client to activate and deactivate reception of the MBS Session.

**MBS User Data Ingest Session:** time, protocols and protocol state (i.e. parameters) provided by an MBS Application Provider for distribution over an MBS User Service, and provided to the MBS-Aware Application as an MBS Application Data Session.

**MBS User Service Session:**

**Multicast MBS session:** an MBS session to deliver the multicast communication service, as defined in TS 23.247 [4].

**Object distribution method:** the delivery method supporting real-time and non-real-time distribution of discrete binary objects, including media segments, to MBS Clients as part of an MBS session.

**Packet distribution method:** the distribution method supporting transparent delivery of Application Data Units to 5MBS Clients as part of an MBS session.

**User Service:** an abstract high-level usage of an MBS session for the purpose of supporting an application that presents a complete service offering to an MBS-Aware Application via a set of APIs that allows the MBS Client to activate and deactivate reception of the MBS session.

**User Service Announcement:** a list of available User Services along with information on the User Service such as the MBS session parameters or the delivery method.

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1], TS 23.501 [2], TS 23.502 [3], TS 23.247 [4] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

MBS Multicast–Broadcast Services

MB‑SMF Multicast–Broadcast Session Management Function

MB‑UPF Multicast–Broadcast User Plane Function

MBSF Multicast–Broadcast Service Function

MBSTF Multicast–Broadcast Service Transport Function

PCF Policy and Charging Function

PDU Protocol Data Unit

NEF Network Exposure Function

SDU Service Data Unit

UE User Equipment

# 4 Reference architecture for 5G Multicast–Broadcast User Services

## 4.1 General

This clause defines a reference architecture for 5G Multicast–Broadcast User Services, including the logical functions involved and the logical reference points between them.

## 4.2 System description

Editor’s Note: Explanation of fundamental concepts in the MBS User Services architecture.

### 4.2.1 Network architecture

Figure 4.2.1-1 depicts the MBS network architecture defined in clause 5.1 of TS 23.247 [5] using the reference point representation.



Figure 4.2.1-1: Network Architecture for MBS User Service delivery and control

The functions and reference points involved in providing MBS User Services within the MBS System are highlighted in green. In particular:

- Reference point Nmb10 is used by the AF/AS to provision MBS User Services in the MBSF by invoking the Nmbsf service.

- Reference point Nmb2 is used by the MBSF to configure and control MBS Distribution Methods in the MBSTF by invoking the Nmbstf service.

- Reference point Nmb8 is used by the MBSTF to ingest content from the AF/AS.

### 4.2.2 User Service network architecture

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 to support configuration option 2 and configuration option 3 defined in annex A of TS 23.247 [5]. It presents a complete service offering to an end-user, via a set of APIs that allows the MBS Client to activate or deactivate reception of the service.

The MBS User Service architecture depicted in figure 4.2.2-1 shows the MBS-related entities involved in providing MBS User Service delivery and control. These are described in the following clauses. The MBS Application Provider plays the role of the AF/AS.



Figure 4.2.2-1: MBS User Service network architecture

### 4.2.3 Distribution methods

Editor’s Note: Decide whether to refer at all to associated delivery procedures.

The MBS distribution methods defined in clause 6 of the present document make use of MBS Sessions (see clause 4.1 of TS 23.247 [5]) to deliver data to the MBS Client. The distribution methods may use either a multicast MBS Session or a broadcast MBS Session. A set of MBS distribution methods is provided by the MBSTF. These provide functionality such as security and key distribution, reliability control (by means of FEC techniques) and associated delivery procedures.

**- Object Distribution Method:** A distribution method that delivers discrete binary objects over an MBS Session. This may be used to support real-time distribution of media segments (as special objects) including Low-Latency CMAF segments.

The use of MBS Sessions by the Object Distribution Method is specified in clause 6.1.

**- Packet Distribution Method:** A distribution method that supports streaming of packetised media data over an MBS Session where Service Data Units (SDUs) are conveyed to the UE as part of Protocol Data Units (PDUs) or IP flows. Examples of upper layer SDU are RTP [8] and packetized MPEG-2 Transport Stream [9].

The use of MBS Sessions by the Packet Distribution Method is specified in clause 6.2.

The above distribution methods may use either a multicast MBS Session or a broadcast MBS Session to distribute content to an MBS Client and may also make use of a set of MBS associated delivery procedures.

### 4.2.4 User Service Announcement

The User Service Announcement provides information needed by the MBS Client to discover and activate the reception of one or more MBS User Services. [User Service Announcement information may be delivered via MBS Sessions or via a regular PDU Session.]

Editor’s Note: The ancillary information needs to be described and defined in the context of the User Service Announcement.

## 4.3 Functional entities

### 4.3.1 General

The MBSF and MBSTF offer service layer functionality for sending data via MBS Sessions. The MBSF (clause 4.3.2) offers control plane functionality while the MBSTF (clause 4.3.3) offers user plane functionality. The MBSTF acts as a User Plane anchor when it sources IP multicast traffic. Reference point Nmb2 provides the means for the MBSF to configure the delivery methods in the MBSTF.

Figure 4.3.1-1 shows the complete set of functional entities involved in supporting MBS User Services when the MBS Application Provider is deployed in the Trusted DN, including client functions in the UE.



NOTE: When the MBS Application Provider is deployed outside the Trusted DN, it interacts with the MBSF via the NEF at reference point N33, as shown in figure 4.2.2‑1, instead of via Nmb10.

Figure 4.3.1-1 MBS User Service reference 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 MBS Application Provider domain, or it may be hosted in a 5GMS AS.

### 4.3.2 MBSF

The functionality of the MBSF is defined in clause 5.3.2.11 of TS 23.247 [5]. It receives provisioning and control commands either directly at reference point Nmb10 or at reference point Nmb5 (via the NEF). The MBSF invokes MBS Session operations on the MB‑SMF at reference point Nmb1. The MBSF configures the MBSTF at reference point Nmb2.

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

The present document defines additional Control Plane functionalities of the MBSF to support MBS User Services including:

- Generating the User Service Announcement for each MBS Session.

- Managing User Service Announcement updates.

- Providing the User Service Announcement information to the MBS Client using one or more of the following mechanisms:

- Unicast User Service Announcement via reference point MBS-5.

- User Service Announcement via an MBS User Service Session.

- User Service Announcement via application-private means at reference point MBS-8.

[- Monitoring the status of ancillary information and configuring its delivery in the same MBS Session as the content with which it is associated if ancillary information is changed and the MBSTF is used.]

Editor’s Note: Usage of QoS is FFS. See clause 4.6.

### 4.3.3 MBSTF

#### 4.3.3.1 General

The functionality of the MBSTF is defined in clause 5.3.2.12 of TS 23.247 [5]. It receives User Plane data traffic at reference point Nmb8 and sends MBS data packets to the MB‑UPF via reference point Nmb9.

Editor’s Note: Check whether the following NOTE should be deleted.

NOTE: The MBSTF may not be present in all deployments of the MBS System.

The present document defines additional User Plane functionalities of the MBSTF to support MBS User Services as follows:

- Receiving Distribution Method configurations from the MBSF at reference point Nmb2.

- Sending notification events to the MBSF, e.g. data ingest failure, session terminated, delivery started via reference point Nmb2.

- Based on the configuration

- MBS delivery of ingested objects or sequences of objects to the MBS Client using the Object Distribution Method (see clause 6.1). This may be used to support real-time distribution of media segments (as special objects) including CMAF segments.

- MBS delivery of ingested packet streams to the MBS Client using the Packet Distribution Method (see clause 6.2).

Editor’s Note: The name of this distribution method is pending further discussion. For example, transparent mode was suggested. The discussion was around whether to describe the MBS distribution function or the service that is supported to the outside by the distribution.

[- Multiplexing of ancillary information into the MBS Session.]

#### 4.3.3.2 MBSTF subfunctions to support Object Distribution Method

The MBSTF subfunctions supporting the Object Distribution Method are depicted in figure 4.3.3.2-1 below.



Figure 4.3.3.2-1: MBSTF architecture overview for Object Distribution Method

The *Object ingest* subfunction supports:

- Pull-based ingest at reference point Nmb8: The Object ingest subfunction in this case fetches one or more objects from the MBS Application Provider (AF/AS) using HTTPS.

- Push-based ingest at reference point Nmb8: The Object ingest subfunction receives one or more objects from the MBS Application Provider (AF/AS) using HTTPS.

The *Object segmentation subfunction* supports the partitioning of an object into payload units suitable for MBS transmission.

The optional *Application Layer FEC* subfunction supports object recovery when some packets are not received by the MBMS Client.

The *Packetisation* subfunction places the payload units (and, optionally, the FEC data) into Nmb9 transmission packets according to clause 6.1.

The *Packet scheduling* subfunction schedules the outgoing packet stream according to target bit rate configuration.

The *Control subfunction* offers support for MBSTF service configuration, status query and notifications at reference point Nmb2.

#### 4.3.3.3 MBSTF subfunctions to support Packet Distribution Method

The MBSTF subfunctions supporting the Packet Distribution Method are depicted in figure 4.3.3.3-1 below.



Figure 4.3.3.3-1: MBSTF architecture overview for Packet Distribution Method

The *Packet ingest* subfunction supports the reception of a packet sequence at reference point Nmb2 from authorized sources.

The optional *Application Layer FEC* subfunction to support object recovery when some packets are not received by the MBMS Client.

The *Packetisation* subfunction places the ingested packets (and, optionally, the FEC data) into Nmb9 transmission packets. Depending on the transmission mode, ingested packets may be reformatted suitable for MBS transmission.

The *Packet scheduling* subfunction schedules the outgoing data stream according to target bit rate configuration.

The *Control subfunction* offers support for MBSTF service configuration and service notifications at reference point Nmb2.

### 4.3.4 MBS AS

The MBS AS performs the following functions to support MBS User Services:

- Providing a byte-range file repair service for use with the Object Distribution Method.

### 4.3.5 MBS Client

The MBS Client function is part of the UE. The functionality of the UE is defined in clause 5.3.2.8 of TS 23.247 [5].

The MBS Client is further divided into the following subfunctions:

- *MBSF Client:* Communicates with the MBSF on MBS User Service control aspects.

- *MBSTF Client:* Communicates with the MBSTF or MBS AS in order to provide an MBS Application Data Session to the MBS-Aware Application.

The MBS Client performs the following functions to support MBS User Services:

- Reception of IP multicast data from either a Multicast MBS Session or a Broadcast MBS Session.

- Exposure of MBS Application Data Sessions towards an 5MBS-Aware Application.

- Using AL-FEC to recover packets or objects , if this optional feature is provisioned for the MBS Session.

- Unicast recovery of the application payload data carried in multicast/broadcast packets that are not successfully received via MBS-4, if unicast repair is provisioned for the MBS Session.

Editor’s Note: Handling roaming is FFS.

Editor’s Note: The MBMS Reception Reporting Service is FFS. In principle, the Reception Reporting is used by the Network Operators to analyse the packet loss rate (Packet Error Rates - PER), and the main target is to adjust the FEC redundancy level to leverage the FEC redundancy level and radio frequency usage efficiency. Reception reporting could be realised by instantiating the EVEX Data Collection and Reporting architecture in the present document.

### 4.3.6 MBS-Aware Application

The MBS Client is typically controlled by an external application which triggers the establishment of an MBS User Services session. The MBS-Aware Application is not defined within the present document, but the function makes use of the MBS Client and the MBS User Services network functions via reference points MBS‑6 and MBS‑7.

## 4.4 Reference points and interfaces

### 4.4.1 Overview

The following reference points defined in clause 5.1 of TS 23.247 [5] are relevant to MBS User Services architecture: Nmb1, Nmb2, Nmb5, Nmb8, Nmb9, Nmb10 and Nmb12.

The following additional reference points are defined by the present document:

**- MBS-4-MC:** Unidirectional multicast distribution of content from the MBSTF to the MBS Client.

**- MBS-4-UC:** File-based unicast repair between the MBS Client and the MBS AS.

**- MBS-5:** Interactions between the MBS Client and the MBSF for the purpose of MBS control plane and service handling.

**- MBS-6:** API exposed by the MBS Client and used by the MBS-Aware Application to manage and control MBS User Services.

**- MBS-7:** API exposed by the MBS Client and used by the MBS-Aware Application to receive user data information distributed using MBS User Services.

**- MBS-8:** Announcement of MBS User Services to the MBS-Aware Application by the MBS Application Provider.

In addition, the following reference points are defined inside the MBS Client function:

- **MBS‑6′:** API exposed by the MBSTF Client and used by the MBSF Client to (de)activate reception of an MBS Session by the MBSTF. The reception parameters are supplied by the MBSF Client.

This reference point is outside the scope of MBS User Services and is not described further in the present document.

- **MBS‑7′:** API exposed by the MSTF Client and used by the MBSTF to supply MBS Session configuration information that has been received from reference point MBS‑4‑MC.

This reference point is outside the scope of MBS User Services and is not described further in the present document.

## 4.4 Domain model

Editor’s Note: The static domain model for services and sessions.

## 4.5 Life-cycle model

Editor’s Note: State charts explaining the dynamics of MBS User Services.

## 4.6 QoS model

Editor’s Note: How MBS User Services make use of the network Quality of Service primitives defined by SA2 is TS 23.247.

## 4.7 Security

Editor’s Note: How MBS User Services makes use of the security primitives studied by SA3 in TR 33.850.

# 5 Procedures for 5G Multicast–Broadcast User Services

## 5.1 General

This clause defines the high-level procedures for 5G Multicast–Broadcast User Services.

## 5.2 High-level baseline procedures

## 5.3 Procedures for User Service discovery/announcement

## 5.4 Procedures for User Service initiation/termination

## 5.5 Procedures for User Service data transfer

## 5.6 Associated delivery procedures

Editor’s Note: Seeking a better name than “associated delivery procedures”.

# 6 MBS User Services Distribution Methods

## 6.1 Object Distribution Method

### 6.1.1 Overview

The Object Distribution Method is used to deliver binary objects to the MBS Client over an MBS Session that have been received from the MBS Application Provider over reference point Nmb8.

The following Use Cases are supported:

- Single file delivery.

- Delivering a root object and its dependent objects as a collection, e.g. a web page and all the assets needed to render it.

- Object carouselling for file delivery, including updates of files.

- Real-time object streaming, for example for regular-latency or low-latency streaming delivery. In the latter case, the objects distributed may be CMAF segments as defined by the 5G Media Streaming DASH Interoperability Point specified in clause 7.3.11 of TS 26.247 [10].

Based on the configuration received from the MBSF via reference point Nmb2, the objects are ingested by the MBSTF from the MBS Application Provider via pull-based or push-based method. As defined in clause 4, the MBSTF segments the objects into appropriate payloads, adds the FEC redundancy and schedule packet transmission to the MBS Client.

File repair functionality may be utilized to repair object fragments transmitted by the MBSTF using the Object Distribution Method but lost or corrupted in transit. In such cases, the MBS Client may request the missing object fragments from the MBS AS. File repair may be done during an ongoing MBS User Services Session or after an MBS User Services Session.

## 6.2 Packet Distribution Method

### 6.2.1 Overview

The Packet Distribution Method is used to deliver ***p***acket streams to the MBS Client over an MBS Session that have been received from the MBS Application Provider over reference point Nmb8. This Distribution Method is particularly useful for multicast and broadcast of IP-based services for which the content delivery protocols are defined outside the scope of the MBS specification.

The MBSTF receives packet streams from the MBS Application Provider, typically in the form of UDP/IP packets, and sends them to the configured MBS Session. Optionally, packet sequence numbering and/or FEC redundancy may be added by the MBSTF.

The Packet Distribution Session may be operated in one of two different modes:

- In the *Forward-only mode*, the transport protocol on top of IP is opaque to the MBS System. The User Service Announcement may be handled by the MBS Application Provider via external means at reference point MBS-8.

- In the *Proxy mode*, the UDP packet payload of the UDP streams is opaque to the MBS Session. An MBS Client is expected to make the UDP Payloads available directly to an application, without further knowledge of the content carried.

Editor’s Note: MBS Reception Reporting for the Packet Distribution Method is FFS.

Annex A (informative):  
Deployment and Collaboration Models

# A.1 Group Communication

# A.2 5G Media Streaming

Editor’s Note: Reference to TS 26.501.

# A.3 MBS Application Provider (AF/AS) in Trusted DN

Figure A.3-1 depicts a collaboration in which the MBS Application Provider (AF/AS) is deployed within the Trusted DN.

1. The AF/AS uses the Nmbsf service directly at reference point Nmb10.

2. The MBSTF injects packets into the MB‑UPF via reference point Nmb9.



NOTE: Italic type is used to annotate service-based interactions.

Figure A.3-1: Deployment with MBS Application Provider (AF/AS) in Trusted DN

# A.4 MBS Application Provider (AF/AS) in external DN

Figure A.4-1 depicts a collaboration in which the MBS Application Provider (AF/AS) is deployed within the External DN.

1. The AF/AS invokes the Nnef service at reference point N33 to access the MBSF via the NEF. The NEF, in turn, invokes the Nmbsf service on the MBSF at reference point Nmb5 on behalf of the AF/AS.

2. The MBSTF injects packets into the MB‑UPF via reference point Nmb9.



NOTE: Italic type is used to annotate service-based interactions.

Figure A.4-1: Deployment with MBS Application Provider (AF/AS) in External DN

# A.5 MBSF/MBSTF-like functions in External DN

Figure A.5-1 depicts a transport-only deployment.

1. The MBSF-like function provisions MBS Services in the MB‑SMF via the Nnef service at reference point N33.

2 The MBS Application Provider (AF/AS) uses an MBSTF-like function to produce packet data compliant with reference point MBS‑4‑MC. The packets are injected directly into the MB-UPF at reference point N6mb (not shown).

3. An MBS Application Provider (AF/AS) in an External DN uses an MBSF-like function to generate a Service Announcement for MBS User Services.

4. The MBS Application Provider (AF/AS) makes file repair available from an MBS AS-like function that is compliant with reference point MBS‑4‑UC.

The MBSF-like, MBSTF-like and MBS AS-like functions produce data streams which are compliant with the present document. Although the 5G System sets up a Transport-only Mode (see configuration option 1 in annex A of TS 23.247 [5]), the MBS Client in the UE follows the procedures defined in the present document.



NOTE: Italic type is used to annotate service-based interfaces.

Figure A.5-1: Deployment with MBSF/MBSTF-like functions in External DN

Annex B (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2021-07 | Post-SA4#114-e ad hoc | S4aI211206 |  |  |  | Initial skeleton document. | 0.0.1 |
| 2021-08 | SA4#115-e | S4-211270 |  |  |  | Implemented agreements at SA4#115-e | 0.1.0 |
| 2021-11 | SA4#116-e | S4-211597  S4-211657  S4-211661  S4-211662 |  |  |  | Reference architecture and reference points.  Definitions of functional entities.  Definitions of two distribution methods.  Collaboration scenarios. | 0.2.0 |