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Contents

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:

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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 protocols and formats for User Services as defined in TS 26.502 [6] and 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 26.502: "5G multicast–broadcast services; User Service architecture".

[7] 3GPP TS 26.346: “MBMS; Protocols and Codecs".

[8] IETF RFC 8866: "Session Description Protocol".

[9] Void.

[10] 3GPP TS 23.003: "Numbering, addressing and identification".

[11] 3GPP TS 24.008: "Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[12] IETF RFC 3926: "FLUTE - File Delivery over Unidirectional Transport".

[13] Void.

[14] OpenAPI: "OpenAPI 3.0.0 Specification", https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md.

[15] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[16] 3GPP TS 29.501: "5G System: Principles and Guidelines for Services Definition; Stage 3".

[17] 3GPP TS 29.580: "5G System; Multicast/Broadcast Service Function services; Stage 3".

[18] 3GPP TS 29.581: "5G System; Multicast/Broadcast Service transport services; Stage 3".

[19] IETF RFC 9110: "HTTP Semantics", June 2022.

[20] IETF RFC 9111: "HTTP Caching", June 2022.

[21] IETF RFC 9112: "HTTP/1.1", June 2022.

[22] IETF RFC 9113: "HTTP/2", June 2022.

[23] Reserved for future use.

[24] IETF RFC 8446: "The Transport Layer Security (TLS) Protocol Version 1.3", August 2018.

[25] Open Mobile Alliance: "OMNA BCAST Service Class Registry", https://technical.openmobilealliance.org/OMNA/bcast/bcast-service-class-registry.html.

[26] IETF RFC 3629: "UTF-8, a transformation format of ISO 10646".

[27] IETF RFC 8141: "Uniform Resource Names (URNs)".

[28] ISO 639-2: "Codes for the representation of names of languages - Part 2: Alpha-3 code".

[29] IETF RFC 6381: "The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types".

[30] 3GPP TS 29.571: "5G System; Common Data Types for Service Based Interfaces; Stage 3".

[31] 3GPP TS 26.512: "5G Media Streaming (5GMS); Protocols".

[32] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

[33] 3GPP TS 33.246: "3G Security; Security of Multimedia Broadcast/Multicast Service (MBMS)".

[34] IETF RFC 3986: "Uniform Resource Identifier (URI): Generic Syntax".

[35] 3GPP TR 26.946: "Multimedia Broadcast/Multicast Service (MBMS) user service guidelines".

[36] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[37] IETF RFC 2046, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types".

[38] IETF RFC 2387: "The MIME Multipart/Related Content-type".

[39] IETF RFC 2557: "MIME Encapsulation of Aggregate Documents, such as HTML (MHTML)".

[40] IETF RFC 2017: "Definition of the URL MIME External-Body Access-Type".

[41] IETF RFC 1952: "GZIP file format specification version 4.3".

[42] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[43] 3GPP TS 29.572: "Location Management Services; Stage 3".

[44] 3GPP TS 26.510: "Media delivery; interactions and APIs for provisioning and media session handling".

[45] ISO/IEC 23009-1: " Information technology — Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats".

[46] IETF RFC 5905: "Network Time Protocol Version 4: Protocol and Algorithms Specification".

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], TS 26.502 [6] 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].

User Service Descriptions document: a version-controlled document that conveys one or more User Service Description objects.

User Service Description object: a JSON object carrying information about a single MBS User Service corresponding to an MBS User Service Announcement.

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].

ALC	Asynchronous Layered Coding
CMAF	Common Media Application Format
DASH	Dynamic Adaptive Streaming over HTTP
ESI	Encoding Symbol Identifier
FDT	File Delivery Table
FLUTE	File Delivery over Unidirectional Transport
FSA	Frequency Selection Area
GBA	Generic Bootstrapping Architecture
HTTP	HyperText Transfer Protocol
HTTPS	HTTP over TLS
JSON	JavaScript Object Notation
MBMS	Multimedia Broadcast Multicast Service
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
MPD	Media Presentation Description
MSK	MBS Service Key
PCF	Policy and Charging Function
NEF	Network Exposure Function
OTI	Object Transmission Information
ROHC	Robust Header Compression
RTP	Real-Time Protocol
SDP	Session Description Protocol
TMGI	Temporary Mobile Group Identity
TOI	Transmission Object Identifier
UDP	User Datagram Protocol
UE	User Equipment
UML	Unified Markup Language
XML	eXtensible Markup Language
YAML	Yet Another Markup Language

3.4 Syntax documentation conventions

The conventions from TS 29.501 [16] apply to this document with the following extensions for OpenAPI [14] structured data type definitions as defined in clause 5.2.4.1 of TS 29.501 [16]:

1. Data types are annotated in Bold face.
2. Properties of data types are noted in codestyle.

4 System overview

The present document defines protocols and formats for MBS User Services as defined in TS 26.502 [6] and 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].

MBS User Services enable high-level applications to make use of the low-level features of the MBS System. An 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]. The MBS User Services architecture is defined in clause 4.2.2 of TS 26.502 [6] and shows the MBS-related entities involved in providing MBS User Services delivery and control.

The MBSF and MBSTF offer service layer functionality for sending MBS data via MBS Sessions. The MBSF offers control plane functionality while the MBSTF offers user plane functionality. The MBSTF acts as a User Plane anchor when it sources IP multicast traffic. Clause 4.3.1 of TS 26.502 [6] defines the set of functional entities involved in supporting MBS User Services, including client functions in the UE.

5 Announcement of MBS User Services

5.0 Overview

MBS User Service Announcement is needed in order to advertise MBS User Services in advance of, and potentially during, the MBS User Service Sessions described. MBS User Service Announcement (as defined in clauses 4.5.7 and 4.5.8 of TS 26.502 [3]) is provided by means of an *MBS User Service Description*, the syntax of which is defined in this clause.

The MBS User Service Announcement plays an equivalent role to the MBMS User Service announcement as defined in TS 26.346 [7], but it is simplified and extended for the needs of Multicast-Broadcast Services.

5.1 User Service Description data model

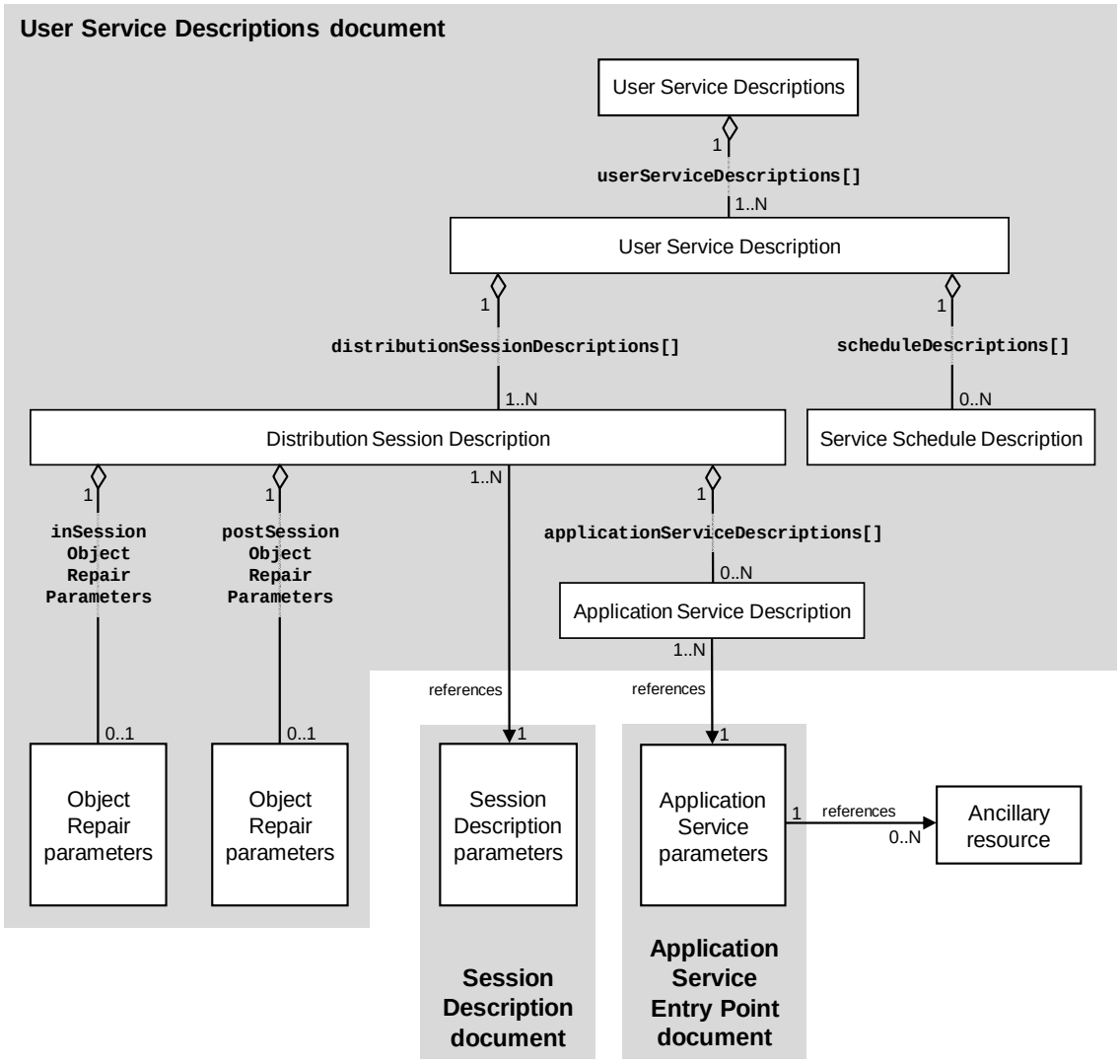
5.1.1 General

An MBS User Service Description is described by a set of metadata documents that are delivered as described in clause 4.3.2 of TS 26.502 [3]. The data model defined in this clause subdivides the parameters defined in [3] and groups them into a set of *metadata documents*.

The metadata consists of:

- A *User Service Descriptions* document (see clause 5.2.2) describing a set of one or more MBS User Services, and containing:
  - One of more *User Service Description* objects (see clause 5.2.3), each describing an MBS User Service Session that is associated with:
    - One or more *Distribution Session Description* objects (see clause 5.2.4), each of which references a Session Description document [8] (see clause 5.2.5) that may be packaged with the User Service Descriptions document for delivery to the MBS Client in the same User Service Bundle (see clause 5.3.4). Each may optionally reference a *Time Synchronization Parameters* object (see clause 5.2.11), and each may optionally reference an *Object Repair Parameters* object (see clause 5.2.8) describing the object repair parameters for the MBS Distribution Session in question. Both in-session and post-session repair are supported.
      - Zero or more alternative *Application Service Description* objects (see clause 5.2.5), each of which references an Application Service Entry Point document (see clause 5.2.6) that may be packaged with the User Service Description document for delivery to the MBS Client in the same User Service Bundle (see clause 5.3.4). Additional resources referenced by the Application Service Entry Point document may also be packaged into the User Service Bundle.
    - Zero or more *Service Schedule Description* objects (see clause 5.2.7) advertising the delivery schedule for the MBS User Service Session.

Figure 5.1-1 illustrates the relationships between these metadata entities using UML for a User Service Descriptions document.



NOTE: "N" means any number in each instance.

Figure 5.1-1: User Service Data Model simple description

A *User Service Description* document shall contain one or more *User Service Description* objects, each of which describes a single MBS User Service Session.

Each User Service Description object shall include at least one *Distribution Service Description* object describing the set of MBS Distribution Sessions currently associated with the MBS User Service Session.

- The Distribution Session Description object shall refer to one *Session Description document.*
- Each Distribution Session Description object may include *Object Repair Parameters* objects for in-session repair and for post-session repair.
- Each Distribution Session Description object may include zero or more alternative *Application Service Description* object, optionally referencing an Application Service Entry Point document (e.g. a DASH MPD, HLS Master Playlist or HTML document) which describes the root of the Application Service associated with this MBS Distribution Session. When multiple Application Service Entry Point documents are referenced by the same Distribution Session Description (not permitted in this release), an MBS Client shall select only one on the basis of a distinct MIME content type indicated in the Application Service Description object.

Each User Service Description object may include *Service Schedule Description* objects. If included, the UE can expect to receive MBS User Service data during the time periods described in the Service Schedule Description object.

5.1A Encoding

The User Service Descriptions document shall be a JSON instance document formatted according to the schema specified in clause A.2 with the following constraints:

- The MIME type of the User Service Description document is specified in clause E.2.
- The encoding of the User Service Description document shall be UTF-8 as defined in IETF RFC 3629 [26].
- The extension of the schemas specified in clause A.2, in particular the addition of information elements, is reserved to 3GPP.
- Additional rules for schema extension are for future study.

5.2 Syntax and associated semantics

5.2.1 General

The following description in this clause presumes a JSON encoding of the information comprising the MBS User Service Announcement as specified in clause 5.1A.

The data types in table 5.2.1-1 from other 3GPP specifications are reused in the remainder of the present document.

Table 5.2.1 1: Externally defined data types used by User Service Description schema

Data type	Comments	Reference
Uri	A Uniform Resource Locator	TS 29.571 [30]
DateTime	A date–time value.	
MbsServiceArea	An MBS Service Area.	
MbsFsaId	An MBS Frequency Selection Area identifier.	
DurationSec	A time duration expressed in seconds.	
Ncgi	A NR cell identifier.	
Tai	A Tracking Area Identifier.	
PointUncertaintyCircle	An area specified as a shape of an ellipsoid point with uncertainty circle.	TS 29 572 [43]
Polygon	An area specified as a shape of a polygon.	
AbsoluteUrl	An absolute URL	TS 26.510 [44]
Percentage	A proportion out of 100.	

The data types in table 5.2.1-2 are defined in the present document.

Table 5.2.1 2: User Service Description schema data types defined in the present document

Data type	Clause
UserServiceDescriptions	5.2.2
UserServiceDescription	5.2.3
DistributionSessionDescription	5.2.4
ApplicationServiceDescription	5.2.6
ServiceScheduleDescription	5.2.7
ObjectRepairParameters	5.2.8
AvailabilityInformation	5.2.9
TargetServiceArea	5.2.9
NrParameterSet	5.2.9
SecurityDescription	5.2.10
TimeSynchronizationParameters	5.2.11
TimeServiceEndpointParameters	5.2.11

5.2.2 User Service Bundle Descriptions document

The MBS User Service Descriptions document conveys one or more *User Service Description* objects. Table 5.2.2-1 provides the detailed semantics for the **`UserServiceDescriptions`** data type that conveys these objects.

Table 5.2.2-1: Semantics of `UserServiceDescriptions` data type

Property name	Data Type	P	Cardinality	Description
version	*integer*	O	0..1	Provides the version number of the MBS User Service Descriptions document. Any two documents that are different shall have different version numbers. A higher number overwrites a lower version number. Minimum value: 1. If not present, the latest delivered document overwrites any previously delivered ones.
userServiceDescriptions	*array(UserService Description)*	M	1..N	A set of one or more *User Service Description* objects (see clause 5.2.3).

5.2.3 User Service Description data type

The **`UserServiceDescription`** data type carries information about a single MBS User Service corresponding to an MBS User Service Announcement as defined in clause 4.5.7 of TS 26.502 [6]. Table 5.2.3-1 provides the detailed semantics for this data type.

Table 5.2.3-1: Semantics of `UserServiceDescription` data type

Property name	Data Type	P	Cardinality	Description
`serviceIds`	*array(Uri)*	M	1..N	The set of *External service identifiers* for the MBS User Service as defined in table 4.5.7-1 of TS 26.502 [6]. Each value is expressed as a URI.
`class`	*Uri*	M	1	The *Service class* of the MBS User Service as defined in table 4.5.7-1 of TS 26.502 [6]. The value is expressed as a fully-qualified term identifier URI.
`names`	*array(object)*	O	1..N	The *Service names* of the MBS User Service as defined in table 4.5.7-1 of TS 26.502 [6]. Each service name is differentiated by a language as defined in the `lang` property.
`name`	*string*	M	1	One of the *Service names*.
`lang`	*string*	M	1	Language of the service name encoded using an ISO "alpha-3" language code according to ISO 639-2 [28].
`descriptions`	*array(object)*	O	1..N	The *Service descriptions* of the MBS User Service as defined in table 4.5.7-1 of TS 26.502 [6].
`description`	*string*	M	1	One of the *Service descriptions*.
`lang`	*string*	M	1	Language of the service description encoded using an ISO "alpha-3" language code according to ISO 639-2 [28].
`serviceLanguage`	*string*	O	0..1	The *Main service language* of the MBS User Service as defined in table 4.5.7-1 of TS 26.502 [6], encoded using an ISO "alpha-3" language code according to ISO 639-2 [28].
`distribution Session Descriptions`	*array(Distribution SessionDescription)*	M	1..N	One or more MBS Distribution Session Descriptions for the MBS User Service (see clause 5.2.4).

Property name	Data Type	P	Cardinality	Description
serviceSchedule Descriptions	*array(Service Schedule Description)*	O	1..N	The *Active periods* of the MBS User Data Ingest Session as defined in clause 4.5.5 of TS 26.502 [6]. An array of service schedules indicating when the MBS User Service is scheduled to be active (see clause 5.2.7). If omitted, the MBS User Service is always active (see NOTE).
NOTE: The current active period for an individual MBS Distribution Session may be further restricted by information in its Session Description document (*t* and/or *r* lines in the SDP) specified in clause 5.2.5.				

5.2.4 Distribution Session Description data type

The **DistributionSessionDescription** data type describes one *MBS Distribution Session* associated with an MBS User Service and carries the MBS Distribution Session Parameters as defined in clause 4.5.8 of TS 26.502 [6]. Table 5.2.4-1 provides the detailed semantics of this data type.

Table 5.2.4-1: Semantics of DistributionSessionDescription data type

Property name	Data Type	P	Cardinality	Description
distribution Method	*DistributionMethod*	M	1	The distribution method used for this MBS Distribution Session. For details, refer to table 5.2.4-2.
conformance Profiles	*array(Uri)*	O	1..N	A list of profiles indicating the set of features that this MBS Distribution Session conforms to and which the MBS Client needs to support in order to fully decode the MBS Distribution Session. For details refer to clause 12. If not present, the MBS Distribution Session is assumed to conform to the "Baseline MBS Distribution Session Profile" specified in clause C.2.
session Description Locator	*AbsoluteUrl*	M	1	URL to a Session Description document carrying the *Session Description parameters* for this MBS Distribution Session as defined in table 4.5.8-1 of TS 26.502 [6]. For details, refer to clause 5.2.5.
application Service Descriptions	*array(Application ServiceDescription)*	O	1..1	If present, an array containing a set of one or more Application Service Descriptions for the MBS User Service (see clause 5.2.6 and text below this table).
inSession ObjectRepair Parameters	*ObjectRepair Parameters*	O	0..1	Parameters to be used by the MBSTF Client at reference point MBS-4-UC for in-session unicast object repair of this MBS Distribution Session, as defined in table 4.5.8-2 of TS 26.502 [6]. For details, refer to clause 5.2.8.
postSession ObjectRepair Parameters	*ObjectRepair Parameters*	O	0..1	Parameters to be used by the MBSTF Client at reference point MBS-4-UC for post-session unicast object repair of this MBS Distribution Session, as defined in table 4.5.8-2 of TS 26.502 [6]. For details, refer to clause 5.2.8.
availability Infos	*array(Availability Information)*	O	1..N	Additional information pertaining to the availability of this MBS Distribution Session within the MBS System. For details, refer to clause 5.2.9.
security Description	*SecurityDescription*	O	0..1	The security parameters for this MBS Distribution Session, as defined in table 4.5.8-1 of TS 26.502 [6]. For details, refer to clause 5.2.10.

Property name	Data Type	P	Cardinality	Description
timeSynchronizationParameters	TimeSynchronizationParameters	O	0..1	Parameters to support synchronisation of the MBS Client with the MBSTF as defined in clause 4.2.7 of TS 26.502 [6]. If omitted, SIB9 presence and usage shall be signalled as defined in clause 4.2.7 of TS 26.502 [6] and shall be used by the MBS Client for time synchronization, if needed. For details, refer to clause 5.2.11.

Table 5.2.4-2: Semantics of `DistributionMethod` enumeration

Enumerated value	Description
OBJECT	The Object Distribution Method.
PACKET	The Packet Distribution Method.

If the `applicationServiceDescriptions` array is present:

1. The `distributionMethod` property of the **`DistributionSessionDescription`** shall be set to *OBJECT*.
2. All members of the `applicationServiceDescription` array shall reference an Application Service Entry Point document (see clause 5.2.6A) that describes an MBS Distribution Session using the Object Distribution Method as specified in clause 6.
3. The `sessionDescriptionLocator` property shall point to a Session Description document (see clause 5.2.5) describing an MBS Distribution Session according to clause 6 delivering objects that are directly or indirectly referenced by the Application Service Entry Point document.

5.2.5 Session Description document

Each MBS Distribution Session shall be described by a Session Description document that shall be formatted according to RFC 8866 [8]. The Session Description document may be packaged in the same MBS User Service Bundle (see clause 5.3.1A) as the MBS User Service Descriptions document.

- The session description for the MBS Object Distribution Method is specified in clause 6.2.2
- The session description for the MBS Packet Distribution Method is specified in clause 7.2.3.

5.2.6 Application Service Description data type

Table 5.2.6-1 provides the detailed semantics for the **`ApplicationServiceDescription`** data type.

Table 5.2.6-1: Semantics of `ApplicationServiceDescription` data type

Property name	Data Type	P	Cardinality	Description
entryPointLocator	*Uri*	M	1	Reference to an *Application Service Entry Point* document, for example to a DASH MPD.
contentType	*string*	M	1	Format of the document referenced by `entryPointLocator`. This shall be a MIME content type, for example `application/dash+xml`.

5.2.6A Application Service Entry Point document

The Application Service Entry Point document shall follow a format consistent with the value of contentType indicated as specified in clause 5.2.6.

In the case of 3GP-DASH formatted content as defined in TS 26.247 [36], the Application Service Entry Point document may be a unified media manifest which describes Representations available for both MBS reception and unicast retrieval, and this shall be used by MBS Clients compliant with the present document. In practical deployments, different subsets of the Representations described by the unified manifest document may be specified for:

- Availability via MBS delivery only,
- Availability via both unicast and MBS delivery,
- Availability via unicast only, and the Representation is redundant in MBS area coverage, i.e. the usage of these resources does not provide an improved user experience. As an example, this may be a lower bitrate Representation of a media component for which a higher bitrate is available over MBS distribution, and
- Availability always via unicast, and the Representation is supplementary in MBS area coverage, i.e. even in MBS area coverage these resources provide an improved user experience. As an example, this may be a secondary language that is only accessible over unicast.

All resources that are directly or indirectly referenced in the Application Service Entry Point document of this metadata unit that are expected to be retrieved by HTTP GET shall be delivered by at least one of the MBS Distribution Sessions associated with the MBS User Service Description.

5.2.7 Service Schedule Description data type

A Service Schedule Description object describes the distribution schedule of a single instance of the MBS User Service and the availability of content via unicast delivery in terms of:

- Start/stop time point; or
- Start time point, time duration and periodicity.

The MBS Client can expect to receive MBS data during the described time period(s).

The Schedule Description object may be delivered to the MBS Client prior to the MBS Distribution Session as part of the User Service Description document (see clause 5.2.2) and may be updated subsequently along with that document.

The Service Schedule Description object with the highest version number shall take priority, such that schedule parameters received prior to the MBS Distribution Session are regarded as "initial defaults", and schedule parameters received during the MBS Distribution Session overwrite the earlier received schedule parameters.

The MBS Distribution Session shall be available to the MBS Client during the time interval(s) announced by the session schedule. The MBS Client shall not activate reception of that MBS Distribution Session outside this time window.

Schedule information received in the Schedule Description object shall take precedence over timing information that may have been received in the Session Description object (*t* and/or *r* lines in the SDP).

Table 5.2.7-1 provides the detailed semantics for the **`ServiceScheduleDescription`** data type which describes a single scheduled instance of the MBS User Service Session.

Table 5.2.7-1: Semantics of `ServiceScheduleDescription` data type

Property name	Type	P	Cardinality	Description
`id`	*string*	M	1	An identifier for the MBS User Service Session instance described by this object, unique within the scope of the MBS System. This value is invariant across all versions of the object.
`version`	*integer*	M	1	The version number of this scheduled MBS User Service Session instance. The value increases monotonically whenever a change to the remaining properties needs to be signalled to the MBS Client. Minimum value: 1.
`start`	*DateTime*	C	1	The start date–time of this MBS User Service Session instance. If present, *stop* shall also be present. This property shall be mutually exclusive with *repetitionRule*.
`stop`	*DateTime*	C	1	The stop date–time of this MBS User Service Session instance. If present, *start* shall also be present. This property shall be mutually exclusive with *repetitionRule*.
`repetitionRule`	*RepetitionRule*	C	1	A rule describing the periodic active time(s) of this MBS User Service Session instance. This property shall be mutually exclusive with *start* and *stop*.
`cancelled`	*boolean*	O	0..1	When set to *true*, indicates that this MBS User Service Session instance is cancelled and the MBS Client shall terminate all ongoing MBS User Service procedures, including object reception, object repair and reporting. The MBS Client shall not attempt to join an MBS User Service Session that is marked as cancelled. If omitted the value is *false*.

Table 5.2.7-2: Semantics of `RepetitionRule` data type

Property name	Type	P	Cardinality	Description
`startTime`	*DateTime*	M	1	The absolute start date–time of the first occurrence of this period.
`duration`	*DurationSec*	M	1	The duration of each occurrence of this period.
`repetitionInterval`	*DurationSec*	M	1	The time between occurrences of the period.

5.2.8 Object Repair Parameters data type

Object Repair Parameters configure the Object Repair as defined in clause 6.2.4.

Table 5.2.8-1 provides the detailed semantics for the **`ObjectRepairParameters`** data type.

Table 5.2.8-1: Semantics of `ObjectRepairParameters` data type

Property name	Data Type	P	Cardinality	Description
`repairLimitPercentage`	*Percentage*	C	0..1	The maximum number of incomplete transmission objects that the MBS Client is allowed to repair out of the last 100 objects received on this session. If not present, the value is assumed to be 100.0. Not present for post-session Object Repair.

Property name	Data Type	P	Cardinality	Description
backOffParameters	*BackOffParameters*	O	0..1	The back-off behaviour of the MBSTF Client when using the Object Repair mechanism (see clause 10.3 for in-session repair and clause 10.2.2.3 for post-session repair). If present, at least one of the contained parameters shall be present. If omitted for in-session repair, default parameter values apply. If omitted for post-session repair, no back-off delay is required.
offsetTime	*DurationSec*	C	1..1	The minimum time that an MBSTF Client shall wait before making an Object Repair request. - For in-session repair: delay after receiving a packet for an object in the object delivery session. If not present the value is determined by the FDT Instance associated with each transmission object. - For post-session repair: delay after completion of the download delivery session. If not present the value is assumed to be zero.
randomTimePeriod	*DurationSec*	C	1..1	The maximum time window length over which an MBSTF Client shall calculate the value of *RandomTime* to be used as a delay to its Object Repair request in addition to o*ffsetTime*. If not present the value is assumed to be zero.
objectDistribution BaseLocator	*Uri*	O	0..1	The *Object distribution base URL* of the MBS Distribution as defined in table 4.5.6-2 of TS 26.502 [6].
objectRepair BaseLocators	*array(AbsoluteUrl)*	M	0..1	The *Object repair base URL* of the MBS Distribution as defined in table 4.5.6-2 of TS 26.502 [6].

5.2.9 Availability Information data type

The **AvailabilityInformation** data type provides additional information pertaining to the availability of the MBS Distribution Session within the 5G Network:

- The targetServiceAreas property declares the one or more service areas in which the MBS Session corresponding to this MBS Distribution Session is currently available. Each target service area is expressed as one of the following:
  - A list of NR Cell Identifiers.
  - A list of Tracking Area Identifiers.
  - An area specified as a list of polygon or circle shapes.
- In the case of a broadcast MBS Session corresponding to this MBS Distribution Session:
  - The mbsFSAId property identifies a preconfigured area within which, and in proximity to, the cell(s) announce the MBS Frequency Selection Area (FSA) ID and its associated frequency.
  - The nrRedCapUEInfo property indicates which classes of UE the MBS Distribution Session is suitable for consumption by.

NOTE 1: This is used to guide frequency selection by the UE for a broadcast MBS Session.

- In the case of a broadcast MBS Session corresponding to this MBS Distribution Session, the `nrParameters` property indicates the one or more radio frequencies in the NG-RAN downlink on which the MBS Session is transmitted in the service area(s) identified by the `serviceArea` property.

NOTE 2: The radio frequencies may be obtained by interrogating the OAM using the value of the `mbsFSAId` property as a lookup key.

Table 5.2.9-1 provides the detailed semantics for the **`AvailabilityInformation`** data type.

Table 5.2.9-1: Semantics of `AvailabilityInformation` data type

Property name	Type	P	Cardinality	Description
`mbsServiceAreas`	*array(MbsService Area)*	O	1..N	This property is deprecated. The property shall be absent in this release.
`targetService Areas`	*array(Target ServiceArea)*	O	1..N	The *Target service areas* of this MBS Distribution Session, as defined in table 4.5.8-1 of TS 26.502 [6]. See table 5.2.9-1a.
`mbsFSAId`	*MbsFsaId*	C	0..1	(Broadcast MBS Distribution Session only.) The *MBS Frequency Selection Area (FSA) Identifier* of the (broadcast) MBS Distribution Session in the parent service area, as defined in table 4.5.8-1 of TS 26.502 [6].
`nrParameters`	*array(Nr ParameterSet)*	M	1..N	(Broadcast MBS Distribution Session only.) The New Radio transmission parameters in the parent service areas, expressed using the data type specified in table 5.2.9-2.
`nrRedCapUEInfo`	*NrRedCapUeInfo*	O	0..1	(Broadcast MBS Distribution Session only.) Indicates whether the MBS session is suitable for consumption by NR RedCap UEs and/or non-RedCap UEs as defined by *Target UE classes* in TS 26.502 [6]. The data type and its enumerated values are specified in TS 29.571 [30]. If omitted, no information is known and the value *NON_REDCAP_UE_ONLY* may be assumed.

Table 5.2.9-1a provides the detailed semantics for the **`TargetServiceArea`** data type.

Table 5.2.9-1a: Semantics of `TargetServiceArea` data type

Property name	Type	P	Cardinality	Description
`ncgiList`	*array(Ncgi)*	C	1..N	List of NR Cell Identifiers.
`taiList`	*array(Tai)*	C	1,,N	List of Tracking Area Identifiers.
`geographicAreaList`	*array(*either *Polygon* or *PointUncertaintyCircle)*	C	1..N	List of geographic areas in the form of polygons or circles.

Exactly one of the following properties shall be present: *ncgiList*, *taiList*, *geographicAreaList*.

Table 5.2.9-2 provides the detailed semantics for the **`NrParameterSet`** data type.

Table 5.2.9-2: Semantics of `NrParameterSet` data type

Property name	Type	P	Cardinality	Description
`freqBandIndicator`	*Uinteger*	M	1	NR frequency band number, corresponding to the *FreqBandIndicatorNR* parameter in clause 6.3.2 of TS 38.331 [42].
`aRFCNValue`	*Uinteger*	M	1	ARFCN applicable to a downlink NR global frequency raster, corresponding to the *ARFCN-ValueNR* parameter specified in clause 6.3.2 of TS 38.331 [42].

5.2.10 Security Description data type

In order to support the transport security for MBS, the **`DistributionSessionDescription`** object may contain an object of type **`SecurityDescription`** indicating the User Plane security parameters for the MBS Distribution Session as defined in table 4.5.8-1 of TS 26.502 [6]. The User Plane security mechanisms between the MBS client and the MBSSF are defined in clause W.4.1.3 of TS 33.501 [32] and clause 6 of TS 33.246 [33].

Table 5.2.10-1: Semantics of `SecurityDescription` object

Property name	Type	P	Cardinality	Description
`mBSSFAddresses`	*array(AbsoluteURL)*	M	1..1	A list of key management servers (i.e., MBSSF instances). At least one endpoint address shall be listed.
`mBSServiceKeyInfo`	*object*	M	1..1	Information about the MBS Service Key (MSK).
`mSKId`	*string*	M	1..1	Identifies the MSK, as defined in clause 6.3.2.1 of TS 33.246 [33].
`mSKDomainId`	*string*	M	1..1	Identifies the MSK domain, as defined in clause 6.3.2.1 of TS 33.246 [33].
`uICCKeyManagement`	*boolean*	O	0..1	Indicates whether UICC-based key management is required for the parent MBS Distribution Session. If *false* or omitted, this is not required.
`2GGBAallowed`	*boolean*	O	0..1	Indicates whether the 2G GBA is permitted for the parent MBS Distribution Session. If *false* or omitted, this is not permitted.
`backOffParameters`	*BackOffParameters*	O	0..1	The back-off behaviour of the MBSF Client when requesting MBS Service Keys (MSKs) from the MBSSF (see clause 11.2.2.2). If present, at least one of the contained parameters shall be present. If omitted, no back-off delay is required.
`offsetTime`	*DurationSec*	C	1..1	The minimum time that an MBSF Client shall wait after initiating reception of the parent MBS User Distribution Session before sending its first MSK request.
`randomTimePeriod`	*DurationSec*	C	1..1	The maximum time window length over which an MBSF Client shall calculate the value of *RandomTime* to be used as a delay to its first MSK request in addition to *offsetTime*.

5.2.11 Time Synchronization Parameters data type

The Time Synchronization Parameters object indicates how the MBS Client obtains for an MBS Distribution Session a wallclock that is synchronised with the MBSTF, and possibly the MBS AS.

Table 5.2.11-1 provides the detailed semantics for the **`TimeSynchronizationParameters`** data type.

Table 5.2.11-1: Semantics of `TimeSynchronizationParameters` data type

Property name	Data Type	P	Cardinality	Description
`ranTimeTransmitted`	*boolean*	O	0..1	Indicates that NR SIB9 is transmitted as defined in clause 4.2.7 of TS 26.502 [6], to be used for time synchronization. If not present, the value is assumed to be *false*.
`timeServiceEndpoints`	*array(TimeServiceEndpointParameters)*	C	1..N	A set of endpoints provided by the MBS AS and used by the MBS Client to synchronise its clock with the needed precision. Shall be present if `ranTimeTransmitted` is *false* or absent. May be present if `ranTimeTransmitted` is *true*. For details refer to table 5.2.11-2.

The semantics of the above parameters are specified as follows:

- If `ranTimeTransmitted` is set *true*, then NR SIB9 as specified in TS 38.331 [42] is carried in the radio frequency carrying the MBS Distribution Session and the relevant MBS functions are time-synchronized to the same UTC wallclock as the NR SIB9 information to a tolerance of ±100 ms or better.

NOTE: NR SIB9 as specified in TS 38.331 [42] conveys information in its `timeInfo` parameter related to a Coordinated Universal Time (UTC) wallclock to an accuracy of 10 ms.

- If `ranTimeTransmitted` is set *false* or absent, the NR SIB9 is either not present, or it does not fulfil the above requirements. In this case, the `timeServiceEndpoints` attribute shall be present and shall contain at least one entry.

- Each entry in `timeServiceEndpoints` describes a time service hosted by the MBS AS using the parameters in table 5.2.11-2 below. If multiple time service endpoints are specified, their order indicates their relative precedence, the first having the highest priority, and the last having the lowest. The MBS Client may choose any endpoint, potentially having to deal with reduced accuracy.

If both options (i.e., SIB9 as well as the MBS AS time service in the MBS AS) are offered by the 5G System, the MBS Client should preferably use the information in NR SIB9.

Table 5.2.11-2 provides the detailed semantics for the **`TimeServiceEndpointParameters`** data type. The data type follows the syntax and semantics of the UTC Timing Descriptor specified in ISO/IEC 23009-1 [45].

Table 5.2.11-2: Semantics of `TimeServiceEndpointParameters` data type

Property name	Data Type	P	Cardinality	Description
`protocolScheme`	*Uri*	M	1	The scheme identifier for the time service drawn from the controlled vocabulary specified in clause C.3. The vocabulary of scheme identifiers shall be restricted to the DASH UTC timing method, whereby instead of the Media Presentation it refers to the MBS Distribution Session.
`endpoint`	*string*	M	1	The endpoint address of the time service, formatted according to the protocol scheme indicated in `protocolScheme` and based on the definition in ISO/IEC 23009-1 [45].
`accuracy`	*integer*	O	0..1	The accuracy of the timing source in relation to the wallclock of the MBS Distribution Session, expressed in a positive number of milliseconds. Indicates that the relevant MBS functions are time-synchronised to the same UTC wallclock as the information provided by this timing source to a tolerance of ±*n* ms or better, where *n* is the value of this parameter. If absent, the default accuracy is assumed to be a tolerance of ±1000 ms.

5.3 Delivery of User Service Descriptions

5.3.1 General

This clause defines the delivery of User Service Descriptions, i.e. the delivery of a User Service Descriptions document, as well as additional resources (documents and possibly ancillary media objects) that are necessary to provide all necessary parameters required by an MBS Client to initiate one or more MBS User Services.

The collection of all necessary resources associated with a User Service Descriptions document is referred to as a *User Service Descriptions Bundle* and is specified in clause 5.3.1A.

A User Service Descriptions Bundle may be delivered to the MBS Client via an MBS Distribution Session at reference point MBS-4-MC (see clause 5.3.2) and/or via a regular unicast PDU Session at reference point MBS-5 (see clause 5.3.3) and/or via application-private means at reference point MBS-8.

5.3.1A User Service Descriptions Bundle

The User Service Descriptions Bundle includes a single MBS User Service Descriptions document as well as all other associated resources that are directly referenced by the MBS User Service Description(s) included in that document or indirectly referenced by other resources in the same User Service Bundle. Each associated resource included in the User Service Bundle shall have a URL and shall have a MIME content type.

The set of resources comprising a User Service Bundle shall be aggregated into a single multipart entity, referred to as a *User Service Descriptions Bundle Entity*. Each such resource shall be encapsulated as a distinct body part of this multipart entity. The headers and body of this entity may be conveyed by different application protocols, for example as the headers and body of an HTTP message or as a multicast transmission object. Individual body parts or the entire entity body may be compressed in transit (e.g. using GZip [41]) if the application protocol supports this.

A User Service Descriptions Bundle Entity (hereafter "entity") shall conform to the following requirements:

- The `Content-Type` header of the entity shall be *multipart/related* as specified in RFC 2387 [38].
- The root body part of the entity shall be a User Service Descriptions document as defined in clause 5.2.2.
  - The `type` parameter of this root body part shall be present as specified in RFC 2387 [38] and shall be set to the MIME content type of the User Service Descriptions document specified in clause E.2.
  - The User Service Descriptions document shall be the first body part of the *multipart/related* entity, and hence the `start` parameter specified in RFC 2387 [38] should be absent. If present, the `start` parameter shall be set to the `content-id` of the MBS User Service Description body part.
- Every other body part in the entity shall have a URI indicated in its `Content-Location` header per RFC 2557 [39] so that it may be cross-referenced by other resources in the same entity. The value of this header may be an absolute URI, or it may be expressed as a path that can be resolved relative to the base URI of the enclosing body part using the rules specified in section 5 of [39].
- All dependent resources of the User Service Descriptions described in the User Service Descriptions document shall be included as body parts in the entity. The User Service Descriptions document shall not use external references to any resource that it directly references.

5.3.2 Delivery of User Service Descriptions Bundle Entity in object carousel

In this case, one or more User Service Bundle Entities are delivered repeatedly by the MBSTF to the MBSTF Client via a suitable MBS Distribution Session at reference point MBS-4-MC using the Object Distribution Method, as defined in clause 4.2.4 of TS 26.502 [6]. This is the realisation of the MBS User Service Announcement Channel. The operating mode of this MBS Distribution Session shall be set to *OBJECT_CAROUSEL* and relies on an object manifest to characterize the repetition and the update pattern of the User Service Bundle Entities in the carousel. The object manifest is specified in clause 6.1.2. The objects described by this manifest shall be User Service Bundle Entities formatted as specified in clause 5.3.1A.

As defined in clause 5.4 of TS 26.502 [6], the MBSTF Client announces the arrival of an MBS User Service Description to the MBSF Client using a suitable notification at internal reference point MBS-7′, and the MBSF Client may subsequently retrieve the MBS User Service Description from the MBSTF Client via internal reference point MBS-6′. It may do so using procedures equivalent to those specified for unicast retrieval at reference point MBS-5 (see clause 5.3.3). In this case, the MBSTF Client acts as a proxy for the MBS AF.

5.3.3 Delivery of User Service Descriptions Bundle Entity via unicast PDU Session

In this case, a result set of one or more User Service Descriptions Bundle Entities is retrieved by the MBSF Client from the MBS AF at reference point MBS-5 via a regular unicast PDU Session.

The API at this reference point is specified in clause 9.2 and the format of the response is specified in clause 9.2.3. The OpenAPI [14] specification of the User Service Description retrieval API can be found in clause A.2.

6 Object Distribution Method

6.1 General

6.1.1 Overview

The Object Distribution Method supports the transmission of media segments, e.g. CMAF media segments [7] and also non-real-time objects.

The MBS Distribution Session shall be provisioned to accommodate the bit rate of the aggregated object flow, accounting for in-band carriage of metadata units, protocol header overheads, and FEC redundancy (if configured).

6.1.2 Object manifest

An object manifest document describes a list of objects to be distributed in an MBS Distribution Session. The syntax of the object manifest is specified in clause D.1. The semantics of the document are specified in table 6.1.2-1 below.

For each object to be delivered in the MBS Distribution session, the attributes under the *objects* property in table 6.1.2-1 shall be maintained by the MBSTF.

Table 6.1.2-1: Properties of object manifest

Property name	Cardinality	Description
updateInterval	Optional	The time interval, expressed in seconds, according to which the MBSTF attempts to re-acquire the object manifest when pull-based object acquisition is provisioned. Ignored by the MBSTF for push-based object acquisition.
objects	Mandatory	The list of objects to be carouselled from the MBSTF to the MBSTF Client.
locator	Mandatory	The URL from which the object is to be ingested by the MBSTF.
repetitionInterval	Optional	The time interval, expressed in milliseconds, according to which the object is to be periodically sent to the MBSTF Client. If omitted, the MBSTF determines the repetition interval for the object. Ignored by the MBSTF in Object Collection operating mode.
keepUpdatedInterval	Optional	The time interval, expressed in seconds, according to which the MBSTF is expected to check for updates made to the object at its origin (as indicated by *locator* or a redirect from there to another location). In case of conflicting information, the MBSTF should give precedence in determining the update interval to the HTTP cache control metadata included in the HTTP response from the object origin. Any changes to the origin object that are detected by the MBSTF shall be reflected in the MBS Distribution Session at the earliest opportunity and the replacement of one object with another shall be signalled to the MBSTF Client by means of the object transport protocol provisioned at reference point MBS-4-MC. If omitted, the MBSTF shall not attempt to check for updates to the object. Ignored by the MBSTF in Object Collection operating mode.
earliestFetchTime	Optional	The MBSTF shall fetch the object no sooner than this UTC timestamp. If absent, then the object shall be present at its origin (as indicated by *locator* or a redirect from there to another location) and the MBSTF may fetch it at a time of its choosing.
latestFetchTime	Optional	The MBSTF shall fetch the object no later than this UTC timestamp. If absent, then the object shall be present at its origin (as indicated by *locator* or a redirect from there to another location) and the MBSTF may fetch it at a time of its choosing.

6.2 Usage of FLUTE for Object Distribution Method

6.2.1 General

If FLUTE [12] is used to realise the Object Distribution Method, the MBS Distribution Session shall conform to the MBMS Download Profile as defined in clause L.4 of TS 26.346 [7] with the additional requirements in clause 6.2 of the present document.

The usage of this distribution method is identified in the MBS Session Description metadata unit as defined in clause 6.2.3, in particular by the indication of the protocol `FLUTE/UDP` in combination with the MBS service type.

The MBSTF shall use the Profiled FDT Schema according to clause L.6 of TS 26.346 [7] to describe the object list currently being transmitted in the MBS Distribution Session.

Generally, the end of transmission of an object is the expiry time for the latest FDT instance describing the object. Objects shall be described in an FDT Instance with the *Expires* attribute. Depending on the operating mode (clause 6.2.4), different settings of the expiry time and different numbers of objects per FDT Instance are recommended.

Inclusion of the `@Content-MD5` and `@File-ETag` FDT Instance attributes is optional.

The `@File-ETag` represents the value of the HTTP entity tag as defined in clause 8.8.3 of RFC 9110 [19] which may also serve as the version identifier of the **`File`** object described by the FDT Instance.

In order to fetch missing portions of an object, the MBS Client may use the Object Repair mechanism for FLUTE specified in clause 6.2.4. This mechanism is provided by the MBS AS at reference point MBS-4-UC, using the User Service Announcement parameters specified in clause 5.2.8 to identify its endpoint address.

6.2.2 Session Description document for FLUTE

6.2.2.1 General

The Session Description document for FLUTE contains the information needed to activate the reception of an MBS Distribution Session using the FLUTE protocol [12] when this is used to realise the Object Distribution Method. The Session Description document is formatted according to the Session Description Protocol [8] and its content is based on the Session Description parameters specified in clause 7.3 of TS 26.346 [7] with the following restrictions and extensions.

Restrictions:

- The *Mode of MBMS bearer per media* parameter (clause 7.3.2.7 of [7]) shall not be used.
- The *QoE Metrics* (as defined in clauses 7.3.2.0 of [7]) shall not be used
- The *Service-language(s) per media* (clause 7.3.2.9 of [7]) shall not be used. It is assumed that the service languages are described within an application manifest.
- The *Alternative TMGI* (clause 7.3.2.12 of [7]) shall not be used.
- The *Start time* and *End time* of the session (SDP *t*-line) shall indicate a superset of the active times specified in the MBS Schedule Description metadata unit in the service schedule descriptions of the MBS Distribution Session (see clause 5.2.7), if present. If there is no service schedule specified, both values of the SDP *t*-line should be set to zero indicating undefined times.

Extensions:

- When an MBS Session is of MBS Service Type *Broadcast* or when the Multicast MBS Session Type uses a TMGI as MBS Session ID, the *MBS service type of MBS Session* declaration attribute as defined in clause 6.2.2.2 shall be present in the Session Description.

6.2.2.2 MBS service type of MBS Session

A new MBS service type declaration attribute *mbs-servicetype* is defined which results in, e.g.:

- *a=mbs-servicetype:broadcast 123869108302929*

or:

- *a=mbs-servicetype:multicast 123869108302929*

The MBS service type declaration attribute shall be used in Session Description metadata to indicate the type of the corresponding MBS Distribution Session as defined in table 6.2.2.2-1.

Table 6.2.2.2-1: Assignment of mbs-servicetype attribute value

Attribute value	Meaning
multicast	The MBS Distribution Session is delivered using a Multicast MBS Session.
broadcast	The MBS Distribution Session is delivered using a Broadcast MBS Session.

The MBS service type attribute shall be declared at session level in the Session Description metadata unit. The session level attribute applies to all media entries without a media-level occurrence of the *mbs-servicetype* attribute. The Session Description metadata unit shall include only a single instance of MBS service type declaration attribute.

Definition:

- *mbs-service-type-declaration-line = "a=mbs-servicetype:" ("broadcast"/"multicast" SP tmgi) CRLF*

- *tmgi = 1*15DIGIT*

EXAMPLE:

UK MCC = 234 *(MCC Digit 1 = 2; MCC Digit 2 = 3 and MCC Digit 3 = 4)*

Vodafone UK MNC = 15

and, with padding, Vodafone UK MNC = 15F *(MNC Digit 1 = 1; MNC Digit 2 = 5 and MNC Digit 3 = F)*

MBS Service ID = 70A886

Therefore, TMGI = 70A886 32F451 (Hex) or 123869108302929 (Decimal)

The Temporary Mobile Group Identity (*tmgi*) information element is defined in TS 24.008 [11] including the coding of the fields. Octets 3 to 8 (MBS Service ID, MCC and MNC) shall be placed in the *tmgi* attribute of the MBS service type declaration line, and are encoded as a decimal number. Octet 3 is the most significant octet. Because this is encoded as a decimal number, leading zeros of the MBS Service ID field may be omitted.

6.2.2.3 SDP examples for FLUTE Session

Listing 6.2.2.3-1 provides a full example of an SDP description describing a FLUTE-based MBS Distribution Session using the Object Distribution Method with a TMGI as MBS Session Id.

Listing 6.2.2.3-1: Session Description metadata unit for FLUTE-based MBS Distribution Session with TMGI

```
v=0
o=user123 2890844526 2890842807 IN IP6 2201:056D::112E:144A:1E24
s=Object Distribution session example
i=More information
t=2873397496 2873404696
a=mbs-servicetype:broadcast 123869108302929
a=FEC-declaration:0 encoding-id=1
a=source-filter: incl IN IP6 * 2001:210:1:2:240:96FF:FE25:8EC9
a=flute-tsi:3
m=application 12345 FLUTE/UDP 0
c=IN IP6 FF1E:03AD::7F2E:172A:1E24/1
b=1000
a=lang:EN
a=FEC:0
```

Listing 6.2.2.3-2 provides a second example of an SDP description describing a FLUTE-based MBS Distribution Session using the Object Distribution Method and which indicates that 25% redundant FEC protection is applied to the FEC encoding of the video Segments of the associated DASH-formatted content.

Listing 6.2.2.3-2: Session Description metadata unit for FLUTE-based MBS Distribution Session with TMGI and 25% FEC redundancy

```
v=0
o=user123 2890844526 2890842807 IN IP6 2201:056D::112E:144A:1E24
s=Object Distribution session carrying 2-hour DASH-packaged programme
i=More information
t=3615124600 3615131800
a=mbs-servicetype:broadcast 123869108302929
a=FEC-declaration:0 encoding-id=1
a=FEC-redundancy-level:0 redundancy-level=25
a=source-filter: incl IN IP6 * 2001:210:1:2:240:96FF:FE25:8EC9
a=flute-tsi:5
m=video 10111 FLUTE/UDP 0
c=IN IP6 FF1E:03AD::7F2E:172A:1E24/1
b=2048
a=lang:EN
```

6.2.3 Operating modes for FLUTE-based Object Distribution Method

6.2.3.1 Introduction

The operating modes for the Object Distribution Method are defined in clause 6.1 of TS 26.502 [6]. Operating modes primarily describe the operation of the MBSTF to convert ingest data into an MBS Distribution Session. The following clauses specify how FLUTE is used for each operating mode.

The Object Repair mechanism for FLUTE specified in clause 6.2.4 may be used with the following operating modes:

- *OBJECT_SINGLE*, as specified in clause 6.2.3.2;
- *OBJECT_COLLECTION*, as specified in clause 6.2.3.3; or
- *OBJECT_CAROUSEL*, as specified in clause 6.2.3.4.

The Object Repair mechanism for FLUTE shall not be used with the *OBJECT_STREAMING* mode (as specified in clause 6.2.3.5) in this Release.

6.2.3.2 Single object operating mode

Single object operating mode (*OBJECT_SINGLE*) refers to the case in which a single object is distributed via the Object Distribution Method.

No specific aspects beyond the general provisions in clauses 6.1, 6.2.1 and 6.2.2 apply to this operating mode.

6.2.3.3 Object collection operating mode

Object collection operating mode (*OBJECT_COLLECTION*) refers to the case in which multiple objects are distributed via the Object Distribution Method. The list of objects to be distributed is described by an object manifest document as specified in clause 6.1.2. The objects listed in the manifest are distributed only once. Each object listed in the manifest is pulled by the MBSTF from the location indicated prior to inclusion in the FLUTE Session corresponding to the MBS Distribution Session.

In this operating mode, each FDT Instance delivered in the FLUTE Session should describe all objects that are currently part of the collection.

6.2.3.4 Object carousel operating mode

Object carousel operating mode (*OBJECT_CAROUSEL*) refers to the case in which one or multiple objects are distributed via the Object Distribution Method in a repeated fashion. The list of objects to be distributed is described by an object manifest document as specified in clause 6.1.2. Each object listed in the manifest is pulled by the MBSTF from the location indicated prior to inclusion in the FLUTE Session corresponding to the MBS Distribution Session.

The list of objects described in the manifest may be updated over time by providing a replacement object manifest.

In this operating mode, the FDT Instance should describe all objects that are currently available in the FLUTE Session, considering the potential object update interval.

6.2.3.5 Segment streaming operating mode

Segment streaming operating mode (*OBJECT_STREAMING*) refers to the case for which a sequence of objects, typically representing timed segments from a timed presentation, are distributed using the Object Distribution Method. The sequence of objects is referred to as an *object flow*. This operating mode is recommended for streaming DASH or HLS content to a Media Player in the UE using MBS User Services.

NOTE: This operating mode may also be used for non-media object flows, e.g. in the absence of an Application Service Description.

For each object associated with the object flow to be delivered in the MBS Distribution Session the following information shall be maintained by the MBSTF in an object list:

- The URL used by the MBS-Aware Application to request the object, derived from the object ingest URL.
- The object's *latest availability start time* at the MBS Client. After this time, the MBS-Aware Application may request the full object from the MBSTF Client by using the URL of the object.

  This value is determined for each object based on an availability start time at the point of ingest (i.e. reception of first byte of the object) combined with a configured distribution offset.
- The object's *availability end time* from the MBSTF Client. After this time, the object may no longer be requested by the MBS-Aware Application.

  This value is determined for each object based on an availability start time at the point of ingest (i.e. reception of first byte of the object) combined with a configured clean-up time.

The object list is typically extended over time, for example as new objects (e.g. media segments) become available.

The object list may, for example, be provided by an explicit object distribution manifest.

NOTE: An object distribution manifest format is not defined in the present document.

The object list may also be defined by a presentation manifest (e.g. DASH MPD), for example in the case of an Application Service, for which the manifest is provided as part of the User Service Description.

When the Application Service Entry Point document is a DASH MPD, this document is used by the MBSTF to update the object list. The DASH MPD may itself be included in the object list, and hence be delivered in band with the media segment objects it describes on the same MBS Distribution Session. If the content of the Application Service Entry Point document changes during an MBS User Data Ingest Session, the updated document shall be reflected in the MBS Distribution Session at the soonest opportunity.

For the segment streaming operating mode, the MBSTF acts as follows based on the object list:

- The MBSTF shall transmit each object in the object list such that the last packet of the delivered FLUTE transmission object (including any FEC recovery packets, when configured) is available at the MBSTF Client no later than its *availability start time*. When the Application Service Entry Point document is a DASH MPD, the availability start time is signalled in this document.
- An FDT Instance object should be sent frequently by the MBSTF, describing all objects of the object list that are not yet fully transmitted.
- The **`Content-Location`** element in the FDT Instance shall match the URL of the corresponding object in the object list. When the Application Service Entry Point document is a DASH MPD, this shall also match the URL of a DASH Representation described by that document after any template identifiers have been substituted.

The URL may be rewritten by the MBSTF using the Object distribution base URL property of the MBS Distribution Session.

- If an update to the Application Service Entry Point document is delivered as a FLUTE transmission object then the Content-Location element in the FLUTE File Delivery Table for the delivered object shall match the URL of the referenced Application Service Entry Point document.
- The **`File`**`@Expires` attribute for each object shall be set such that it is equal to or earlier than its *latest availability start time*.
- The **`Cache-Control`**`@Expires` attribute shall be used to indicate the *availability end time of the object.*
- **`Content-MD5`** and **`File-ETag`** may optionally be used.

6.2.4 Object Repair mechanism for FLUTE

6.2.4.1 General

In order to fetch missing portions of an object, the MBS Client shall support the post-session Object Repair procedure as specified in clause 6.2.4.2.

If the User Service Description provides the Object Repair parameters specified in clause 5.2.8, then:

- An MBS AS instance assigned to each active MBS User Service Session shall host all objects transmitted on its MBS Distribution Session(s) at the network location *location*.
- An MBS Client shall initiate the post-session Object Repair procedure as needed according to the procedure specified in clause 6.2.4.2.

NOTE: The use of **`File`**`@Alternate-Content-Location-1` and **`File`**`@Alternate-Content-Location-2` to advertise the Object Repair parameters in the FLUTE FDT instance as defined in TS 26.346 [7] is not supported in MBS User Services.

6.2.4.2 Post-session Object Repair procedure

The post-session Object Repair procedure is aligned with the File Repair procedures defined in clause 9.3 of TS 26.346 [7].

It is assumed that a FLUTE File Delivery Table (FDT) Instance document as defined in clauses L.4 and L.6 of TS 26.346 [7] is available in the MBS Client that contains at least the following information:

- **FDT**@Expires attribute indicating the expiry date of the FDT Instance.
- For one or multiple transmission objects in the FLUTE session, a **File** element with:
  - **File**@TOI attribute indicating the ALC Transport Object Identifier of the transmission object.
  - **File**@Content-Location attribute indicating the URI of the transmission object.
  - **File**@Content-Length attribute indicating the size (in bytes) of the transmission object.
  - **File**@File-ETag attribute indicating the entity tag value of the transmission object.

NOTE: Object Repair without the FDT as, for example, defined in clause 9.3.9 of TS 26.346 [7], is not specified by the present document.

Then, based on the introduction in clause 9.3.1 of TS 26.346 [7], the MBS Client generally acts as follows.

1. The MBS Client identifies the end of the MBS Distribution Session. The latest time for this is the value of the @Expires attribute indicated in the root element of the FDT Instance document. However, according to clause 9.3.2 of TS 26.346 [7], an MBS Client may determine an earlier end of transmission of files,
   a) if an end-of-session signal (A-flag) is received in an ALC/FLUTE header in the ongoing Object Distribution Session before the FDT instance expires; or
   b) if the end of file transmission time is reached according to the service schedule description specified in clause 5.2.7.
2. The MBS Client identifies that data is missing from an MBS Object Distribution Session for one or multiple FLUTE transmission objects delivered in the Object Distribution Session following the principles in clause 9.3.3 of TS 26.346 [7].
3. The MBS Client shall select an MBS AS instance *repair URL* randomly from the list of objectRepairBase Locators if present in the **ObjectRepair** object defined in table 5.2.8-1.
4. For each incomplete FLUTE transmission object defined by a **File** element in the FDT Instance document and as identified in step 2:
   a) The MBS Client shall form the network location *location* (URL) of the repair object as defined in clause 6.4.2.4 using (i) the value of the **File**@Content-Location attribute, (ii) the *repair URL* selected in step 3 (if any) and (iii) the value of objectDistributionBaseLocator as *distribution URL* if present in the **ObjectRepair** object defined in table 5.2.8-1.
   b) The MBS Client shall define an appropriate *list of byte ranges Range[M]* with *M* the number of independent ranges and *Range[m].start* the start of the *m*th range and *Range[m].end* the end of the *m*th range from the repair object using the list of received symbols and additional information from the FDT as defined in clause 6.4.2.5.
5. The MBS Client shall then use the object repair procedures as defined as defined in clause 10.2.2 using the following parameters:
   - The offsetTime and randomTimePeriod parameters indicated in the **ObjectRepair** object as defined in table 5.2.8-1.
   - For each incomplete FLUTE transmission object in the FDT Instance document, the MBSTF Client shall use from the corresponding FDT **File** entry the network location *location* formed in step 4a, the size of the transmission object (in bytes), the entity tag value and the minimal *list of byte ranges Range[M]* determined in step 4b.

6. The MBS Client uses the received *list of byte ranges* and the received data in the MBS Object Distribution Session to recover the missing object as defined in clause 6.4.2.6.

6.2.4.3 In-session object repair procedure

6.2.4.3.1 Introduction

The generic terms "object delivery client" and "object repair server" are used in the following clauses to refer to the MBSTF Client and the MBS AS respectively.

NOTE: This system-independent terminology allows the procedures to be referenced by delivery systems other than MBS User Services.

The mapping of these procedures to MBS User Services protocols is specified in clause 10.3.

6.2.4.3.2 Parameters

It is assumed that a FLUTE File Delivery Table (FDT) Instance document as defined in clauses L.4 and L.6 of TS 26.346 [7] is available in the object delivery client that contains at least the following information:

- **FDT**@Expires attribute indicating the expiry date of the FDT Instance.
- For one or multiple transmission objects in the FLUTE Session, a **File** element with:
  - **File**@TOI attribute indicating the ALC Transport Object Identifier of the transmission object.
  - **File**@Content-Location attribute indicating the URI of the transmission object.
  - **File**@Content-Length attribute indicating the size (in bytes) of the transmission object.
  - **File**@File-ETag attribute indicating the entity tag value of the transmission object.

NOTE: Object Repair without the FDT as, for example, defined in clause 9.3.9 of TS 26.346 [7], is not specified by the present document.

In addition, the following parameters are assumed to be available:

- **File**@FEC-Redundancy-Level: indicating the level of FEC redundancy used for the delivery of this transmission object.
- *repairStartTime*: provides the the wallclock time at which the object delivery client is permitted to initiate repair requests for a specific object. The value is the sum of *OffsetTime* and *RandomTime* defined as follows:
  - a wallclock time *OffsetTime* defined as:
    - the value of the **File**@RepairStart attribute in the FDT Instance, if present, else
    - the sum of (i) the reception time of the first packet of this transmission object and (ii) the value of a parameter in the service announcement *offsetTime* associated with this FLUTE Session in milliseconds, if the *offsetTime* parameter is present, or else
    - the value of the **FDT**@Expiry time.
  - and, a time period *RandomTime* defined by the following:
    - if the *randomTimePeriod* parameter is present, it is used as the *Random Time Period* to determine *RandomTime* as defined in clause 9.3.4.2 of TS 26.346 [7], or else
    - the value is 0.
- *repairLimitPercentage*: the maximum number of unicast repairs that the object delivery client is permitted to attempt over the last 100 objects received on this session. The value is obtained as follows:
  - the value of the **File**@RepairMaxAttempts attribute in the FDT Instance for the associated transmission object, if present, else

- the value of a parameter *repairLimitPercentage* in the service announcement, if present, or else
- set to 100, i.e. no restrictions.

- *object distribution base locator*: the base locators for the distribution to be used to map the URL in the **File**@Content-Location to construct the repair URL request.
- *object repair base locators*: a list of absolute URLs corresponding to the object distribution base locator that can be used to construct the URL for the repair object requests.

6.2.4.3.3 General procedure

While the object delivery client is receiving a FLUTE Session and is configured for in-band session repair, it shall act as follows based on the parameters summarised in clause 6.2.4.3.2:

1. When the object delivery client receives an FDT Instance document that includes at least one **File** element, it shall parse the FDT Instance and, together with information potentially provided externally, it has access to the parameters specified in clause 6.2.4.3.2 above.
2. The transmission objects described by **File** elements in the FDT Instance are received from the FLUTE Session. Once the *repairStartTime* for a particular transmission object has been reached, and the object delivery client determines that reception of the object from the FLUTE Session is not complete according to clause 6.2.4.3.4, unicast repair of this transmission this object may be initiated. In particular, if the object delivery client has made fewer than *repairLimitPercentage* unicast Object Repair requests over the last 100 transmission objects received on this session, it shall initiate unicast requests according to the following steps. Otherwise, the repair procedure for this transmission object shall terminate.
3. The object delivery client shall select a *repair base URL* randomly from the list of *object repair base locators*.
4. For an incomplete FLUTE transmission object defined by a **File** element in the FDT Instance document and as identified in step 2:
   a) The object delivery client shall form the network location (URL) *location* of the repair object according to the relevant procedures using (i) the value of the **File**@Content-Location attribute, (ii) the *repair base URL* selected in step 3 (if any) and (iii) the value of *object distribution base locator* as *distribution URL* if present.
   b) The object delivery client shall either:
      - define an appropriate *list of byte ranges Range[M]* with *M* the number of independent ranges and *Range[m].start* the start of the *m*th range and *Range[m].end* the end of the *m*th range from the repair object using the list of received symbols and additional information from the FDT as defined in clause 6.2.4.5, or
      - determine to request a copy of the entire transmission object from the object repair server.

NOTE: requesting the entire transmission object may be a preferred choice by the object delivery client to avoid processing partially received objects and delaying the completion of the object for the application.

5. The object delivery client shall then use the unicast repair procedure specified in clause 6.2.4.3.5. The object delivery client shall use from the corresponding FDT **File** entry the network location *location* formed in step 4a, the size of the transmission object (in bytes), the entity tag value and the minimal *list of byte ranges Range[M]* or the full object as determined in step 4b.
6. The object delivery client shall either:
   - use the received data *list of byte ranges* and the received data in the FLUTE Session to recover the missing transmission object as defined in clause 6.2.4.3.5, or
   - use the complete received object via unicast and dismiss the received data in the FLUTE Session for this transmission object. In this case, the data while received may be proxied to the application.
7. If the unicast repair is unsuccessful within the time to provide the object to the application, the object delivery client should terminate the unicast repair procedure for this object.

6.2.4.3.4 Determining non-completion

While receiving the FLUTE Session, the object delivery client may determine that the data received up to *repair-time* are not sufficient to complete object reception.

Any of the following indicate that no more packets will be received for a particular transmission object:

- The FDT Instance describing the transmission object has expired.
- A Close Object signal (B-flag) is received in an ALC/FLUTE header in the ongoing FLUTE Session.
- A FLUTE packet with a TOI different from the current object and different from 0 is received and the SDP indicates that the *sequential sending* FLUTE sending rule for multiple objects is in use for the object streaming session per clause 7.3.2.5 of TS 26.346 [7], in particular rule 2 or 3.
- A FLUTE packet with a TOI *TOInew* higher than the TOI of the latest object *TOIcurrent* and different from 0 is received (indicating that no more packets will be received for all objects with TOI in between *TOIcurrent* and *TOInew* − 1 inclusive) and the SDP indicates that both the *object sequence number* and *sequential sending* FLUTE sending rules for multiple objects are in use for the object streaming session per clause 7.3.2.5 of TS 26.346 [7], i.e. rule 3.

If at this time the received symbols are not sufficient to complete the recovery of the object, non-completion shall be declared by the object delivery client.

In addition, if the attribute **`File`**`@FEC-Redundancy-Level` is included within the **`File`** element of the FDT Instance to indicate the FEC redundancy level for the file, and together with the information in the **`File`**`@FEC-Content-Length`, the object delivery client may determine that the number of packets received is insufficient to recover the object.

6.2.4.3.5 Unicast Repair requests

The object delivery client sends one or more requests to an object repair server (as specified in the URLs) requesting transmission of data that allows recovery of missing object data.

Object repair requests and responses for a particular object shall take place in a single HTTP session [19]. HTTP sessions may be reused to repair multiple objects but should be terminated after some idle timeout period.

The object delivery client shall start the initial request immediately. If there is more than one repair request to be made for a particular object, these are sent one straight after another without further delay.

The object delivery client shall send separate HTTP `GET` requests for each object to be repaired.

For each object to be repaired, based on the parameters in clause 6.2.4.3.2, the object delivery client shall act as follows:

1. If the requested range is the entire object, i.e. *M = 1*, *Range[0].start = 0* and *Range[0].end = F*, where *F* is the value of the *content length*, then the HTTP `GET` method shall be used.
2. If the requested range is only a subset of the object, a HTTP partial `GET` request shall be used with the `Range` request header (as specified in section 14.1.2 of RFC 9110 [19]) present.
   - If *M >1*, the object delivery client shall include multiple byte range requests within a single partial `GET` request. In particular, the object delivery client shall include as many byte ranges as possible in a single HTTP request message without exceeding 2048 bytes for all request headers. If this length is exceeded, the request shall be split into as few requests as possible without any of those exceeding the 2048-byte limit.
3. If the *entity tag* for the damaged object is available to the object delivery client, it shall be used as the entity tag value in the `If-Match` or `If-Range` header of a conditional byte-range request.
4. If the *entity tag* for the damaged object is not available to the object delivery client, it may omit the `If-Match` or `If-Range` header from its byte-range request.

NOTE 1: The nominal objective of the object delivery client using the `If-Match` header is to receive the requested range(s) of the HTTP resource representation associated with the entity tag, or no repair data if the request cannot be satisfied by the object repair server.

NOTE 2 The nominal objective of the object delivery client using the `If-Range` header is to receive the latest version of the entire HTTP resource representation in case the version associated with the entity tag that was transmitted in the FLUTE Session and partially received by the object delivery client is no longer available on the object repair server.

6.2.4.4 Network location of repair object

The determination of the network location *location* of the repair object uses the **`File`**`@Content-Location` attribute in the FDT Instance document, a *repair base URL* (if present) and a *distribution base URL* (if present) as follows:

- If the *repair base URL* is not present, then the network location of the repair object is the value of **`File`**`@Content-Location`.
- If the *repair base URL* is present, but not the *distribution base URL*, then the network location of the repair object is the value of **`File`**`@Content-Location` with the Retrieval URI according to RFC 3986 [34] replaced with the *repair base URL*.
- If both the *repair base URL* and the *distribution base URL* are both present, then the network location of the repair object is the value of **`File`**`@Content-Location` with the Base URI according to RFC 3986 [34] being the *distribution base URL* replaced with the *repair base URL*.

Additionally, if the **`File`**`@Content-Encoding` attribute is present in the FDT Instance document and is set to the value *gzip*, then a ".gz" extension shall be appended to the path part of the repair object's *location* prior to the query part of the URL, if any. In this case, the GZipped [41] version of the repair object shall be hosted on the MBS AS. The MBSTF Client shall only use this in connection with a byte range request if the `@File-ETag` attribute is present in the FDT Instance of that object, for use as the entity-tag in the request. Otherwise, the MBSTF Client shall request the complete object from the MBS AS.

6.2.4.5 Byte range determination

The selection of the byte range is aligned with clause 9.3.6.2 of TS 26.346 [7]. This clause focuses on the selection of a sufficient byte range for an individual FLUTE transmission object requiring repair. For each damaged transmission object, FDT parameters are assumed to be available.

NOTE: This clause does not address protocol-related aspects specified in clause 9.3.6.2 of TS 26.346 [7]; these are specified in clause 10 of the present document.

The MBS Client shall identify a *minimal set of source symbols* identified by a list of Encoding Symbol Identifiers (ESIs) that, combined with the already received symbols, allows the FEC decoder to recover the file as follows:

- When the Compact No-Code FEC scheme is used (i.e., if the FDT parameter `@FEC-OTI-FEC-Encoding-ID` is set to 0), the MBS Client shall consider already received source symbols when making the determination of the repair byte range symbols. The MBS Client shall identify the ESIs of the missing source symbols which constitute the minimal set.
- When the Raptor FEC scheme is used (i.e., if the FDT parameter `@FEC-OTI-FEC-Encoding-ID` is set to 1), the MBS Client shall consider already received source and repair symbols when making the determination of the repair byte range required. In particular, the MBS Client shall identify a minimal set of source symbols that, combined with the already received symbols, allows the Raptor FEC decoder to recover the file.

NOTE: One way to determine a minimum set of source symbols for repair is described in clause 6.1.3.1 of TR 26.946 [35]. However, any set of symbols that has the same number of necessary source symbols as the set determined according to clause 6.1.3.1 of [35] may be considered a minimal set.

Once a minimal set of sufficient source symbols for recovery is determined as an ordered list of ESIs, *SS[0], …– SS[N − 1],* with *N* the total number of source symbols, the list of source symbols is converted to an ordered list of *M* independent byte ranges *Range[M]* indexed from 0 in which *Range[m].start* is the start of the *m*th range and *Range[m].end* is the end of the *m*th, range. In the pseudocode presented in listing 6.2.4.5-1, *T* is the value of the **File**@FEC-OTI-Encoding-Symbol-Length FDT attribute, and *F* is the value of the **File**@Content-Length FDT attribute.

Listing 6.2.4.5-1: Pseudocode for determining repair byte ranges

```
m=-1;
for (n=0; n < N; n++) {
    if (n > 0 && SS[n] == (SS[n-1] + 1)) { // Extend same range
        Range[m].end += T
    }
    else { // New Range
        m++;
        Range[m].start = SS[n] * T;
        Range[m].end = Range[m].start + T;
    }
}
Range[m].end = min(F, Range[m].end)
```

Range[M] then describes the smallest list of byte ranges needed to recover the damaged FLUTE transmission object.

NOTE: When *M = 1*, *Range[0].start = 0* and *Range[0].end = F* the range describes the entire object.

6.2.4.6 Object recovery procedure

Using the byte ranges recovered from the MBS AS, the MBSTF Client shall:

1. Convert the received data into source symbols with appropriate ESIs.
2. Apply FEC decoding using the originally received symbols and those recovered from the MBS AS.
3. Recover the transmission object together with the corresponding metadata in the FDT.
4. Make the recovered object (along with its metadata) available to the MBS-Aware Application from its Media Server via reference point MBS-7.

7 Packet Distribution Method

7.1 General

The Packet Distribution Method reuses different delivery concepts from TS 26.346 [7]. Additional distribution methods may be defined in future.

7.2 Re-using MBMS Delivery Method as Packet Distribution Method

7.2.1 General

The Packet Distribution Method combines three different delivery methods of TS 26.346 [7] (namely the MBMS Streaming Delivery Method, Group Communication Delivery Method and Transparent Delivery Method) into a single distribution method, with a set of modifications.

For the Packet Distribution Method, the MBSTF may handle the ingested content on two different protocol layers according to the operating mode provisioned for the MBS Distribution Session:

- *Proxy mode:* The MBSTF handles UDP packet payloads and forwards UDP packet payloads from ingest into the MBS Distribution Session. The MBSTF may use different UDP ports for the MBS Distribution Session. The MBSTF re-uses the Proxy Mode of the Transparent Delivery Method as defined in clause 8B of [7].

- *Forward-only mode:* The MBSTF receives complete IP packets and forwards the ingested packets as MBS PDUs. The MBSTF re-uses the Group Communication Delivery Method as defined in clause 8A of [7] and the Forward-Only Mode of the Transparent Delivery Method as defined in clause 8B of [7].

NOTE: A specific treatment of RTP sessions, for example as provided by the MBMS Streaming Delivery Method, is not provided by MBS User Services. However, RTP sessions may be delivered in proxy or forward-only mode.

7.2.2 Void

7.2.3 Session Description

7.2.3.1 General

The Session Description document contains the needed information to activate the reception of a Packet Distribution Method. The Session Description document is formatted according to the Session Description Protocol [8]. The Session Description document for the Packet Distribution Method is based on the Session Description parameters as defined in clauses 8.3, 8A.3 and 8B.3 of TS 26.346 [7] with the following restrictions and extensions.

Restrictions:

- The *Mode of MBMS bearer per media* parameter (clauses 8.3.1.5 and 8B.3.2 of [7]) shall not be used.

- The *QoE Metrics* (as defined in clauses 8.3.2.1 and 8.4 of [7]) shall not be used.

- ROHC header compression (as defined in clauses 8A.4 and 8B.4 of [7]) shall not be used.

NOTE: ROHC is handled by RAN in 5MBS.

- The *Alternative TMGI* (clause 7.3.2.12 of [7]) shall not be used.

- The *Start time* and *End time* of the session (SDP *t* line) shall indicate a superset of the active times specified in the MBS Schedule Description metadata unit, if present in the service schedule descriptions of the MBS Distribution Session (see clause 5.2.7). If there is no service schedule specified, both values of the SDP *t*-line should be set to zero indicating undefined times.

Extensions:

- When the MBS User Service is of MBS Service Type *Broadcast* or when an MBS User Service of type *Multicast* uses a TMGI as its MBS Session ID, the *MBS service type of MBS Session* declaration attribute as defined in clause 6.2.2.2 shall be present in the Session Description.

7.2.3.2 SDP examples for Packet Distribution Method

Below is a full example of SDP description describing the media streams part of an MBS Packet Distribution session for RTP streaming:

Listing 7.2.3.2-1: Session description for RTP streaming

```
v=0
o=ghost 2890844526 2890842807 IN IP4 192.168.10.10
s=3GPP MBS Packet Distribution SDP Example
i=Example of MBS Packet Distribution SDP file
u=http://www.infoserver.example.com/ae600
e=ghost@mailserver.example.com
c=IN IP6 FF1E:03AD::7F2E:172A:1E24
t=0 0
b=AS:77
a=mbs-mode:broadcast 123869108302929
a=source-filter: incl IN IP6 * 2001:210:1:2:240:96FF:FE25:8EC9
m=video 4002 RTP/AVP 96
b=TIAS:62000
b=RR:0
b=RS:600
a=maxprate:17
a=rtpmap:96 H264/90000
a=fmtp:96 profile-level-id=42A01E; packetization-mode=1; sprop-parameter-
sets=Z0IACpZTBYmI,aMljiA==
```

The following is a full example of SDP description for transparent streaming with two MPEG-2 Transport Streams:

Listing 7.2.3.2-2: Session description for MPEG-2 Transport Stream

```
v=0
o=ghost 2890844526 2890842807 IN IP4 192.168.10.10
s=3GPP MBS Transport-only SDP Example
i=Example of MBS transport-only SDP file
u=http://www.infoserver.example.com/ae600
e=ghost@mailserver.example.com
c=IN IP6 FF1E:03AD::7F2E:172A:1E24
t=3034423619 3042462419
b=AS:8000000
a=mbs-mode:broadcast 123869108302929

a=source-filter: incl IN IP6 * 2001:210:1:2:240:96FF:FE25:8EC9
m=video 4002 UDP/RTP/AVP 96
b=TIAS:4000000
a=mms-framing-header:0 2
a=rtpmap:100 MP2T/90000
m=video 4002 RTP/AVP 98
b=TIAS:4000000
a=rtpmap:100 MP2T/90000
a=MBS-framing-trailer:0 2
```

8 General aspects of APIs for MBS User Services

8.1 HTTP resource URIs and paths

The resource URI used in each HTTP request to the API provider shall have the structure defined in subclause 4.4.1 of TS 29.501 [16], i.e.:

{apiRoot}/{apiName}/{apiVersion}/{apiSpecificResourceUriPart}

with the following components:

- *{apiRoot}* shall be set as described in TS 29.501 [16].
- *{apiName}* shall be set as defined by the following clauses.
- *{apiVersion}* shall be set to "v1" in this release.
- *{apiSpecificResourceUriPart}* shall be set as described in the following clauses.

8.2 Usage of HTTP

8.2.1 HTTP protocol version

8.2.1.1 General

Content interfaces at reference points specified in the present document shall expose an HTTP/1.1 [21] endpoint to API clients. They may additionally expose an HTTP/2 [22] endpoint, including support for the HTTP/2 starting mechanisms specified in section 3 of [22]. The API client may choose any supported HTTP protocol version. TLS [24] shall be supported on these interfaces and, where the option to use cleartext HTTP is available in the version of HTTP selected by the API client, it should opt for HTTPS interactions in preference.

8.2.1.2 MBSF

The HTTP protocol version used to invoke *Nmbsf* service operations on the MBSF at reference point Nbm10 is specified in clauses 6.1.2.1 and 6.2.2.1 of TS 29.580 [17].

8.2.1.3 MBSTF

The HTTP protocol version used to invoke *Nmbstf* service operations on the MBSTF at reference point Nmb2 is specified in clause 6.1.2.1 of TS 29.581 [18].

The endpoint exposed by the MBSTF to the MBSF at reference point Nmb2 for the purpose of pushing object manifests into the MBSTF shall comply with the general provisions specified in clause 8.2.1.1.

The endpoint exposed by the MBSTF to the MBS Application Provider (AF/AS) at reference point Nmb8 for the purpose of pushing objects into the MBSTF shall comply with the general provisions specified in clause 8.2.1.1.

8.2.1.4 MBS AF

The endpoint exposed by the MBS AF to the MBSF Client at reference point MBS-5 for the purpose of retrieving User Service Descriptions using the API specified in clause 9.2 shall comply with the general provisions specified in clause 8.2.1.1.

The endpoint exposed by the MBS AF to the MBSTF at reference point MBS-11 for the purpose of retrieving object manifests and User Service Descriptions shall comply with the general provisions specified in clause 8.2.1.1.

All responses from the MBS AF that carry a message body shall include a strong entity tag in the form of an `ETag` response header field and a modification timestamp in the form of a `Last-Modified` response header per section 8.8 of RFC 9110 [19].

All endpoints exposed by the MBS AF shall support conditional HTTP requests using the header fields `If-none-Match` and `If-Modified-Since` per section 13 of RFC 9110 [19].

8.2.1.5 MBS AS

The endpoint exposed by the MBS AS to the MBSTF Client at reference point MBS-4-UC for the purpose of unicast object repair shall comply with the general provisions specified in clause 8.2.1.1.

Byte range requests per section 14 of RFC 9110 [19] shall be supported by the MBS AS at reference point MBS-4-UC for the purpose of efficient unicast object repair by the MBSTF Client.

8.2.1.6 MBSSF

The endpoint exposed by the MBSSF to the MBSF Client at reference point MBS 10 for the purpose of MBS Service Key (MSK) retrieval shall comply with the general provisions specified in clause 8.2.1.1.

All responses from the MBSSF that carry a message body shall include a strong entity tag in the form of an ETag response header field and a modification timestamp in the form of a Last-Modified response header per clause 8.8 of RFC 9110 [19].

All endpoints exposed by the MBSSF shall support conditional HTTP requests using the header fields If-none-Match and If-Modified-Since per clause 13 of RFC 9110 [19].

8.2.2 HTTP message bodies for API resources

Individual APIs in the present document specify the syntax and encoding of HTTP request and response message bodies. MIME content types for a subset of these are registered in annex E.

Message bodies compressed using GZip [41] content encoding may be returned by HTTP servers if the client indicates that this is acceptable per clause 12.5.3 of RFC 9110 [19]. In this case the content encoding is indicated as specified in clause 8.4 of RFC 9110 [19].

8.2.3 Usage of HTTP headers

8.2.3.1 General

Standard HTTP headers shall be used in accordance with clause 5.2.2 of TS 29.500 [15], encoded appropriately for the version of HTTP in use.

8.2.3.2 User Agent identification

8.2.3.2.1 General

When one of the MBS User Services functions defined in TS 26.502 [6] makes requests to an HTTP endpoint specified in the present document, it shall identify itself to the HTTP server using a `User-Agent` request header field (see section 10.1.5 of RFC 9110 [19]) that includes a *product* identifier indicating the type of client function making the request in its *token* element.

The optional *product-version* suffix shall be present and should indicate the version number of the present document (without the leading "V") with which the client implementation complies and shall, at minimum, indicate the 3GPP release number with which the implementation complies.

The `User-Agent` request header field may also include *comment* elements (see section 5.6.5 of RFC 9110 [19]) following the above specified *product* identifier, as well as additional vendor-specific *product* identifiers and *comment* elements compliant with the syntax and guidance provided in section 10.1.5 of RFC 9110 [19].

EXAMPLE 1: `MBSTF/17.4.0 (build2114) libhttp/1.23.2`

EXAMPLE 2: `MBSFClient/17`

8.2.3.2.2 MBSF identification

When invoking the *Nmbstf* service at reference point Nmb2, the MBSF identifies itself to the MBSTF using a `User-Agent` request header as specified in clauses 6.1.2.2.1 and 6.2.2.2.1 of TS 29.580 [17].

8.2.3.2.3 MBSTF identification

When ingesting content using the pull-based object acquisition method (see table 4.5.6-2 of TS 26.502 [6]), the MBSTF shall identify itself to the MBS Application Provider (AF/AS) at reference point Nmb8 and to the MBS AF at reference point MBS-11 using a `User-Agent` request header field that complies with the general provisions specified in clause 8.2.3.2.1. The product identifier *token* shall be set to the value `MBSTF`.

8.2.3.2.4 MBSF Client identification

The MBSF Client shall identify itself to the MBS AF at reference point MBS-5 and to the MBSSF at reference point MBS-10 using a `User-Agent` request header field that complies with the general provisions specified in clause 8.2.3.2.1. The product identifier *token* shall be set to the value `MBSFClient`.

8.2.3.2.5 MBSTF Client identification

The MBSTF Client shall identify itself to the MBS AS at reference point MBS-4-UC using a `User-Agent` request header field that complies with the general provisions specified in clause 8.2.3.2.1. The product identifier *token* shall be set to the value `MBSTFClient`.

8.2.3.3 Server identification

8.2.3.3.1 General

When one of the MBS User Services functions defined in TS 26.502 [6] responds to an HTTP request, it shall identify itself to the requesting client using a `Server` response header (see section 10.2.4 of RFC 9110 [19]) that includes a *product* identifier indicating the type and host name of the responding server in its *token* element. The server type and host name shall be separated by a single hyphen ('-') character.

The optional *product-version* suffix shall be present and should indicate the version number of the present document (without the leading "V") with which the server implementation complies and shall, at minimum, indicate the 3GPP release number with which the implementation complies.

The `Server` response header field may also include *comment* elements (see section 5.6.5 of RFC 9110 [19]) following the above specified *product* identifier, as well as additional vendor-specific *product* identifiers and *comment* elements compliant with the syntax and guidance provided in section 10.2.4 of RFC 9110 [19].

EXAMPLE 1: `MBSTF-vm10665.mno.net/17.4.0 (api=1.0.0) libsbi/2.1 libnf/1.2`

EXAMPLE 2: `MBSAF-vm10240.mno.net/17 (api=1.0.0) libsbi/2.1 libnf/1.2`

8.2.3.3.2 MBSF identification

When responding to *Nmbsf* service operations made by the MBS Application Provider (AF/AS) at reference point Nmb10, the MBSF's `Server` response header is set as specified in clauses 6.1.2.2.1 and 6.2.2.2.1 of TS 29.580 [17].

8.2.3.3.3 MBSTF identification

When responding to *Nmbstf* service operations made by the MBSF at reference point Nmb2, the MBSTF's `Server` response header is set as specified in clause 6.1.2.2.1 of TS 29.581 [18].

When acknowledging objects published using the push-based object acquisition method by the MBSF at reference point Nmb2 or by the MBS Application Provider (AF/AS) at reference point Nmb10, the MBSTF shall identify itself using a

`Server` response header field that complies with the general provisions specified in clause 8.2.3.3.1. The product identifier token shall be set to the value `MBSTF`.

8.2.3.3.4 MBS AF identification

The MBS AF shall identify itself to the MBSF Client at reference point MBS-5 and to the MBSTF at reference point MBS-11 using a `Server` response header field that complies with the general provisions specified in clause 8.2.3.3.1. The product identifier token shall be set to the value `MBSAF`.

8.2.3.3.5 MBS AS identification

The MBS AS shall identify itself to the MBSTF Client at reference point MBS-4-UC using a `Server` response header field that complies with the general provisions specified in clause 8.2.3.3.1. The product identifier token shall be set to the value `MBSAS`.

8.2.3.4 Support for conditional HTTP GET requests

The provisions in clause 5.2.2 of TS 29.500 [15] relating to conditional `GET` requests using the `If-None-Match` and `If-Modified-Since` request headers apply to all Network Functions in the MBS System. In particular:

- This is specified for invocations of the *Nmbsf* service at reference point Nmb10 in clauses 6.1.2.2.1 and 6.2.2.2.1 of TS 29.580 [17].
- This is specified for invocations of the *Nmbstf* service at reference point Nmb2 in clause 6.1.2.2.1 of TS 29.581 [18].

All responses from the MBS AF at reference points MBS-5 and MBS-11 that carry a resource message body shall include:

- a strong entity tag for the resource, conveyed in an `ETag` response header per section 8.8.3 of RFC 9110 [19],
- a resource modification timestamp, conveyed in a `Last-Modified` response header per section 8.8.2 of RFC 9110 [19], and
- a predicted time-to-live period for the resource, conveyed in a `Cache-Control: max-age` response header per section 5.2 of RFC 9111 [20].

All API endpoints on the MBS AF that expose the HTTP `GET` method shall support conditional requests using the `If-None-Match` and `If-Modified-Since` request headers per section 13.1.2 and 13.1.3 respectively of RFC 9110 [19]. API clients should not attempt to revalidate their cached copy of a resource using a conditional `GET` request before the indicated time-to-live period has elapsed.

8.2.3.5 Support for conditional HTTP POST, PUT, PATCH and DELETE requests

The provisions in clause 5.2.2 of TS 29.500 [15] relating to conditional `POST`, `PUT`, `PATCH` and `DELETE` requests using the `If-Match` request header apply to all Network Functions in the MBS System. In particular:

- This is specified for invocations of the *Nmbsf* service at reference point Nmb10 in clauses 6.1.2.2.1 and 6.2.2.2.1 of TS 29.580 [17].
- This is specified for invocations of the *Nmbstf* service at reference point Nmb2 in clause 6.1.2.2.1 of TS 29.581 [18].

8.2.3.3.6 MBSSF identification

The MBSSF shall identify itself to the MBSF Client at reference point MBS 10 using a Server response header field that complies with the general provisions specified in clause 8.2.3.3.1. The product identifier token shall be set to the value MBSSF.

8.3 HTTP response codes

Guidelines for error responses to the invocation of APIs of NF services are specified in clause 4.8 of TS 29.501 [16]. API-specific error responses are specified in the respective technical specifications.

9 MBS AF APIs (MBS-5)

9.1 General

This clause specifies the network APIs exposed by the MBS AF with reference to the general provisions of clause 8 as they apply to the reference point in question.

9.2 User Service Description retrieval API

9.2.1 General

In the case where *Service announcement modes* (see table 4.5.3-1 of TS 26.502 [6]) indicates that the MBS User Service Announcement for an MBS User Service is advertised at reference point MBS-5, the User Service Description retrieval API is used by the MBSF Client to retrieve a User Service Descriptions Bundle from the MBS AF that enable reception of the MBS User Service(s) to be initiated by the MBSF Client.

In the case where *Service announcement modes* (see table 4.5.3-1 of TS 26.502 [6]) indicates that the MBS User Service Announcement for an MBS User Service is advertised via the User Service Announcement Channel at reference point MBS-4-MC, the User Service Description retrieval API is used by the MBSF Client at reference point MBS-7′ to retrieve a User Service Descriptions Bundle from the MBSTF Client that enable reception of the MBS User Service(s) to be initiated by the MBSF Client.

In the absence of prior knowledge about which Service announcement mode(s) are configured for currently provisioned MBS User Services, an MBSF Client may use either or both of the above procedures to proactively retrieve User Service Descriptions Bundles.

9.2.2 Resource structure

The User Service Description retrieval API is accessible from the MBS AF at reference point MBS-5 and from the MBSTF Client at reference point MBS-7′ through the following URL base path:

{apiRoot}`/3gpp-mbs-user-service-discovery/`*{apiVersion}*`/`

The operations and the corresponding HTTP methods in table 9.2.2-1 are supported through the above API base path. In each case, the sub-resource path specified in the second column shall be appended to the URL base path. The provisions of clause 8.2.3.4 shall apply to all operations.

Table 9.2.2-1: Operations supported by the User Service Description retrieval API

Operation	Sub-resource path	Allowed HTTP method(s)	Description
Discover User Service Descriptions	`user-service-descriptions?` *{queryParameters}*	`GET`	Used to discover a set of User Service Descriptions that match a set of filtering criteria corresponding to at least one of the query parameters specified in table 9.2.2-2. Multiple query parameters may be concatenated using the ampersand ('&') character as a separator with the resulting semantics of logical conjunction (i.e., Boolean AND). It is an error to invoke this operation with no query parameters. A User Service Descriptions Bundle (see clause 9.2.3.1) is returned containing User Service Descriptions matching all of the specified filtering criteria and their dependent resources, which may be empty if none match all of the criteria.
Retrieve User Service Description	`user-service-descriptions/` *{externalServiceId}*	`GET`	The *{externalServiceId}* uniquely identifies a single User Service Description resource in the MBS AF. If the requested User Service is known to the MBS AF, a User Service Descriptions Bundle (see clause 9.2.3.2) is returned comprising a single User Service Description and its dependent resources. Otherwise, a suitable HTTP error response code is returned.

Table 9.2.2-2 specifies the query parameters that may be combined with the operations specified in table 9.2.2-1.

Table 9.2.2-2: Query parameters supported by the User Service Description retrieval API

Applicable operation	Filter name	Query parameter	Description
Discover User Service Descriptions	Service class	`service-class=` *{serviceClassTermId}*	Used to select User Service Descriptions that are tagged with the supplied service class term identifier (see table 4.5.3-1 of TS 26.502 [6]), which is expressed as a fully-qualified URI string from a controlled vocabulary (e.g., OMNA BCAST Service Class [25]) with appropriate URL encoding applied.
	Conformance profile	`profile=` *{conformanceProfileTermId}*	Used to select User Service Descriptions that include Distribution Session Descriptions tagged with the supplied conformance profile term identifier (see clause 12), which is expressed as a fully-qualified URI string from a controlled vocabulary (e.g., clause C.2) with appropriate URL encoding applied.

9.2.3 Response format

9.2.3.1 User Service Descriptions result

The HTTP response message shall convey a User Service Descriptions Bundle Entity as specified in clause 5.3.1A in which the root body part is a User Service Descriptions document that includes a User Service Description for each User Service that matches the filtering criteria. This response message shall conform to the following requirements:

- The User Service Descriptions Bundle Entity shall include any dependent resources as additional body parts per clause 5.3.1A.
- The headers of the User Service Descriptions Bundle Entity shall be conveyed in the headers of the HTTP response message.
- A strong entity tag shall additionally be conveyed in the headers of the HTTP response per clause 8.2.3.4.
- The body of the User Service Descriptions Bundle Entity shall be conveyed in the body of the HTTP response message.

- The MBS AF may apply GZip [41] encoding to individual body parts of the User Service Descriptions Bundle Entity, or to the entity as a whole, subject to the provisions of clause 8.2.2.

9.2.3.2 User Service Description result

The HTTP response message shall convey a User Service Bundle Entity as specified in clause 5.3.1A in which the root body part is a User Service Descriptions document that includes a single User Service Description. This response message shall conform to the following requirements:

- The User Service Descriptions Bundle Entity shall include any dependent resources as additional body parts per clause 5.3.1A.
- The headers of the User Service Descriptions Bundle Entity shall be conveyed in the headers of the HTTP response message.
- A strong entity tag shall additionally be conveyed in the headers of the HTTP response per clause 8.2.3.4.
- The body of the User Service Descriptions Bundle Entity shall be conveyed in the body of the HTTP response message.
- The MBS AF may apply GZip [41] encoding to individual body parts of the User Service Descriptions Bundle Entity, or to the entity as a whole, subject to the provisions of clause 8.2.2.

10 MBS AS protocols (MBS-4-UC)

10.1 General

This clause specifies the protocols between the MBSTF Client and the MBS AS with reference to the general provisions of clause 8 as they apply to these functional entities at reference point MBS-4-UC.

The following protocols are defined in this release:

- Unicast Object Repair protocol for post-session (clause 10.2) between the MBSTF Client and the MBS AS when the delivery of one of several objects in an MBS download delivery session using the Object Distribution Method was not completely successful.
- Unicast Object Repair protocol for in-session (clause 10.3) between the MBSTF Client and the MBS AS when the delivery of objects in an MBS object delivery session using the Object Distribution Method was not completely successful and completion is done during the ongoing session.

10.2 Post-session unicast Object Repair protocol

10.2.1 Overview

This clause defines the unicast Object Repair retrieval protocol between the MBSTF Client and the MBS AS at reference point MBS-4-UC when the delivery of one of several objects in an MBS User Service Session was not completely successful and repairs are made after the session has finished. The unicast Object Repair protocol is based on HTTP [19] and the general requirements specified in clause 8.2 and 8.3 of the present document shall apply to all interactions between these two functional entities at this reference point.

- An MBSTF Client shall implement the procedures defined in clause 10.2.2 to support the object repair protocol.
- An MBS AS shall implement the procedures defined in clause 10.2.3 to support the object repair protocol.

10.2.2 MBSTF Client procedures

10.2.2.1 General

This clause defines the MBSTF Client procedures for the unicast Object Repair protocol.

It is assumed that at a specific time instance, the MBSTF Client is triggered to initiate the Object Repair procedures based on the parameters defined in clause 10.2.2.2.

Once initiated, the MBSTF Client shall calculate a random *back-off time* using the `offsetTime` and `randomTimePeriod` parameters as defined in clause 10.2.2.3. The MBSTF Client shall start making repair requests as described in clause 10.2.2.3 at the computed *back-off* time. The MBSTF Client shall not start sending any repair request messages before this calculated time *back-off time* has elapsed.

10.2.2.2 Parameters

The following parameters are assumed to be available to the MBSTF Client for unicast Object Repair:

- The `offsetTime` parameter and the `randomTimePeriod` parameter for the back-off time computation.
- For each object with missing data:
  - If available to the MBSTF Client in the MBS Distribution Session metadata, an *entity tag* value for the damaged object.
  - The *length* (in bytes) of the damaged object.
  - The network location *location* referring to a corresponding object hosted on the MBS AS.
  - A minimally sized *list of byte ranges* of dimension *Range[M]* with *M* the number of independent ranges and *Range[m].start* the start of the range and *Range[m].end* the end of the range from the repair object.

10.2.2.3 Back-off time computation

The computation of the *back-off time* uses the `offsetTime` parameter and the `randomTimePeriod` parameter. In particular, the MBS Client shall implement the back-off timing computation specified in clause 9.3.4 of TS 26.346 [7] as follows:

- The value of the `offsetTime` parameter is used as the *OffsetTime* as defined in clause 9.3.4.1 of TS 26.346 [7].
- The value of the `randomTimePeriod` parameter is used as the *Random Time Period* as defined in clause 9.3.4.2 of TS 26.346 [7] to determine a *RandomTime*.
- The back-off time is the sum of *OffsetTime* and *RandomTime*.

10.2.2.4 MBSTF Client unicast repair request

The MBSTF Client sends one or more requests to an MBS AS instance requesting transmission of data that allows recovery of missing object data. All unicast Object Repair requests and responses for a particular MBS Distribution Session shall take place in a single HTTP session [19].

The MBSTF Client shall start the initial request once initiated after the back-off time, if any, has elapsed (see clause 10.2.2.3). If there is more than one repair request to be made, these are sent one straight after another without further delay.

The MBSTF Client shall send separate HTTP `GET` requests for each damaged object.

For each damaged object, based on the parameters in clause 10.2.2.2, the MBSTF Client shall act as follows:

1. If the requested range is the entire object, i.e. *M = 1*, *Range[0].start = 0* and *Range[0].end = F*, with *F* the value of the *content length*, then the HTTP `GET` method shall be used.

2. If the requested range is only a subset of the object, a HTTP partial `GET` request shall be used with the `Range` request header (as specified in section 14.1.2 of RFC 9110 [19]) present.

   - If *M >1*, the MBSTF Client shall include multiple byte range requests within a single partial `GET` request. In particular, the MBSTF Client shall include as many byte ranges as possible in a single HTTP request message without exceeding 2048 bytes for all request headers. If this length is exceeded, the request shall be split into as few requests as possible without any of those exceeding the 2048-byte limit.

3. If the *entity tag* is available to the MBSTF Client for the damaged object, it shall be used as the entity tag value in the `If-Match` or `If-Range` header of a conditional byte-range file request.

4. If the *entity tag* is not available to the MBSTF Client for the damaged object, the MBSTF Client may omit the `If-Match` or `If-Range` header from its byte range request.

NOTE 1: The nominal objective of the MBSTF Client using the `If-Match` header is to receive the requested range(s) of the HTTP resource representation associated with the entity tag, or no repair data if the request cannot be satisfied by the MBS AS.

NOTE 2 The nominal objective of the MBSTF Client using the `If-Range` header is to receive the latest version of the entire HTTP resource representation in case the version associated with the entity tag that was transmitted in the MBS User Service Session and partially received by the MBSTF Client is no longer available on the MBS AS.

10.2.3 MBS AS requirements

An MBS AS instance is assigned to an MBS User Service Session and hosts all objects at a location as specified in clause 6.2.4.4.

An MBS AS shall be an HTTP server that complies with the general provisions in clause 8.2 and 8.3 of the present document and shall respond to all requests as specified in clause 10.2.2.4.

10.3 In-Session unicast Object Repair protocol

10.3.1 Overview

This clause defines the unicast Object Repair retrieval protocol between the MBSTF Client and the MBS AS at reference point MBS-4-UC when the delivery of an object in an MBS User Service Session was not completely successful during the session and repairs are made before the end of the session. The unicast Object Repair protocol is based on HTTP [19] and the general requirements specified in clause 8.2 and 8.3 of the present document shall apply to all interactions between these two functional entities at this reference point.

- The mapping of the in-session object repair procedure parameters to the MBS User Service Parameters

- An MBSTF Client shall implement the procedures defined in clause 10.3.3 to support the in-session unicast Object Repair protocol.

- An MBS AS shall implement the procedures defined in clause 10.3.4 to support the in-session unicast Object Repair protocol.

10.3.2 Parameter mapping to MBS

Clause 6.2.4.3.2 defines generic parameters for the in-session Object Repair procedure. Table 10.3.2-1 provides a mapping of these abstract parameters to the properties included in the Object Repair Parameter data type specified in clause 5.2.8.

Table 10.3.2-1: Mapping of abstract in-session repair parameters to `ObjectRepairParameters` data type

Abstract parameter	ObjectRepairParameters property
offsetTime	`backoffParameters.offsetTime`
randomTimePeriod	`backoffParameters.randomTimePeriod`
repairLimitPercentage	`repairLimitPercentage`
object distribution base locator	`objectDistributionBaseLocator`
object repair base locations	`objectRepairBaseLocators`

10.3.3 MBSTF Client procedures

This clause defines the MBSTF Client procedures for the unicast Object Repair protocol for in-session repair.

The MBSTF Client shall follow the requirements and recommendations of the object delivery client defined in clause 6.2.4.3.

10.3.4 MBS AS requirements

A commonly addressable set of deployed MBS AS instances is assigned to an MBS User Service Session and hosts all objects at a location as specified in clause 6.2.4.4.

An MBS AS shall be an HTTP server that complies with the general provisions in clause 8.2 and 8.3 of the present document and shall respond to all requests as specified in clause 10.3.3.

When used for in-session repair, the MBS AS shall follow the requirements and recommendations of the object repair server defined in clause 6.2.4.3.

11 MBSSF security protocols (MBS-10)

11.1 General

This clause is applicable when the MBS User Plane Security mechanism is provisioned for an MBS User Service. This provisioning is indicated to the MBS Client by the presence of the **`SecurityDescription`** object in a **`Distribution SessionDescription`** object (see clause 5.2.10) of a User Service Description it has obtained by one of the methods specified in clause 5.3.

11.2 MBS Service Key retrieval from MBSSF

11.2.1 Overview

Whenever it needs an MBS Service Key (MSK), the MBSF Client shall interact with the MBSSF at reference point MBS-10 using the protocol specified in clause 6.3 of TS 33.246 [33]. The key retrieval protocol is based on HTTP [19]

and the general requirements specified in clause 8.2 and 8.3 of the present document shall apply to all interactions between these two functional entities at this reference point.

11.2.2 MBSF Client procedures

11.2.2.1 MBSSF endpoint selection by MBSF Client

Aligned with TS 26.346 [7], before communicating with the MBSSF as part of an MBS User Service Session, the MBSF Client shall first choose an MBSSF endpoint address from those listed in the `mBSSFAddresses` property of the **`SecurityDescription`** object specified in table 5.2.10-1. The MBSF Client shall use the same endpoint address for all subsequent requests to the MBSSF relating to that MBS User Service Session.

If the MBSSF at the chosen endpoint address proves to be unresponsive after a number of retry attempts, a different endpoint shall be chosen by the MBSF Client from those listed, if any.

11.2.2.2 Back-off time computation

When the back-off mode parameters are present in the **`SecurityDescription`** object, these are used to calculate a random back-off time as specified in clause 6.3.2.1A of TS 33.246 [33] and clause 11.3.1 of TS 26.346 [7] in order to avoid overloading the MBSSF.

In case of an MSK request, the MBSF Client shall calculate the random *back-off time* according to clause 10.2.2.3 of the present document, using the `offsetTime` and `randomTimePeriod` parameters indicated in the `backOffParameters` object as specified in table 5.2.10-1.

12 Conformance profiles for MBS Distribution Sessions

12.1 Definition

This clause defines conformance profiles used to characterise MBS Distribution Sessions.

MBS Distribution Sessions are characterized by features that are required for the consumption of the MBS Distribution Session. An MBS Client needs to support all features of the MBS Distribution Session in order to consume the MBS Distribution Session.

Conformance profiles are defined to enable interoperability and the signalling of the use of features.

A conformance profile imposes a set of specific restrictions:

- It may constrain features of the MBS Distribution Session, i.e. the Distribution Method in use.
- It may constrain the content delivered within the MBS Distribution Session, such as the media content types, media format(s), codec(s), and protection formats.
- It may constrain quantitative parameters, such as bit rate.

NOTE: A conformance profile can also be understood as permission for an MBS Client that only implements the features required by the profile to process the MBS Distribution Session.

Conformance profiles defined in the present document constrain features specified in the present document. Externally defined conformance profiles may additionally impose restrictions on other aspects.

12.2 Identification of conformance profile

A conformance profile is uniquely identified by a fully-qualified term identifier URI from a controlled vocabulary. The term identifiers in the controlled vocabulary shall conform to either the *pro-simple* or *pro-fancy* productions specified in

section 4.5 of IETF RFC 6381 [29], without the enclosing *DQUOTE* characters, i.e. only the *unencodedv* or *encodedv* productions respectively.

- Profile identifiers defined in the present document shall be URNs conforming to IETF RFC 8141 [27]. A controlled vocabulary of conformance profiles defined in the present document is specified in clause C.2.
- Externally defined conformance profiles may use profile identifiers that are URNs conforming to IETF RFC 8141 [27] or URLs conforming to IETF RFC 3986 [34].
  - When a URL is used, it should also contain a date specifier in the form YYYY-MM. The assignment of the URL shall be authorized by the owner of the domain name in the *authority* part of the URL on or very close to that date, to avoid problems when domain names change ownership.

12.3 Semantics of conformance signalling in User Service Description

The `conformanceProfiles` property as defined in clause 5.2.4 indicates a list of profiles to which an MBS Distribution Session conforms.

The MBS Distribution Session shall conform to every profile listed.

An MBS Client conforming to any of the listed profiles is permitted to access and process the MBS Distribution Session and shall process the MBS Distribution Session according to the client requirements defined by its chosen conformance profile.

MBS Distribution Sessions conforming to the *Baseline MBS Distribution Session Profile* defined in clause 12.4 may omit the `conformanceProfiles` property.

12.4 Baseline MBS Distribution Session Profile

The Baseline MBS Distribution Session Profile characterises MBS Distribution Sessions as specified in the present document.

For MBS Distribution Sessions conforming to the Baseline MBS Distribution Session Profile, the following applies:

- If the User Service Description indicates the Object Distribution Method, then the MBS Distribution Session shall conform to the requirements in clause 6.
- If the User Service Description indicates the Packet Distribution Method, then the MBS Distribution Session shall conform to the requirements in clause 7.

An MBS Client conforming to this profile shall support the MBS Client requirements for the Object Distribution Method as defined in clause 6 and the MBS Client requirements for the Packet Distribution Method as defined in clause 7.

The Baseline MBS Distribution Session Profile is identified by the URI `urn:3GPP:26517:17:baseline` as specified in annex C.2.

Annex A (normative): Syntax for Service Announcement

A.1 Void

A.2 JSON-based representation

A.2.1 MBS User Service Announcement schema

Editor's Note: This needs to be updated to address the necessary changes for In-session repair and the OpenAPI needs to be added to 3GPP forge.

Below is the schema specifying the format of User Service Descriptions instance documents using a JSON-based representation. The schema filename is "TS26517_MBSUserServiceAnnouncement.yaml".

Documents following this schema shall be identified with the MIME media type *application/3gpp-mbs-user-service-descriptions+json* as registered in clause E.2.1 including the following parameters:

- The *profiles* parameter (see clause E.2.2) shall include a fully-qualified term identifier from the controlled vocabulary specified in clause C.2.
- The *version* parameter (see clause E.2.3) shall contain the value "Rel19" to indicate conformance with this version of the present document.

```
openapi: 3.0.0

info:
  title: 'MBS User Service Announcement'
  version: 2.2.0
  description: |
    MBS User Service Announcement Element units.
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

externalDocs:
  description: 3GPP TS 26.517 V19.0.0; 5G Multicast-Broadcast User Services; Protocols and Formats
  url: http://www.3gpp.org/ftp/Specs/archive/26_series/26.517/
paths:
  /user-service-descriptions:
    get:
      operationId: discoverUserServiceDescriptions
      summary: 'Discover User Service Descriptions'
      description: 'Discover User Service Descriptions that match the supplied query filter(s). At
least one filter query parameter must be included in the request URL.'
      parameters:
        - in: query
          name: service-class
          schema:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
          required: true
          description: 'Filter for User Service Descriptions tagged with the supplied service
class term identifier expressed as a fully-qualified URI string from a controlled vocabulary'
      responses:
        '200':
          # OK
          description: "Success"
          content:
            multipart/related:
              schema:
                type: string
        '204':
          # No Content (no matching User Service Descriptions)
          description: "No Matches Found"
```

```
        '500':
          # Internal Server Error
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          # Service Unavailable
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'

  /user-service-descriptions/{externalServiceId}:
    get:
      operationId: retrieveUserServiceDescription
      summary: 'Retrieve User Service Description'
      description: 'Retrieve the User Service Description of a single service by supplying its
external service identifier.'
      parameters:
        - name: externalServiceId
          in: path
          required: true
          schema:
            type: string
          description: 'The external service identifier of a User Service provisioned in the
MBSF.'
      responses:
        '200':
          # OK
          description: "Success"
          content:
            multipart/related:
              schema:
                type: string
        '404':
          # Not Found
          $ref: 'TS29571_CommonData.yaml#/components/responses/404'
        '500':
          # Internal Server Error
          $ref: 'TS29571_CommonData.yaml#/components/responses/500'
        '503':
          # Service Unavailable
          $ref: 'TS29571_CommonData.yaml#/components/responses/503'
        default:
          $ref: 'TS29571_CommonData.yaml#/components/responses/default'

components:
  schemas:
    UserServiceDescriptions:
      description: 'A document announcing one or more MBS User Services.'
      type: object
      properties:
        version:
          type: integer
          minimum: 1
        userServiceDescriptions:
          type: array
          items:
            $ref: '#/components/schemas/UserServiceDescription'
          minItems: 1
      required:
        - userServiceDescriptions

    UserServiceDescription:
      description: 'A description of a single MBS User Service.'
      type: object
      properties:
        serviceIds:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
          minItems: 1
        class:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        names:
          type: array
          items:
            type: object
            properties:
              name:
                type: string
```

```
            lang:
              type: string
              pattern: '^[a-zA-Z]{3}$'
              example: 'eng'
          required:
            - name
            - lang
        minItems: 1
      descriptions:
        type: array
        items:
          type: object
          properties:
            description:
              type: string
            lang:
              type: string
              pattern: '^[a-zA-Z]{3}$'
              example: 'eng'
          required:
            - description
            - lang
        minItems: 1
      serviceLanguage:
        type: string
        pattern: '^[a-zA-Z]{3}$'
        example: 'eng'
      distributionSessionDescriptions:
        type: array
        items:
          $ref: '#/components/schemas/DistributionSessionDescription'
        minItems: 1
      serviceScheduleDescriptions:
        type: array
        items:
          $ref: '#/components/schemas/ServiceScheduleDescription'
        minItems: 1
    required:
      - serviceIds
      - class
      - distributionSessionDescriptions

  DistributionSessionDescription:
    type: object
    properties:
      distributionMethod:
        $ref: '#/components/schemas/DistributionMethod'
      conformanceProfiles:
        type: array
        items:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        minItems: 1
      sessionDescriptionLocator:
        $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
      applicationServiceDescriptions:
        type: array
        items:
          $ref: '#/components/schemas/ApplicationServiceDescription'
        minItems: 1
      postSessionObjectRepairParameters:
        $ref: '#/components/schemas/ObjectRepairParameters'
      availabilityInfos:
        type: array
        items:
          $ref: '#/components/schemas/AvailabilityInformation'
        minItems: 1
      securityDescription:
        $ref: '#/components/schemas/SecurityDescription'
      timeSynchronizationParameters:
        $ref: '#/components/schemas/TimeSynchronizationParameters'
    required:
      - distributionMethod
      - sessionDescriptionLocator

  DistributionMethod:
    anyOf:
      - type: string
        enum:
```

```
            - OBJECT
            - PACKET
        - type: string
          description: >
            This string provides forward-compatibility with future
            extensions to the enumeration but is not used to encode
            content defined in the present version of this API.

    ApplicationServiceDescription:
      type: object
      properties:
        entryPointLocator:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        contentType:
          type: string
          pattern: '^[a-zA-Z]+\/[a-zA-Z]+$'
          example: 'application/dash+xml'
      required:
        - entryPointLocator
        - contentType

    AvailabilityInformation:
      type: object
      properties:
        mbsServiceAreas:
          deprecated: true
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/MbsServiceArea'
          minItems: 1
        targetServiceAreas:
          type: array
          items:
            $ref: '#/components/schemas/TargetServiceArea'
          minItems: 1
        mbsFSAId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/MbsFsaId'
        nrParameters:
          type: array
          items:
            $ref: '#/components/schemas/NrParameterSet'
          minItems: 1
        nrRedCapUEInfo:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/NrRedCapUeInfo'

    TargetServiceArea:
      description: Target Service Area
      type: object
      oneOf:
        - required: [ncgiList]
        - required: [taiList]
        - required: [geographicAreaList]
      properties:
        ncgiList:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Ncgi'
          minItems: 1
          description: List of NR Cell Identifiers
        taiList:
          type: array
          items:
            $ref: 'TS29571_CommonData.yaml#/components/schemas/Tai'
          minItems: 1
          description: List of Tracking Area Identifiers
        geographicAreaList:
          type: array
          items:
            anyOf:
              - $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/Polygon'
              - $ref: 'TS29572_Nlmf_Location.yaml#/components/schemas/PointUncertaintyCircle'
          minItems: 1

    NrParameterSet:
      type: object
      properties:
        freqBandIndicator:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
```

```
        aRFCNValue:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
      required:
        - freqBandIndicator
        - aRFCNValue

    ObjectRepairParameters:
      type: object
      properties:
        backOffParameters:
          $ref: '#/components/schemas/BackOffParameters'
        objectDistributionBaseLocator:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uri'
        objectRepairBaseLocator:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'

    BackOffParameters:
      type: object
      properties:
        offsetTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
        randomTimePeriod:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      anyOf:
        - required: [offsetTime]
        - required: [randomTimePeriod]

    ServiceScheduleDescription:
      type: object
      properties:
         id:
           type: string
         version:
           type: integer
           minimum: 1
         start:
           $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
         stop:
           $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
         repetitionRule:
           $ref: '#/components/schemas/RepetitionRule'
      required:
        - id
        - version
      oneOf:
        - required: [start, stop]
        - required: [repetitionRule]

    RepetitionRule:
      type: object
      properties:
        startTime:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
        duration:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
        repetitionInterval:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DurationSec'
      required:
        - startTime
        - duration
        - repetitionInterval

    SecurityDescription:
      type: object
      properties:
        mBSSFAddresses:
          type: array
          items:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
          minItems: 1
        mBSServiceKeyInfo:
          type: object
          properties:
            mBSId:
              type: string
            mBSDomainId:
              type: string
          required:
```

```
            - mBSId
            - mBSDomainId
        uICCKeyManagement:
          type: boolean
        2GGBAallowed:
          type: boolean
        backOffParameters:
          $ref: '#/components/schemas/BackOffParameters'
      required:
        - mBSSFAddresses
        - mBSSessionKeyInfo

    TimeSynchronizationParameters:
      type: object
      properties:
        ranTimeTransmitted:
          type: boolean
        timeServiceEndpoints:
          type: array
          items:
            $ref: '#/components/schemas/TimeServiceEndpointParameters'
          minItems: 1

    TimeServiceEndpointParameters:
      type: object
      properties:
        protocolScheme:
          type: string
          items:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
        endpoint:
          type: string
        accuracy:
          type: integer
          minimum: 1
      required:
        - protocolScheme
        - endpoint
```

Annex B (informative): Service Announcement examples

B.1 XML-based representation

B.2 JSON-based representation

This example is for future study.

Annex C (normative): 3GPP Registered URIs

C.1 General

This annex documents the registered URIs in the present document following the process in https://www.3gpp.org/3gpp-groups/core-network-terminals-ct/ct-wg1/uniform-resource-identifier-uri-list.

As required by this process, the tables in the following clauses list all registered URI values as well as:

- a brief description of its functionality;
- a reference to the specification or other publicly available document (if any) containing the definition;
- the name and email address of the person making the application; and
- any supplementary information considered necessary to support the application.

C.2 Controlled vocabulary of conformance profile identifiers

Table C.2-1: Controlled vocabulary of conformance profile identifiers

URI	Description	Reference	Contact	Remarks
urn:3GPP:26517:17:baseline	Baseline MBS Distribution Session Profile	TS 26.517, clause 12.4	Thomas Stockhammer tsto@qti.qualcomm.com	None.

C.3 Controlled vocabulary of timing schemes

The controlled vocabulary of timing schemes is a subset of the term identifiers for DASH UTC Timing Schemes specified in clause 5.8.5.7 of ISO/IEC 23009-1 [45].

Table C.3-1: Controlled vocabulary of timing schemes

URI	Description	Reference	Remarks
urn:mpeg:dash:utc:sntp:2014	The time service endpoint indicates the host name or IP address of an SNTP server compliant with RFC 5905 [45].	ISO/IEC 23009-1 [45] clause 5.8.5.7	None.
urn:mpeg:dash:utc:http-xsdate:2014	The time service endpoint indicates an HTTP URL of a resource representation of the current date–time.	ISO/IEC 23009-1 [45 clause 5.8.5.7	None.

Annex D (normative): Syntax for object manifest

D.1 Object manifest schema

Below is the formal syntax of the JSON-based object manifest for use with the Object Collection or Object Carousel operating mode. The schema shall have the filename "TS26517_MBSObjectManifest.yaml".

Documents following this schema shall be identified with the MIME media type *application/3gpp-mbs-object-manifest+json* as registered in clause E.3.1 including the following parameters:

- The *version* parameter (see clause E.3.2) shall contain the value "Rel17" to indicate conformance with this version of the present document.

```
openapi: 3.0.0
info:
  title: MBS User Services Object Manifest
  version: 2.0.0
  description: |
    MBS User Services Object Manifest syntax
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
tags:
  - name: MBS User Services Object Manifest
    description: '5G Media Streaming: Common Data Types'
externalDocs:
  description: 'TS 26.517 V18.1.0; 5G Multicast-Broadcast User Services; Protocols and Formats'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.517/'
paths: {}
components:
  schemas:
    ObjectManifest:
      type: object
      description: A manifest describing a set of binary objects to be transmitted by the MBSTF as
part of the MBS Distribution Session.
      required:
        - objects
      properties:
        updateInterval:
          type: integer
          format: int32
          description: The time period (in seconds) after which the MBSTF attempts to re-acquire
the object manfiest when pull-based object acquisition is provisioned.
        objects:
          type: array
          description: The list of binary objects to be carouselled from the MBSTF to the MBSTF
Client.
          items:
            $ref: '#/components/schemas/Object'
    Object:
        type: object
        description: A binary object to be transmitted by the MBSTF as part of the MBS
Distribution Session.
        required:
          - locator
        properties:
          locator:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
          repetitionInterval:
            type: integer
            format: int32
            description: The MBSTF sends the object repeatedly to the MBSTF Client with the given
interval (in milliseconds). This parameter is ignored in the case of Object Collection operating
mode.
          keepUpdatedInterval:
            type: integer
            format: int32
            description: The MBSTF checks for changes to the object with the given interval (in
seconds). This parameter is ignored in the case of Object Collection operating mode.
          earliestFetchTime:
            type: string
```

```
            format: date-time
            description: The MBSTF shall pull each object from its origin location no sooner than
this time or, if this parameter is omitted, at a time of its choosing.
          latestFetchTime:
            type: string
            format: date-time
            description: The MBSTF shall pull each object from its origin location no later than
this time, or, if this parameter is omitted, at a time of its choosing.
```

Annex E (normative): IANA registration

E.1 General

This annex provides the formal registrations of MIME media types for different resources specified in the present document. It is referenced from the IANA registry at http://www.iana.org/assignments/media-types.

E.2 Registration of MIME media type for MBS User Service Descriptions document

E.2.1 General

The MIME media type specified in table E.2.1-1 below denotes that the message body is a JSON instance document compliant with the *UserServiceDescriptions* YAML schema specified in clause A.2.1.

Table E.2.1-1: MIME media type registration for MBS User Service Descriptions document

Parameter		Value
MIME media type name		*application*
MIME subtype name		*3gpp-mbs-user-service-descriptions+json*
Required parameters		*version* (see clause E.2.3 of 3GPP TS 26.517).
Optional parameters		*profiles* (see clause E.2.2 of TS 26.517).
Encoding considerations		This is a JSON document, and the encoding considerations are the same as for media type *application/json* defined in IETF RFC 8259.
Security considerations		This media format is used to configure the receiver on how to participate in one or more MBS User Services. This format is highly susceptible to manipulation or spoofing for attacks desiring to mislead a receiver about a session. Both integrity protection and source authentication are recommended to prevent misleading of the receiver.
Interoperability considerations		The specification defines a platform-independent expression of an entry point document, and it is intended that wide interoperability can be achieved.
Published specification		3GPP TS 26.517
Applications which use this media type		3GPP MBS-based applications and services
Fragment identifier considerations		The provisions of RFC 6901 (JSON Pointer) apply.
Restrictions on usage		None
Provisional registration?		No
Additional information	Deprecated alias names	None
	Magic number(s)	None
	File extension(s)	json
	Macintosh File Type Code(s)	None
	Object Identifier(s) of OID(s)	None
Intended usage		COMMON
Other information and general comments		None
Contact person	Contact name	Dongwook Kim
	Contact e-mail address	dongwook.kim@etsi.org
	Author/Change controller	3GPP TSG SA WG4

E.2.2 Profiles parameter

Table E.2.2-1 specifies the *profiles* parameter to be used with the MIME media type registered in clause E.2.1.

Table E.2.2-1: Definition of profiles parameter

Parameter	Value
Parameter name	*profiles*
Parameter value	Optional attribute indicating one or more profiles to which the resource representation claims conformance. The contents of this attribute shall conform to either the *pro-simple* or *pro-fancy* productions specified in section 4.5 of IETF RFC 6381. The value is a fully-qualified term identifier URI from a controlled vocabulary. The set of profile identifiers indicated in this parameter should match the set indicated in the profiles attribute of the corresponding User Service Description.

EXAMPLE: `application/3gpp-mbs-user-service-description+json;`
`**profiles="urn:3GPP:26517:17:baseline**;version="Rel17"`

E.2.3 Version parameter

Table E.2.3-1 specifies the *version* parameter to be used with the MIME media type registered in clause E.2.1.

Table E.2.3-1: Specification of version parameter

Parameter	**Value**
Parameter name	*version*
Parameter value	A comma-separated list of versions of the Object Manifest schema to which the document conforms. The value specified in clause D.1 of 3GPP TS 26.517 encodes the last 3GPP release in which a change to the document schema was approved. The purpose of the parameter is to allow schema conformance to be assessed by a recipient before attempting to parse the contents of a received document.

EXAMPLE: `application/3gpp-mbs-user-service-description+json;`
`profiles="urn:3GPP:26517:17:baseline";**version="Rel17"**`

E.3 Registration of MIME media type for MBS User Services object manifest document

E.3.1 General

The MIME media type specified in table E.3.1-1 below denotes that the message body is a JSON instance document compliant with the *ObjectManifest* YAML schema specified in clause D.1.

Table E.3.1-1: MIME media type registration for MBS User Services object manifest document

Parameter		Value
MIME media type name		*application*
MIME subtype name		*3gpp-mbs-object-manifest+json*
Required parameters		*version* (see clause E.3.2 of 3GPP TS 26.517).
Optional parameters		None.
Encoding considerations		This is a JSON document, and the encoding considerations are the same as for media type *application/json* defined in IETF RFC 8259.
Security considerations		This media format is used to describe a set of objects to the MBS Transport Function to be transmitted in an MBS Distribution Session as part of an MBS User Service. This format is highly susceptible to manipulation or spoofing for attacks designed to affect the set of objects ingested by the MBSTF and transmitted to receivers. Both integrity protection and source authentication are recommended to prevent misleading of the receiver.
Interoperability considerations		The specification defines a platform-independent manifest document format, and it is intended that wide interoperability can be achieved.
Published specification		3GPP TS 26.517 clause D.1
Applications which use this media type		3GPP MBS-based applications and services
Fragment identifier considerations		The provisions of RFC 6901 (JSON Pointer) apply.
Restrictions on usage		None
Provisional registration?		No
Additional information	Deprecated alias names	None
	Magic number(s)	None
	File extension(s)	json
	Macintosh File Type Code(s)	None
	Object Identifier(s) of OID(s)	None
Intended usage		COMMON
Other information and general comments		None
Contact person	Contact name	Dongwook Kim
	Contact e-mail address	dongwook.kim@etsi.org
	Author/Change controller	3GPP TSG SA WG4

E.3.2 Version parameter

Table E.3.2-1 specifies the *version* parameter to be used with the MIME media type registered in clause E.3.1.

Table E.3.2-1: Specification of version parameter

Parameter	Value
Parameter name	*version*
Parameter value	A comma-separated list of versions of the Object Manifest schema to which the document conforms. The value specified in clause D.1 of 3GPP TS 26.517 encodes the last 3GPP release in which a change to the document schema was approved. The purpose of the parameter is to allow schema conformance to be assessed by a recipient before attempting to parse the contents of a received document.

EXAMPLE: `application/3gpp-mbs-object-manifest+json;`**`version="Rel17"`**

Annex F (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2022-02	SA4#117-e	S4-200141				Initial skeleton document.	0.0.1
2022-02	SA4#117-e	S4-220285				Revised skeleton document	0.1.0
2022-03	SA4#117-e	SP-220249				Presentation for information at SA#95-e	1.0.0
2022-04	SA4#118-e	S4-220521				S4-220570: Service Announcement specification and schemas. S4-220470: Packet Distribution Method initial specification. S4-220471: Object Distribution Method initial specification	1.1.0
2022-05	SA4#119-e	S4-220867				S4-220864: Service Announcement corrections. S4-220865: Object Distribution Method updates. S4-220866: Packet Distribution Method updates.	1.2.0
2022-06	SA#96	SP-220605				For presentation to Plenary	2.0.0
2022-06	SA#96	SP-220605				Under Change Control	17.0.0
2022-12	SA#98-e	SP-221059	0003	3	F	[5MBP3] Alignment of User Service Announcement with Stage 2	17.1.0
2023-03	SA#99	SP-230254	0006	1	F	[5MBP3] Corrections on Headings and Terms	17.2.0
2023-06	SA#100	SP-230744	0007	7	F	[5MBP3] Manifest format for Object Collection and Carousel	17.3.0
2023-09	SA#101	SP-230916	0010	3	F	[5MBP3] API for unicast retrieval of MBS User Service Announcement	17.4.0
2024-03	SA#103	SP-240272	0001	23	F	[5MBP3] General Updates and Corrections	17.5.0
2024-04	-	-	-	-	-	Update to Rel-18 version (MCC)	18.0.0
2024-05	-	-	-	-	-	Editorial fixes (MCC)	18.0.1
2024-06	SA#104	SP-240570	0014	3	F	Aggregated corrections	18.1.0
2024-06	SA#104	SP-240858	0020		F	Essential object manifest schema update	18.1.0
2024-09	SA#105	SP-241109	0021	1	A	[5MBP3, TEI18] Make radio parameters optional	18.2.0
2025-03	SA#107	SP-250141	0023	1	F	[5MBP3, TEI18] Tighten data type of service-class query parameter	18.3.0
2025-06	SA#108	SP-250693	0026	2	A	[5MBP3] MIME media type registration for object manifest	18.4.0
2025-09	SA#109	SP-250919	0033		A	[5MBP3] Update IANA MIME media type proforma	18.5.0
2025-09	SA#109	SP-250930	0030	5	F	Target Service Area Data Type in Service Announcement	19.0.0
2025-10	SA#109	SP-250931	0031	6	B	[AMD_PRO-MED] Consolidated Additions for Advanced Media Delivery	19.0.0
2025-10						Editorial correction (correction of reference "D.2" to "E.2" in Clause 5.1A	19.0.1

History

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