**3GPP TSG-SA4 Meeting #129-e *S4-241471***

**Online, , 19th Aug 2024 - 23rd Aug 2024 revision of S4aI240097**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **26.802** | **CR** | **0001** | **rev** | **2** | **Current version:** | **17.0.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | [FS\_AMD] In-session Unicast Repair for MBS Object Distribution | | | | | | | | | |
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| ***Source to WG:*** | Qualcomm Germany | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_AMD | | | | |  | ***Date:*** | | | 2024-08-12 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
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| ***Reason for change:*** | | For live and low-latency live services using the Object Distribution Method in MBS, in certain cases the transmission of an object is not successful. In this case, unicast repair for individual MBS Clients can improve the service quality. However, the timing of such requests needs to be carefully studied in order to avoid network overloads or significant latencies in the delivery. A study to extend MBS User Services and object streaming to address in-session repair is of relevance. | | | | | | | | |
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| ***Summary of change:*** | | Addresses the work item objectives for this key issue   * Documents the key issue in more detail, in particular how they relate to the 3GPP Media Delivery architecture and/or the MBS User Service architecture * Studies collaboration scenarios between the Application Service Provider and the 5G System and for each of the key topics. * Based on existing architectures, provides one or more deployment architectures that address the key topics and the collaboration models. * Maps the key topics to basic functions and develop high-level call flows. * Identifies the issues that need to be solved. * Provides candidate solutions including call flows, protocols and APIs for each of the identified issues.   Identifies gaps and recommend potential normative work for stage-2 and stage-3, including which existing specifications would be impacted and/or if any new specifications would preferably be developed. | | | | | | | | |
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| ***Consequences if not approved:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 1, 2, 3.2, 5.9 (new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | |  |  |  |  | | --- | --- | --- | --- | | [S4aI240097](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240097.zip) | [FS\_AMD] In-session Unicast Repair for MBS Object Distribution | Qualcomm Germany | Thomas Stockhammer |   **Revisions**: none  **Presenter**: Thomas Stockhammer  **Online Discussion**:   * Richard: For scenario 3, is the object compilation done in external DN. You identified a missing reference point. It is quite interesting. It is a gap. * Thomas: Yeah, there is dotted line, but no number. For post repair, it is less of an issue. For in session repair, it has to be tightly coupled   **Decision**:  [S4aI240097](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240097.zip) is **endorsed**.  This CR progresses the work and is submitted for endorsement. | | | | | | | | |

## ===== CHANGE =====

# 1 Scope

This Technical Report identifies and evaluates potential enhancements to the 5G Media Streaming (5GMS) [1] in order to provide multicast-broadcast media streaming services. It has the following objectives:

- Define scenarios where multicast ingestion or multicast distribution might be used, including potential IGMP termination options [2], [3], and [4]. Examples for such collaboration scenarios are transparent multicast delivery, multicast linear IPTV delivery, hybrid unicast/multicast (e.g. MooD or service continuity), and multicast Adaptive Bit Rate (ABR) for Over the Top (OTT) live streaming.

- Identify the relevant key issues and gaps in 5GMS to support the above scenarios based on the existing 5GS multicast architecture.

- Document architecture extensions and procedures to support the above-defined scenarios.

- Identify protocols to support the above extensions and procedures in 5GMS.

- Identify Procedures for managing downlink multicast streaming and session lifecycle.

- Select a subset of relevant scenarios that should be supported in extensions to 5G Media Streaming.

In a second revision this Technical Report identifies and evaluates a set of potential improvements and extensions, referred to as key topics. The initial set of key topics were:

- In-session Unicast Repair for MBS Object Distribution.

- MBS User Service and Delivery Protocols for eMBMS.

- Selected MBMS Functionalities not supported in MBS.

For each of the above key topics, the following objectives are identified:

1. Document the key topics in more detail, in particular how they relate to the 3GPP Media Delivery architecture and/or the MBS User Service architecture.

2. Study collaboration scenarios between the Application Service Provider and the 5G System and for each of the key topics.

3. Based on existing architectures, develop one or more deployment architectures that address the key topics and the collaboration models.

4. Map the key topics to basic functions and develop high-level call flows.

5. Identify the issues that need to be solved.

6. Provide candidate solutions including call flows, protocols and APIs for each of the identified issues.

7. Coordinate work with other 3GPP groups e.g. SA2, SA3, SA5, SA6 and others as needed.

8. Coordinate work with external organizations such as DASH-IF, CTA WAVE, ISO/IEC JTC29 WG3 (MPEG Systems), 5G-MAG, DVB or IETF, as needed.

9. Identify gaps and recommend potential normative work for stage-2 and stage-3, including which existing specifications would be impacted and/or if any new specifications would preferably be developed.

## ===== CHANGE =====

# 2 References

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

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

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

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

[1] 3GPP TS 26.501: "5G Media Streaming (5GMS); General description and architecture”".

[2] IETF RFC 2236: "Internet Group Management Protocol, Version 2".

[3] IETF RFC 4604: "Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast".

[4] IETF RFC 3376: "Internet Group Management Protocol, Version 3".

[5] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[6] 3GPP TS 23.246: "MBMS Architecture and functional description".

[7] 3GPP TR 23.757: "Study on architecture enhancements for 5G multicast-broadcast services".

[8] 3GPP TS 23.316: "Wireless and wireline convergence access support for the 5G system".

[9] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[10] 3GPP TS 23.502: "System architecture for the 5G System (5GS)".

[11] 3GPP TS 23.503: "System architecture for the 5G System (5GS)".

[12] ETSI TS 103 769: "Digital Video Broadcasting (DVB); Adaptive media streaming over IP multicast", v1.1.1, November 2020.

[13] CableLabs OC-TR-IP-MULTI-ARCH-C01: "IP Multicast Adaptive Bit Rate Architecture Technical Report", October 2016. Internet Available https://www.cablelabs.com/specifications/ip-multicast-adaptive-bit-rate-architecture-technical-report

[14] ETSI TS 103 285: "Digital Video Broadcasting (DVB); MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks".

[15] 3GPP TS 26.348: "Northbound Application Programming Interface (API) for Multimedia Broadcast/Multicast Service (MBMS) at the xMB reference point", Release 16.

[16] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and Codecs", Release 16.

[17] ATSC A/331: "ATSC Standard: Signaling, Delivery, Synchronization, and Error Protection".

[18] 3GPP TS 29.468: "Group Communication System Enablers for LTE (GCSE\_LTE); MB2 Reference Point; Stage 3".

[19] 3GPP TS 23.468: "Group Communication System Enablers for LTE (GCSE\_LTE); Stage 2".

[20] RFC 6733: "Diameter Base Protocol", October 2012.

[21] 3GPP TS 26.347: "Multimedia Broadcast/Multicast Service (MBMS); Application Programming Interface and URL", Release 16.

[22] 3GPP TS 22.146: "Multimedia Broadcast/Multicast Service (MBMS); Stage 1", Release 16.

[23] RFC 5053: “Raptor Forward Error Correction Scheme for Object Delivery”, October 2007.

[24] RFC 5445: “Basic Forward Error Correction (FEC) Schemes”, March 2009.

[25] RFC 3695: “Compact Forward Error Correction (FEC) Schemes”, February 2004.

[26] 3GPP TS 23.247, v0.1.0: "Architectural enhancements for 5G multicast-broadcast services; Stage 2;" Release 17.

[27] 3GPP TS 26.511: "5G Media Streaming (5GMS); Profiles, codecs and formats".

[28] 3GPP TS 26.512: "5G Media Streaming (5GMS); Protocols".

[26502] 3GPP TS 26.502: "5G multicast-broadcast services; User service architecture".

[26517] 3GPP TS 26.517: "5G Multicast-Broadcast User Services; Protocols and Formats".

## ===== CHANGE =====

## 3.2 Abbreviations

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

5MBS 5G Multicast/Broadcast Service

5GMS 5G Media Streaming.

ABR Adaptive Bit Rate.

AL‑FEC Application-Level Forward Error Correction

ATSC Advanced Television Systems Committee

BM-SC Broadcast-Multicast - Service Centre

CMAF Common Media Application Format

DASH Dynamic Adaptive Streaming over HTTP

DNS Domain Name Service

DVB Digital Video Broadcasting

FEC Forward Error Correction

FLUTE File deLivery over Unidirectional Transport

HLS HTTP Live Streaming

HTTP HyperText Transfer Protocol

IGMP Internet Group Management Protocol

IPTV Internet Protocol Television

ISO BMFF International Standardization Organization Base Media File Format

MABR Multicast ABR

MBMS Multimedia Broadcast/Multicast Service

MBS Multicast/Broadcast Service

MBSF Multicast/Broadcast Service Function

MBSTF Multicast/Broadcast Service Transport Function

MLD Multicast Listener Discovery

MPEG Moving Picture Experts Group

OTT Over-The-Top

RoHC Robust Header Compression

ROUTE Real-time transport Object delivery over Unidirectional Transport

TMGI Temporary Mobile Group Identity

XML Extensible Markup Language

## ===== CHANGE =====

## 5.9 Key Issue #8: In-session Unicast Repair for MBS Object Distribution

### 5.9.1 Description

Clause 4.2.6 of TS 26.502 [26502] defines object repair. However, only a post-session repair procedure is defined up to and including Release 18; in-session object repair procedures are declared as being for further study. Accordingly, clause 6.2.4 of TS 26.517 [26517] defines an object repair mechanism for FLUTE, but only a post-session repair procedure is defined in clause 6.2.4.2; in-session object repair procedures in 6.2.4.3 are for further study.

However, for live and low-latency live services using the Object Distribution Method in MBS, in certain cases the transmission of an object is not completely successful. In this case, unicast repair for individual MBS Clients can improve the service quality. However, the timing of such requests needs to be carefully studied in order to avoid network overloads or significant latencies in the delivery. A study to extend MBS User Services and object streaming to address in-session repair is of relevance.

### 5.9.2 Collaboration scenarios

Different high-level collaboration scenarios may apply:

1) Based on the collaborations in clauses A3 and A.4 of TS 26.502 [26502], objects ingested by the MBSTF at reference point Nmb8 are made available to the MBS AS within the Trusted DN. The MBS AS function may, for example, be co-located with a 5GMSd AS function.

2) Based on the collaboration in clause A.5 of TS 26.502 [26502], the MBS Application Provider provides the delivery functions, i.e. the MBS Application Provider (AF/AS) uses an MBSTF-like function to produce packet data compliant with reference point MBS-4-MC and the MBS Application Provider (AF/AS) makes object repair available from an MBS AS-like function that is compliant with reference point MBS-4-UC. The MBS AS-like function may, for example, be co-located with a 5GMSd AS-like function.

3) A mixture of 1 and 2 not yet documented in annex A of TS 26.502 [26502], for which:

- An MBS AS-like function that is compliant with reference point MBS-4-UC is provided by the MBS Application Provider (AS/AF). Objects published to the MBSTF at reference point Nmb8 are also ingested by the MBS AS-like function.

- the MBS Application Provider (AF/AS) makes object repair available from an MBS AS-like function that is compliant with reference point MBS 4 UC. The MBS AS-like function may, for example, be co-located with a 5GMSd AS-like function.

### 5.9.3 Architecture mapping

The MBS User Services network architecture in clause 4.2.2 of TS 26.502 [26502] and the MBS User Service reference architecture in clause 4.3.1.1 of [26502] apply to all collaboration scenarios described in clause 5.9.2 above.

For scenario 1,a mapping to a deployment architecture is provided in clause A.4 of [26502]. It is noted that while figure 4.2.2-1 of [26502] depicts a reference point between the MBSTF and the MBS AS, it is marked out of scope up to and including Release 18. This reference point may be more formally defined as indicated in figure 5.9.3-1.



Figure 5.9.3-1: MBS User Services network architecture highlighting the potential need for a new reference point between MBSTF and MBS AS

For scenario 2, a mapping to a deployment architecture is provided in clause A.5 of TS 26.502 [26502].

For scenario 3, a mapping to a deployment architecture is provided is provided in figure 5.9.3-2.



Figure 5.9.3-2 Deployment with MBS Application Provider (AF/AS) hosting MBS AS in External DNIn this collaboration:

- The MBS AS-like entity is not configured by the MBSF, and hence reference point MBS-9 is not instantiated.

- An equivalent of the considered MBS-NEW reference point is also not required between the MBS AS-like entity and the MBSTF.

This new collaboration scenario is not considered in the prime focus of this key issue and is not further studied.

### 5.9.4 High-level call flow

#### 5.9.4.1 Existing call flows for post-session object repair

Up to and including Release 18, TS 26.502 [26502] does not include any procedural call flows for object repair.

Clause 6.2.4.2 of TS 26.517 [26517] includes a detailed procedure for post-session object repair. For now, Microsoft Co-Pilot™ was asked to create a call flow which is provided in figure 5.9.4.1-1.



Figure 5.9.4.1-1 Call flow for post-session object repair as specified in TS 26.517 [26517], clause 6.2.4.2

Editor’s Note: The call flow lacks provisioning and ingest and needs to be updated.

#### 5.9.4.2 In-Session Call-Flow

For an in-session repair of objects, figure 5.9.4.2-1 provides a modified version of the post session repair from figure 5.9.4.1-1. In this case, MBS object delivery and repair of objects typically runs in parallel.



Figure 5.9.4.2-1 Call flow for in-session object repair

One of the crucial parts in the above call flow is the timing, when the delivery of the object is declared completed and repair procedures are initiated. If the completion is considered to early, all participants in the MBS object delivery may initiate a repair request. If it is too late, then the recovery of the object is delayed for the application.

Secondly, parallel execution of distribution and repair may be achieved using broadcast reception concurrently with unicast uplink repair requests and downlink reception of repair data. In case the MBS User service made available via a Receive-Only Mode system (for example MBMS-ROM or via Non-Terrestrial Network), the MBS Client may even require use of multiple Radio Access Networks at the same time.

### Editor’s Note: Provisioning, Ingest, Distribution, Repair are now interleaved.5.9.5 Gap analysis and requirements

The following aspects are identified to be missing:

1) Formal definition of a reference point between the MBSTF and the MBS AS in order to publish objects to the MBS AS for the purpose of object repair.

2) Reliable signalling from the MBSTF to the MBS Client via reference point MBS-4 of when the delivery of an object is completed.

3) Signalling from MBSTF to MBS Client via reference point MBS-4 when the object needs to be released to the application.

4) The execution of parallel MBS object delivery and repair.

Editor’s Note: More issues are expected to be identified.

### 5.9.6 Candidate Solutions

Editor’s Note: Provide candidate solutions including call flows, protocols and APIs for each of the identified issues.

### 5.9.7 Summary and Conclusions