**SA WG2 Meeting # S2-20xxxxx**

**Source: Apple**

**Title: Solution for Key Issue #7: Reliable delivery mode switching between unicast and multicast**

**Document for: Approval**

**Agenda Item: x.x**

**Work Item / Release: FS\_5MBS / Rel-17**

*Abstract of the contribution: This contribution proposes a solution for Key Issue #7: Reliable delivery mode switching between unicast and multicast.*

# 1. Introduction

This solution is proposed for Key Issue #7 to study *Reliable delivery mode switching between unicast and multicast*.

The following aspects will be studied:

- Triggers for delivery mode switching in 5GS.

- How delivery mode switching between unicast and multicast modes is performed in the 5GS (including the UE) while supporting service continuity.

**\* \* \* \* First Change \* \* \* \***

## 6.0 Mapping of solutions to key issues

Editor's note: This clause describes the mapping between solutions and key issues.

Table 6.0-1: Mapping of solutions to key issues

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Key Issues | | | | | | | | |
| Solutions | 1  MBS session management | 2  Service levels definition | 3  Levels of authorization for MC | 4  QoS for MC and BC | 5  BC TV and Radio services | 6  Local MBS | 7  MC-UC delivery mode switch | 8  BC-UC delivery method switch | 9  IWK with EPC/eMBMS for Public Safety |
| 1 |  | x |  |  |  |  |  |  |  |
| 2 | x |  |  |  |  |  |  |  |  |
| 3 | x |  |  |  |  |  |  |  |  |
| 4 | x |  |  |  |  |  |  |  |  |
| 5 | x |  |  |  |  |  |  |  |  |
| 6 | x |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  | x |  |  |  |
| X |  |  |  |  |  |  | x |  |  |

**\* \* \* \* Next Change (All new text) \* \* \* \***

## 6.X Solution #X: Reliable delivery mode switching between unicast and multicast based on threshold counter

### 6.X.1 Architectural requirements

This solution addresses KI#6 "Reliable delivery mode switching between unicast and multicast".

MSF (Multicast Session Function) with control plane and user plane instances can be used to handle the application session function for MBS requirements. This NF for MBS services may be a separate entity that provides multicast session for efficient transmission of one to many MBS session to UE in 5G network. Further, RAN node may be used to start or stop the multicast session to UE(s).

Editor’s Note: RAN impacts shall be studied in RAN WGs.

The control of content to be provided using unicast/multicast session and enablement/disablement of services may reside with UE MBS application, which may directly contact MSF for collecting information related to MBS Session. The control plane part of the network enables SMF to create/modify/delete the session for multicast services with the policies provided by PCF for the session.

Multicast/Broadcast services might be provided to UE(s)/groups within a RAN Notification Area, Tracking Area or Registration Area depending upon the count of active UEs on the application and/or request of the same content or channels.

The following is the reference architecture:

AF/MSF-C

MSF-U

N5/Nnef

N7

PCF/NEF

N11

SMF

AMF

Content Provider

N4

N2

N1

N6

N3

RAN

UPF

UE

Figure: 6.X.1-1: MBS Architecture (AF as MSF-C)

MSF-C is expected to behave as an AF for content mode switching and delivery requirements connected with NEF/PCF via N5/Nnef interface, thus enabling the function to perform operation from TS 23.502 [8] clause 4.15.6.7.

Triggers to start multicast session may be aligned but not limited to counters at MSF and SMF, UE policies for session and QoS requirements for session delivery and UE subscription.

### 6.X.2 High Level Description

- PDU Session is active for content delivery from MSF to 5GC. Content can be delivered via unicast PDU session to UE(s) or multicast using RAN.

- Multicast Start request: UE originated request to switch mode of delivery from unicast session to multicast (as per active multicast session information from MSF to MBS application).

- Multicast Stop request: UE MBS application may be stopped or requesting access to different content than that was available with multicast, and switch to unicast delivery mode.

- Counters at SMF and MSF signify that when count of UE(s), within an area, accessing the same content are increased over threshold, the content is moved to multicast delivery and vice versa. This ensures efficient content delivery by switching mode of delivery.

### 6.X.3 Procedures

The triggers and counters at UE and MSF can be used to initiate the switch between unicast and multicast. Figure 6.X.3.1 describes the detailed procedure.

Content Provider

UE

1.Unicast or multicast session ongoing with MSF/Content Provider on active PDU Session

PCF

RAN

AMF

UPF

SMF

MSF

2. MBS Availability Info

Ongoing MBS Session Information

3. Trigger at UE MBS Application

5. Notification

Session Update, TMGI, PDU Session ID

4. Multicast Start/Stop Request (IGMP/MLD)

TMGI, Session ID, SUPI

9. Session Start/Stop Response

Session ID, TMGI

6. Counter for UE count to switch delivery mode between unicast & multicast PDU

7. Session Start/Stop Request

Session ID, TMGI, UE count

8. Counter for UE accessing same content to switch delivery mode between unicast & multicast

10a. N2 message transfer to RAN for Multicast Session Start/Stop Request

10b. PDU Session create/modify for switch between Unicast & Multicast session with UE

11. AF/MSF initiated Policy modification/association for Multicast Session with UE as 23.502 clause 4.15.6.7

**Figure: 6.X.3-1: Delivery mode switch between unicast and multicast**

Solid line messages are control plane messages and dashed line messages are user plane message transfer over current PDU session.

1. Initially, either unicast or multicast session may be ongoing between UE and Content provider. MBS application on UE is connected via user plane and accessing contents.

2. MBS Availability Information about the current ongoing multicast sessions in the network, including session ID and other related information, is shared with UE MBS application.

NOTE 1: MBS Availability Information when received on UE MBS application may be used to trigger request to switch between multicast and unicast depending upon the requirements and policies for the active session(s).

3. UE checks whether any trigger conditions are met, to initiate delivery mode switch request.

NOTE 2: The trigger conditions may be (but not limited to) UE MBS subscription changes, QoS requirements for multicast session, handover or reselection to target RAN supporting or not supporting MBS, user switching MBS application to view multicast channel/content, user switching off the MBS application to stop multicast session, or any other policy exceptions.

4. UE sends Multicast Session Start/Stop request to UPF for current TMGI, Session ID and SUPI on user plane.

5. UPF forwards the request over N4 interface to SMF.

6. SMF has predefined threshold count for minimum count of UEs in unicast session required to start delivery through multicast session and similarly, if the count moves below a threshold, switch delivery mode to unicast PDU session for content delivery.

NOTE 3: The thresholds can be part of initial policy created at PCF or updated by AF/MSF-C by process similar to step 11.

7. SMF forwards the Session Start/Stop request to MSF-C with session ID.

8. MSF checks whether the count of UEs subscribed and utilizing the same content is over a certain threshold. For efficient content delivery, the counters are set at predefined value which may be changed in DNN.

9. In case the UE count is lower than a threshold, MSF may send Session Stop Request, or else if the count is higher than a threshold within a Registration/Tracking/RAN area, it will forward the Session Start request to respective SMF.

10a. SMF forwards the N2 message via AMF to RAN to Start/Stop the multicast session for the current session ID in RNA.

10b. UE or network-initiated PDU session create/modify request depending upon the node initiating the request for delivery mode switch between multicast and unicast.

11. MSF may initiate policy update depending upon the subscription and content delivery using procedure from TS 23.502 [8] clause 4.15.6.7.

NOTE 4: Delivery mode switch requires timely counter update and sync between nodes to ensure that session count and delivery nodes are kept updated.

### 6.X.4 Impacts

**AF:** MSF-C performs the operation of AF for efficient content delivery.

**SMF/MSF:** Keeps counter for current active UEs in multicast PDU session within respective coverage area (RNA, TA, RA).

**UPF:** UPF shall be able to send the Notification of user plane request from UE to respective SMF over N4 interface.

**RAN:** Switching the multicast session on SMF N2 request forwarded from AMF.

### 6.X.5 Solution evaluation

**\* \* \* \* End of Changes \* \* \* \***