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**Title: Multicast session start/stop/update procedure**

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*Abstract of the contribution: Multicast session start/stop/update procedure.*

# 1 Introduction

This paper proposes procedure of Multicast session start/stop/update.

# 2 Discussion

In order to make it better to understand the detail procedure, the following figure shows a high level view for session start/stop/update:

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Considering UE may move in idle state before session start or after session stop, the MB-SMF shall command SMF to page the UEs.

For mobile internet environment, following facts need to be considered:

1). The mobile server/client may have its own member management functions, which does not relies on IGMP/MLD, and it is the major way for APP to interact with server, which can provide more fruitful UI and information to user.

2) It is not mandatory for Application Client to send IGMP/MLD data for receiving multicast data (e.g. static multicast tree configuration, mobile internet environment, same IP domain environment, etc.). Especially in mobile internet environment, the multicast tree is configured via 3GPP protocol, which also can be setup according to AF requests. For flexibility in mobile internet environment, 5GC needs to allow mobile APP to not send IGMP/MLD data or TMGI, which will not trigger the modem to send NAS Session Join message.

3) In most cases, there will be only one foreground APP running on UE, the APP does not need to consider multicast data receiving by multiple APPs for multiple multicast sessions simultaneously, hence when the mobile APP is a foreground APP, it may only monitor data arrival from a listening socket binding with any IP address as destination, the AF IP as source, and a listening port number, in this case, the mobile APP may not need to know the IP multicast address. This is also based on the fact that <source IP=AF IP, source port=any port, dest IP=any IP, dest port=listening port> also can be used to identify a MBS session.

To make the 5MBS feature easy to be deployed, besides of providing authorization information to 5GC, the 5GC shall support AF requesting update an active multicast session with establishing resources for some new members or releasing resources for some removed members.

**Proposal 1: During multicast session update procedure, AF can command to establish resources for some new members or release resources for some removed members.**

Considering that MBS has not been commercially deployed, if the system needs lots of upgrading [for the intial deployment of 5MBS, it will hamper the deployment](http://www.baidu.com/link?url=VvZ9MGyMJCAu3983mh7XYu1AKEypekeKemkAp9JPNhq96ypGce-5BBusn6weXAUwk2OyM3J3BU-NkI7KVkq4UefKlx1XzHbRQ_wZGk35ETmm-FjrFeZXDdrLoOwvjpRL). If the initial deployment of the 5MBS only needs upgrading limited number of AMF, SMF, and NEF, it will be easier for operator to initially deploy 5MBS for public.

We have studied to use PDU Session for multicast data delivery, which does not impact RAN node, if UE also can be legacy to receive multicast data via PDU Session, then we can archive the extreme simple 5MBS system deployment.

To archive the extreme simple 5MBS system, it is proposed to support AF requested member join/leave as described above. With this option, UE can join a multicast session via application layer, and 5GC performs multicast tree building, paging, and PDU Session modification procedure with the UEs.

The extreme simple deployment for 5MBS still is different from IPTV feature because the PDU Session in IPTV supports UP join due to the fixed deployment of NG-RG, while the extreme simple deployment for 5MBS needs dynamic

**Proposal 2: UE triggered session join/leave is not mandatory to be used.**

For the sake of configuration simplicity, the current example call flow assumes 5GC is unaware of the 5MBS capability of each RAN node, the AMF delivers the enhanced N2 message to RAN node and RAN node handles the enhanced N2 message based on its capability.

Considering that dedicated paging is needed for session start when UE moves to legacy RAN node, the AMF needs to know the RAN capability for page and start notification delivery. The 5MBS capability of RAN nodes can be preconfigured in AMF or can be dynamically recorded during MBS session operations.

**Proposal 3: For the sake of configuration simplicity, 5GC is able to dynamically manage the 5MBS capability of RAN nodes, which may result in delivering two types of N2 message to the RAN node.**

# 3 Proposal

It is proposed to approve following changes with the adoption of the following proposals:

**Proposal 1: During multicast session update procedure, AF can command to establish resources for some new members or release resources for some removed members.**

**Proposal 2: UE triggered session join/leave is not mandatory to be used.**

**Proposal 3: For the sake of configuration simplicity, 5GC is not preconfigured with RAN capability information, and may deliver N2 message without considering whether the RAN node support 5MBS.**

\* \* \* \* First change \* \* \* \*

### 7.1.3 Multicast session (re)start/stop/update procedure

#### 7.1.3.1 General

The following figure shows the high level view of the multicast session (re)start/stop/update procedure:

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**Figure 7.1.3.1-1: High level view of multicast session start/stop/update procedure**

The session (re)start operation is triggered by AF via control plan or by MB-UPF via user plan when data arrival, which triggers the 5GC to notify all joined members in group or individually for establishing multicast data transmission resources towards them.

The session stop operation is triggered by AF via control plan or by MB-UPF via user plan when no data detected, which triggers the 5GC to release multicast data transmission resources towards all joined members.

The session update operation is triggered by AF via control plan. The difference from the configuration procedure as described in clause 7.0.1 is that it is only for an active multicast session, which means the multicast session has started. There're two kinds of session update operation: with or without joined member change. This clause describes the session update operation without joined member change, which triggers the 5GC to update QoS parameters for the multicast data transmission resources towards all joined members.

#### 7.1.3.2 Information flow

The following call flow depicts the multicast session start/stop/ update procedure. The SMF and MB-SMF can be identical, and the UPF and MB-UPF can be identical.

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**Figure 7.1.3.2-1: Multicast session start/stop/update procedure**

1. [Optional] The content provider may send a request to start/stop (i.e. activation/deactivation) a multicast session, or send a request to update an activated multicast session to the NEF (MBSF) as described in clause 7.0.1.

2. [Optional] The MB-UPF may detect data arrival or no data.

3. [Optional] The MB-UPF may report data arrival or no data to the MB-SMF according to the configuration from the MB-SMF. The report of data arrival is treated as multicast session start, and the report of no data is treated as multicast session stop.

4. [Optional] The MB-SMF performs following:

- For updating an active multicast session with QoS requirements change, where the PCF is triggered to update the QoS parameters towards the MB-SMF for the multicast session, the MB-SMF invokes Namf\_Communication\_NonUeN2MessageTransfer (RAN node list, N2 SM container (Multicast Update request (MBS Session ID, MB-SMF ID, multicast QoS flow information))) towards the AMF that can interact with the RAN node in the RAN node list to update the resources for 5GC Shared MBS traffic delivery method.

- For stopping a multicast session, the MB-SMF invokes Namf\_Communication\_NonUeN2MessageTransfer (RAN node list, N2 SM container (Multicast Release request (MBS Session ID, MB-SMF ID))) towards the AMF that can interact with the RAN node in the RAN node list to release the resources for 5GC Shared MBS traffic delivery method.

5. The MB-SMF retrieves the SMFs of the MBS Session from the multicast session context (root) managed by the MB-SMF and performs following:

- For (re)starting a multicast session that already has joined members, invokes Nsmf\_MBSession\_Update (MBS Session ID, multicast QoS flow information, N2 SM container (Multicast Create request)) towards the SMFs. The N2 Multicast Create request is same as described in step 4.

- For updating an active multicast session with QoS requirements change, invokes Nsmf\_MBSession\_Update (MBS Session ID, multicast QoS flow information) towards the SMFs to update the resources of the PDU Sessions related to the multicast session that are used or intend to be used for 5GC Individual MBS traffic delivery method.

- For stopping a multicast session, invokes Nsmf\_MBSession\_Release (MBS Session ID) towards the SMFs to release the resources of the PDU Sessions related to the multicast session that are used or intend to be used for 5GC Individual MBS traffic delivery method.

6. The SMF obtains the binding information of the multicast session, which include PDU Session IDs and SUPIs. Depends on the requested operation, the SMF generates the QoS flow information for the PDU Sessions with consideration of the received multicast QoS flow information, or without consideration of the stored multicast QoS flow information related to the multicast session.

The SMF performs following for transmission resources management:

- The SMF invokes Namf\_Communication\_N1N2MessageTransfer (SUPI, N2 SM container (Session Modification request (PDU Session ID, QoS flow information, MBS Session ID, [dedicated unicast QFIs related to multicast], [mapping information between unicast QFI and multicast QFI])) towards the AMF per the served member for PDU Session modification.

- For session (re)start, the SMF also invokes Namf\_Communication\_N1N2MessageTransfer (SUPI, N2 SM container (Multicast Create request (MBS Session ID, MB-SMF ID, multicast QoS flow information, [LL MC address, common DL tunnel ID]))) towards the AMF per the served member to establish multicast session resources for the UEs.

The dedicated unicast QFIs related to multicast is used to aid the RAN node for the N3 resource reservation for the associated PDU Session.

Editor’s note: The mapping information between unicast QFI and multicast QFI is used for forwarding multicast traffic during handover from source gNB supporting 5MBS to target gNB not supporting 5MBS, whether to include the mapping information in the N2 SM information is determined during normative work according to the conclusion of RAN WG for the forwarding issue.

7. The AMF performs following to handle the N2 SM container related to 5MBS:

- If it is not related to a specific UE (i.e. N2 Multicast Update/Release request), the AMF delivers it to the RAN node as required.

- If it is N2 Multicast Create request related to a specific UE, the AMF forwards it to the RAN node based on the 5MBS capability of the RAN node. The AMF shall be able to deliver the N2 Multicast Create request to the RAN nodes that the UE possibly camps on.

- If it is N2 Session Modification request (related to a specific UE), when the UE is in idle state, the AMF sends page message to the RAN node based on the 5MBS capability of the RAN node. The RAN node pages the UE.

The AMF is aware of the 5MBS capability of RAN nodes after receiving the N2 Multicast Create response, which includes MB-SMF ID.

NOTE 1: The 5MBS capability of RAN nodes can be preconfigured to the AMF.

8. [Optional] When the N2 Multicast Create request is received, and the multicast session is not on-going in the 5MBS capable RAN node, the RAN node performs the access network session start notification.

Editor’s note: The details of access network session start notification and access network resource modification should be studied in the RAN WGs.

9. [Optional] If the UE is in idle state, the UE performs Service Request procedure to transit into connected state when receiving page message, the UE may perform Service Request procedure to transit into connected state for obtaining the access network resource information for the multicast session after receiving the access network session start notification.

NOTE 2: For updating an active multicast session with QoS requirements change or stopping a multicast session, the AMF does not page the UE.

Editor’s note: Whether UE shall perform SR after receiving session start notification in RRC-IDLE state is FFS.

10. If the UE is in connected state, the AMF forwards the N2 Session Modification request to the RAN node.

11. The RAN node performs following for access network resources management:

- When N2 Multicast Create request is received, which is related to a specific UE, if the RAN node supports 5MBS and does not have transmission resources for the multicast session, when interesting indication of the multicast session is received, the RAN node performs the necessary access network resource establishment such as configuration of PTP or PTM bearers for establishing resources for the multicast session.

- When N2 Multicast Update request is received, which is not related to a specific UE, the RAN node performs the necessary access network resource modification for updating resources of the multicast session.

- When N2 Multicast Release request is received, which is not related to a specific UE, the RAN node performs the necessary access network resource modification for removing resources of the multicast session and the context related to the multicast session. If multicast transport for multicast sessions is used, the RAN node leaves the multicast tree of the multicast session.

- When N2 Session Modification request is received and the RAN node does not support 5MBS, the RAN node configures bearers for the associated PDU Session to add/update/remove resources for the multicast session.

12. [Optional] The RAN node performs following for shared N3 resources management:

- For N2 Multicast Create request, when the RAN node supports 5MBS and has not signalled a N2 Multicast Create response for the multicast session to the MB-SMF via an AMF, the RAN node signals a N2 Multicast Create response (MB-SMF ID, N2 SM container (MBS Session ID, RAN node ID, [DL tunnel information])) towards the AMF. If the RAN node is configured to use a unicast transport for multicast sessions, it allocates a DL tunnel ID (a GTP-U TEID) for receiving data of the multicast session, and includes the DL tunnel information (IP address of the RAN node and the DL tunnel ID) in the response.

- For N2 Multicast Update request, the RAN node signals a N2 Multicast Update response (MB-SMF ID, N2 SM container (MBS Session ID, RAN node ID)) towards the AMF.

- For N2 Multicast Release request, the RAN node signals a N2 Multicast Release response (MB-SMF ID, N2 SM container (MBS Session ID, RAN node ID)) towards the AMF.

13. [Optional] The AMF performs following for shared N3 resources management:

- If N2 Multicast Create response is received, the AMF invokes Nsmf\_MBSession\_CreateSMContext (SUPI, N2 SM container) towards the MB-SMF according to the received MB-SMF ID. The MB-SMF adds the <RAN node ID, [DL tunnel information]> in the multicast session context (root), and if multicast transport is used, increases the count of UP node by 1.

- If all the N2 Multicast Update responses are received, the AMF invokes Nsmf\_MBSession\_UpdateSMContext (SUPI, N2 SM container) towards the MB-SMF according to the received MB-SMF ID to confirm the update.

- If all the N2 Multicast Release responses are received, the AMF invokes Nsmf\_MBSession\_ReleaseSMContext (SUPI, N2 SM container) towards the MB-SMF according to the received MB-SMF ID. The MB-SMF removes the RAN node ID and corresponding DL tunnel information if exists in the multicast session context (root), and if multicast transport is used, decreases the count of UP node by 1.

14. The RAN node performs following for PDU Session resource management if N2 Session Modification request is received:

- The RAN node sends the N2 Session Modification response (PDU Session ID, N2 SM container ([MBS Session ID])) towards the AMF. If the RAN node supports 5MBS, the response includes the MBS Session ID and the RAN node reserves N3 resources for the PDU Session without consideration of those QoS flows indicated by the dedicated unicast QFIs related to multicast if received.

15. If N2 Session Modification response is received, the AMF invokes Nsmf\_PDUSession\_UpdateSMContext (SUPI, N2 SM container) towards the SMF. When MBS Session ID is included in the N2 SM container, the 5GC Shared MBS traffic delivery method is/was used and the SMF reserves N3 resources for the PDU Session without consideration of those QoS flows indicated by the dedicated unicast QoS flows related to multicast if sent. When MBS Session ID is not included in the N2 SM container, the 5GC Individual MBS traffic delivery method is/was used.

16. [Optional] The SMF performs following for N9 tunnel resources management:

- For (re)starting a multicast session, this step is same as step 20 in clause 7.1.1.2 with the following differences:

- If Nsmf\_MBSession\_Update is invoked, the SMF always responses (MBS Session ID, [node status], [DL tunnel information]) towards the MB-SMF. The node status is included to indicate "UP node join" if UPF joins the multicast tree of the multicast session when multicast transport is used.

- For updating an active multicast session with QoS requirements change, when the QoS information of all the PDU Sessions served by the SMF that are used for the 5GC Individual MBS traffic delivery method has been modified, the SMF responses the Nsmf\_MBSession\_Update with (MBS Session ID) towards the MB-SMF to confirm the update. If the SMF does not serve PDU Session that is used for the 5GC Individual MBS traffic delivery method, the SMF immediately responses.

- For stopping a multicast session, this step is same as step 17 in clause 7.1.2.2 with the following differences:

- The SMF always responses Nsmf\_MBSession\_Release with (MBS Session ID, [node status], [DL tunnel information]) towards the MB-SMF.

- The node status does not indicate "CP node leave" if included.

17. The MB-SMF performs following for transmission resource management:

- For (re)starting a multicast session, this step is same as step 21 in clause 7.1.1.2.

- For updating an active multicast session with QoS requirements change, when the all the confirmation from SMF and AMF are received, the MB-SMF configures the MB-UPF to update the transmission resources for the multicast session.

- For stopping a multicast session, this step is same as step 18 in clause 7.1.2.2.

18. [Optional] This step is same as steps 23-25 in clause 7.1.1.2.

### 7.1.3a Multicast session update with AF requested member join procedure

#### 7.1.3a.1 General

The following figure shows the high level view of the multicast session update with AF requested member join procedure:

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**Figure 7.1.3a.1-1: High level view of AF requested member join procedure**

The session update operation with new members join request is triggered by AF for an active multicast session, which triggers the 5GC to notify the new members in group or individually for establishing multicast data transmission resources towards them. This operation may be performed with session start.

#### 7.1.3a.2 Information flow

The following call flow depicts the multicast session update procedure with AF requested member join.

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**Figure 7.1.3a.2-1: Multicast session update procedure with AF requested member join**

1. The content provider requests updating an active multicast session to establish multicast session resources towards new members.

2. The MB-SMF checks whether the UE has joined the multicast session, if yes then stop the procedure. The MB-SMF authorize the members with UDM as described in step 3 of clause 7.1.4. The MB-SMF may retrieve QoS profile from PCF.

3. The MB-SMF obtains serving AMF for the new members from UDM and invokes Namf\_Communication\_N1N2MessageTransfer (SUPI, N2 SM container (Multicast Create request (MBS Session ID, MB-SMF ID, multicast QoS flow information, [LL MC address, common DL tunnel ID])), N1 SM container (MBS Session Join CMD (MBS Session ID))) towards the AMF per the new member.

4. This step is the same as steps 6-7 and 9-10 in clause 7.1.1.2 for PDU Session binding with the following differences:

- The AMF interacts with the MB-SMF in step 3, which serves the MBS Session.

5. [Optional] This step is the same as steps 7-15 related to session (re)start in clause 7.1.3.2 for AN and N3 resources management with the following difference:

- The AMF also provides MBS Session Join CMD to the UE when UE is in connected state.

6. [Optional] This step is same as steps 20-25 in clause 7.1.1.2 for N9 tunnel resources management and data transmission.

### 7.1.3b Multicast session update with AF requested member leave procedure

#### 7.1.3b.1 General

The following figure shows the high level view of the multicast session update with AF requested member leave procedure:

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**Figure 7.1.3b.1-1: High level view of AF requested member leave procedure**

The session update operation with members leave request is triggered by AF for an active multicast session, which triggers the 5GC to release PDU Session resources related to the multicast session towards the leaved members if used or intend to be used, and decrease the user count towards the RAN node serving the removed members if they are in connected state.

#### 7.1.3b.2 Information flow

The following call flow depicts the multicast session update procedure with AF requested member leave.

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**Figure 7.1.3b.2-1: Multicast session update procedure with AF requested member leave**

1. The content provider requests updating an active multicast session to release multicast session resources towards removed members.

2. The MB-SMF obtains serving SMFs for the removed members, e.g. based on the multicast session context (root) and the information obtained from UDM, and invokes Nsmf\_MBSession\_Release (MBS Session ID, SUPIs, N2 SM container (Multicast Release request (MBS Session ID, MB-SMF ID))) per the SMF.

3. [Optional] This step is same as step 6 in clause 7.1.3.2 with the following differences:

- The SMF only obtains the binding information related to the removed members.

- The invocations are per removed member and the N2 SM container is for update resources for 5GC Shared MBS traffic delivery method.

- If the PDU Session will not bind any MBS Session after the leaving, the disassociating indicator is included in the invocation

4. When the UE is in idle state, the AMF waits the UE to be connected.

5. If the UE is in connected state, the AMF forwards the N2 Multicast Release request to the serving RAN node for indicating a UE leaving to the RAN node.

6. If the UE is in connected state, the AMF forwards the N2 Session Modification request to the RAN node for updating resources of the associated PDU Session.

7. The AMF provides MBS Session Leave CMD to the UE when UE is in connected state.

8. This step is same as step 12-15 in clause 7.1.2.2 for AN and N3 resources management.

9. [Optional] This step is same as step 17 in clause 7.1.2.2 for individual delivery management with the following differences:

- The SMF always responses with (MBS Session ID, [node status], [DL tunnel information]) towards the MB-SMF.

10. [Optional] If the response includes DL tunnel information (i.e. unicast transport is used), the MB-SMF configures MB-UPF to stop data forwarding to the destinations (UPF or RAN node) corresponding to the received DL tunnel information. If the last node leaves the multicast tree of the multicast session, the MB-SMF configures MB-UPF to stop transmission of the data for the multicast session, and the MB-SMF may also configure the MB-UPF to leave the multicast tree towards the content provider.

\* \* \* \* End of changes \* \* \* \*