**SA WG2 Meeting #143E S2-2101017**

**Electronic meeting, Feb 24 – Mar 09, 2020** *(Revision of S2-210nnnn)*

**Source: Nokia, Nokia Shanghai Bell**

**Title: KI#1: Conclusion update for MBS Session activation/deactivation and UE join/leave**

**Document for: Approval**

**Agenda Item: 8.9.1**

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

*Abstract of the contribution: This contribution updates the conclusions for key issue 1 to answer related RAN questions and clarify the session activation and deactivation*

# 1 Discussion

**Problem**

The meaning of terms “start/activation” and “stop/deactivation” is not clear in the conclusions for KI1 of TR 23.757, This is reflected in the following Note:

*NOTE 5: Whether the terms "stop/deactivated" or "start/activation" denote the same actions needs to be further clarified.*

There are also the following related Notes and editor´s notes:

*NOTE 4: Whether the MBS QoS flow need be removed from the MBS Session context is to be decided in normative phase.*

*Editor's note: Coordination with RAN WGs are needed.*

RAN2 and RAN3 also asked for related clarifications in their liaison statement. This document provides further discussion on the issue of multicast session activation and deactivation. Furthermore, UE join and leave operations should be also clarified considering RAN2 feedback.

From [**S2-2100142**](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_143e_Electronic/Docs/S2-2100142.zip) (Reply LS from RAN 2 on 5MBS progress and issues to address (R2-2102480)):

|  |
| --- |
| **RAN2 response:**  RAN2 assumes that in case the UE which joined the multicast session is in RRC CONNECTED state when the session is started, the gNB sends RRC Reconfiguration message with relevant MBS configuration to the UE and there is no need for separate session start notification for this UE. It is not clear whether the same should apply for session activation. To resolve this issue, RAN2 would like to request a clarification from SA2 about whether and what the difference is between a session start and session activation and between a session stop and session deactivation.  RAN2 has not yet discussed how the UEs in RRC IDLE and RRC INACTIVE states are notified of the multicast session start (and/or activation) and RAN2 will inform SA2 once the progress on that aspect is made. |

From **[S2-2100110](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_143e_Electronic/Docs/S2-2100110.zip" \t "_blank)** (Reply LS from RAN3 on 5MBS progress and issues to address (R3-211296)):

|  |
| --- |
| 1. *Editor's note: How the NG-RAN node notify session activation to UEs relies on RAN WG feedback.*   **RAN3 feedback:** To progress this topic, RAN3 would like to ask SA2 to clarify the differences between the following terms: session start/session activation and session deactivation/session stop and their implication to NG-RAN functions.  RAN3 also deduces from the TR that a UE may be in any CM/RRC state at MBS Session activation/start.  Further, RAN3 would like to ask for confirmation from SA2 whether a UE is supposed to receive the MBS Session activation notification also when served by a non-supporting NG-RAN node.  RAN3 would like to ask RAN2 and SA2 to consider how to page the UEs which are not in RRC\_CONNECTED state, whether a group notification towards NG-RAN supporting MBS and, if applicable, to NG-RAN nodes not supporting MBS is needed/feasible/beneficial comparing to the legacy paging methods. |

**Clarification of terms**

The AF can include an indication in the Multicast Session Request (step 1 in Figure 8.2.3-2) whether the requested multicast session shall be established in an active stated or an inactive state. For instance, the AF may request a TMGI for a service announcement and provide no other information about the multicast session before it activates the multicast session (compare with MB2 TMGI request). The AF may also request that a multicast session is established in inactive state before it starts the data transmission, for instance to allow UEs to already join. When the AF requests a TMGI or a multicast session to be established in the inactive state, then the AF can send a separate request to activate the multicast session, or it can provide a start time to indicate when the 5GS shall activate the multicast session. A multicast session can also be established based on configuration or the first UE requesting to join the multicast session.

The AF can decide that a multicast session is terminated and then request the 5GS to release all related resources. The AF can either send an explicit request or provide a release time at an earlier stage. It is proposed to call the relating 5GS procedure "MBS session release"

A multicast session can be activated or deactivated upon

- an AF request; or

- an indication of user plane activity or inactivity from MB-UPF.

Current procedures toward RAN and UE differ between those cases, which would introduce extra states and complexity. It is proposed to remove those differences.

It also needs to be further clarified what happens when a UE joins a multicast session that was established but is in the inactive state. The UE may not be aware of the state of the multicast session when it joins, so it seems reasonable to allow UEs to join an MBS session also when it is inactive.

To sum up. the following procedures and states are proposed:

- **Configured multicast session**: No multicast data are transmitted. Information about the multicast session is configured, but no resources are reserved. No UEs are allowed to join.

- **Active multicast session**: Multicast data are transmitted to UEs that joined the multicast session. Corresponding Radio resources are reserved depending on participating UE locations. UEs that joined the multicast session are in CM CONNECTED state. UEs are allowed to join the multicast session (subject to authorization check).

- **Inactive multicast session**: No multicast data are transmitted. No Radio resources are reserved. UEs that joined the multicast session may be in CM CONNECTED or CM IDLE state. UEs are allowed to join the multicast session (subject to authorization check).

- **Multicast Session configuration**: The AF can provide information about the multicast session and/or request the allocation of an TMGI. The configuration may be combined with establishment and activation.

configuration and/or If the establishment is not combined with the activation.

- **Multicast Session Activation**: State transition from inactive to active multicast session. CM IDLE UEs that joined the multicast session are paged. Radio resources are reserved.

- **Multicast Session Deactivation**: State transition from active to inactive multicast session. Radio resources are released.

- **Multicast Session Release**: All resources for the multicast session are released in an irreversible manner in both 5GC nodes and RAN nodes, UEs the joined the multicast session are notified. The release is possible for an active or inactive multicast session. The Release may be combined with the deconfiguration of a multicast session

- **Multicast Session Deconfiguration**: All information about the multicast session is removed from the 5GC and TMGIs are deallocated.



**Multicast session activation**

After the MB-SMF receives the trigger to re-activate the MBS session, we see three major approaches to implement the re-activation of idle mode UEs mostly depending on the type of paging used as described below:

**Option 1**: individual paging

The MB-SMF identifies the SMF(s) involved in the MBS session and sends an Activate message to each of these SMFs.

**Variant 1a** (If multicast QoS flows are maintained in PDU session at MBS session deactivation):

Each SMF identifies the deactivated MBS-related PDU sessions and triggers individual PDU session request messages to the AMF. The AMF identifies that the involved UE is idle and retrieves its registration area (RA). The AMF pages this individual UE. UE replies with service request to get connected. The PDU session is setup again.

**Variant 1b** (If multicast QoS flows are removed in PDU session at MBS session deactivation):

Each SMF identifies all MBS-related PDU sessions. For deactivated PDU session the SMF sends individual PDU session request messages to the AMF. If the AMF identifies that the involved UE is idle and retrieves its registration area (RA). The AMF pages this individual UE. UE replies with service request to get connected. The PDU session is setup again. For active PDU session the SMF sends PDU session modification request messages adding multicast Qos flows.

**Option 2**: group paging over RA

The MB-SMF identifies the SMF(s) involved in the MBS session and sends an Activate message to each of these SMFs. Each SMF identifies the deactivated MBS-related PDU sessions and the corresponding list of idle UEs. Each SMF sends an Activate message to the AMF including the list of idle UEs. The AMF determines a group paging area corresponding to the union of the involved RAs and triggers a group paging (paging with group identifier) to this group paging area. Involved UE replies with service request to get connected. The PDU session is re-activated.

**Option 3**: group paging over SA (irrespective of UE location)

The MB-SMF knows the MBS Service Area associated with the MBS session and sends an Activate message toward the AMF including the MBS Service Area. The AMF triggers a group paging (paging with a group identifier) over this service area. Involved UE replies with service request to get connected. The PDU session is re-activated.

Option 3

Option 2

Option 1

AMF

MB-UPF

UE

SMF

MB-SMF

**Service Request**

List of SMFs in context or from UDR

**MBS Activate (MBS session ID + mcast qos info)**

**PDU session Setup Req (MBS session ID)**

**MBS activate**

**Paging UE id**

NG-RAN

**MBS data delivery**

**Group Paging (all RAs)**

AF (NEF)

**MBS activate**

**N\_smf-update (PDU session activate)**

**Activate list of UEs**

**PDU session Setup Req (MBS session ID)**

Identification of UEs with deactivated PDU sessions

**Service Request**

**PDU session Setup Req (MBS session ID)**

Identification of UEs with deactivated PDU sessions

**MBS Activate (MBS session ID + mcast qos info)**

Timer Expiry

**MBS activate (MB session id, SA)**

**Group Paging (all RAs)**

**Service Request**

**N\_smf-update (PDU session activate)**

**PDU session Setup Req (MBS session ID)**

**Comparison of the options**

All options end up with per UE individual Service Request and per UE (individual) setting up (or re-activation) of the MBS-related PDU session. Therefore, no difference here.

The main difference is the load of paging attempts:

In option 1 there is individual paging of each UE therefore high load on paging channel.

Variant 1a seems preferable compared to variant 1b since the number of PDU session related requests is smaller.

In option 2/3 there is group paging so less load over the paging channel. The paging area is larger in option 3 than it could be since the full service area is paged regardless of where the UEs are located (i.e. regardless of the RA).

Option 2 sems the optimum compromise where group paging is used so less load over the paging channel, also this group paging takes place over a group paging area limited to the RAs of the UEs. However, whether the benefit of group paging can be taken ultimately depends on RAN2 support of group paging.

In summary option 2 generates less paging load than options 1 and 3. However, group paging needs confirmation by RAN.

**Proposal 1**: Select option 2 if RAN introduces group paging and otherwise option 1 (individual paging).

**Multicast session deactivation**

If the RAN also releases resources related to the reception of multicast data, extra signalling load is generated when the multicast session transitions again to the active state, as all RAN nodes that serve related UEs will request the re-establishment of the shared delivery almost simultaneously. This may lead to a processing bottleneck at MB-SMF and MB-UPF.

Further, a trigger to re-establish the shared delivery when the multicast session is activated would be required. However. proposals for the activation further down aim to reduce signalling load and not to send any activation signalling for CM CONNECTED UEs. Such UES could thus not receive contents when the multicast session is re-activated.

Also, for time-sensitive applications, extra delay is avoided for the first packets if shared delivery resources have been kept. For example, downlink packets can immediately arrive at RAN node for delivery to connected UEs or for immediate paging of RRC inactive UEs.

**Proposal 2**: RAN shall not release resources related to the reception of shared delivery for an inactive multicast session while it still serves CM CONNECTED UEs within that multicast session-

To avoid that all PDU session for CM CONNECTED UE need to be modified when the MBS session is activated by adding multicast related QoS flows (Variant 1b for session activation) it seems preferable to maintain related information in the PDU session.

**Proposal 3**: Maintain multicast related QoS flows within PDU session at multicast session deactivation

The RAN needs to be informed about Multicast session deactivation to allow to free related radio resources and to enable that UEs in the multicast session transition to CM IDLE state. In what follows different related signalling options are compared:

**Option 1**: UE-associated: Individual PDU session release/modify via SMF/AMF

The MB-SMF knows the SMFs which are involved in the MBS session, either from contexts stored in MB-SMF or retrieved from UDR. The MB-SMF can send a Deactivate message including the MBS session id to all involved SMFs. Each SMF can trigger individual (per UE) PDU session release/modify messages.

**Option 2**: Non UE-associated: Deactivate message per NG-RAN node

Each NG-RAN node involved in the MBS session can receive from the MB-SMF a Deactivate message including the MBS session id via the SMF/AMF (variants described below). The NG-RAN nodes keep the MBS contexts for RRC connected and RRC inactive UEs. Only for UEs which the NG-RAN node decides to move to RRC idle, the NG-RAN node triggers the NG Release Request. As a result the MBS associated PDU sessions are deactivated for those UEs.

There are three possible variants for MB-SMF to send a non-UE associated Deactivate message to NG-RAN nodes, depending on the level of involvement of the SMF and the AMF.

**Variant 2a**: list of UEs via SMF/AMF

The MB-SMF knows the SMFs which are involved in the MBS session, either from contexts stored in MB-SMF or retrieved from UDR. The MB-SMF can send a Deactivate message including the MBS session id to all involved SMFs. Each SMF can determine the list of UEs involved in this MBS session. Each SMF can send a Deactivate message including the list of UEs involved in the MBS session to the relevant AMF. Each AMF can identify from the list of UEs the list of relevant NG-RAN nodes and can send a Deactivate message including the MBS session ID. AMF needs to filer or one NG-RAN node may receive multiple redundant Deactivate messages.

**Variant 2b**: list of NG-RAN node ids via SMF/AMF

The MB-SMF can store the NG-RAN nodes ids involved in an MBS session. It could for example learn and memorize it from the MBS session user plane setup phase, when an NG-RAN node triggers UP setup to MB-UPF via the MB-SMF. The MB-SMF can then send a Deactivate message to one SMF involved including the list of targeted NG-RAN node ids. This SMF knows at least one AMF involved in the MBS session and propagates the Deactivate message to the AMF. This AMF duplicates the Deactivate message to the indicated NG-RAN node ids.

**Variant 2c**: list of NG-RAN node ids via AMF

The MB-SMF can store the NG-RAN nodes ids involved in an MBS session plus the associated AMF ids. It could for example learn and memorize this from the MBS session user plane setup phase. The MB-SMF can then send the Deactivate message including the list of targeted NG-RAN node ids directly to one involved AMF. This AMF duplicates the Deactivate message to the indicated NG-RAN node ids.

Option 2

Option 1

Idle UEs

AMF

MB-UPF

UE

SMF

MB-SMF

**DeActivate (MBS session ID)**

**NG Release Request/command**

**MBS deactivate**

NG-RAN

**PDU session Modify/Release**

MBS contexts and N3 removed for all UEs

MBS contexts and N3 may be kept for connected and inactive UEs

AF (NEF)

**MBS deactivate**

UE moved to idle: all RAN contexts removed as of today

Variant 2a

**NG Release Complete (PDU session list)**

**Nsmf\_PDUsessionUpdate (deactivate (PDU session id))**

Variant 2b

Variant 2c

**Deactivate (MBS session id)**

**Deactivate (MBS session id, list of UEs)**

**DeActivate (MBS session id, list of NG-RAN nodes)**

**DeActivate (MBS session ID)**

**DeActivate (MBS session id, list of NG-RAN nodes)**

The option 1 has the disadvantage to require lot of signalling messages: for all UEs there is individual PDU session release/modify procedure. These PDU session release/modify would also be sequential and take longer. Another drawback is that all PDU sessions associated UE MBS context information is removed for all UEs, even those UEs which the NG-RAN nodes will decide to keep RRC connected or RRC inactive, i.e. Proposal 2 is not addressed

In contrast option 2 only sends a few non-UE associated Deactivate messages (see below). Also each NG-RAN node can keep the MBS context information for connected and inactive UEs, which will facilitate the re-activation. Only for those UEs moved to RRC idle, legacy signalling will lead to PDU session deactivation.

The variant 2a is obviously more complicated. Also, it requires processing in all involved SMFs and all involved AMFs. There is also a risk of duplication of messages in the NG-RAN nodes unless AMF makes additional filtering.

The variants 2c avoids SMF impact and allows the largest signalling reduction.

**Proposal 3**: Each NG-RAN node receives a non-UE associated message indicating that the MBS session is deactivated. The deactivation message is sent by the MB-SMF via AMF.

**Other Suggested improvements**

In RAN2 LS, RAN2 clarifies that 5GC is expected to inform RAN about the UE leaving of MBS session and RAN2 assumes NAS signalling is used for that purpose. The MBS session membership status of a UE should be consistent between the UE and the 5GC. Therefore, if the MBS session membership status changes in the UE, the UE shall inform the 5GC about the change regardless of CM or RRC state using NAS signalling.

The conclusions of TR 23.757 also state the following

|  |
| --- |
| - The UE may perform application level join/leave to a multicast session, the 5GC shall support multicast session join/leave operation for a user**, e.g based on AF request**. |

It is not clear to what possible AF request the text above refers. The AF can provide information about a multicast session (including information about users authorized to join a multicast session), but it is not clear why it should request that a user is added to a multicast session, This would lead to extra complexity and user consent would then not be guaranteed. A join/leave to/from a multicast session at application layer shall result in corresponding join and leave operation from a UE in 5GS. Therefore, it is proposed to clarify this conclusion as well

# 2 Conclusions

This paper proposes to agree the following changes to TR 23.757 to capture the clarifications.

**Proposed changes to TR 23.757**

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

### 8.2.2 Conclusions

8.2.2.1 General

- For MBS session management the following conclusions are reached as baseline for normative work:

- The MBS session is identified throughout the 5G system transport on external interface towards AF and between AF and UE, and towards the UE with an MBS Session ID.

- MBS Session ID may have the following types: TMGI (MBS broadcast and multicast Session), source specific IP multicast address (MBS multicast Session).

- For MBS multicast Session, source specific IP multicast address can be assigned by 5GC or external network.

- TMGI definition is updated for 5G MBS to be able to identify the MBS session when used for the Multicast Session Context and to identify the MBS service when used for the Multicast service context. (see Figure 8.2.2.2-1).

Editor's note: How TMGI can identify MBS sessions/services in an SNPN and how to signal this efficiently need coordination with FS\_eNPN.

- The UE shall be able to obtain at least one MBS Session ID via MBS service announcement.

8.2.2.2 Multicast session

- The Multicast session model is depicted in Figure 8.2.2.2-1, with the following conclusions:

- The Multicast Service Context applies when the MBSF is used.

- The SMF/MB-SMF based approach (i.e., SMF/MB-SMF handles session management for the UE) for Multicast session is adopted.

Editor's note: The following aspects need to be studied:

- How the SMF gets MB-SMF ID

- For location dependent MB service: how the additional identifier (e.g. Flow Id or Area Session identifier) handled;

- UE joining 5MBS may get rejected causing denial of service attack type situation

- Roaming aspects

- UE join MB service when involving ETSUN procedure

- For support of 5GC Shared MBS traffic delivery method and 5GC Individual MBS traffic delivery method:

- Both 5GC Shared MBS traffic delivery method and 5GC Individual MBS traffic delivery method shall be standardized for multicast data delivery. 5GC Shared MBS traffic delivery method is always mandatory, and 5GC Individual MBS traffic delivery is required to support UE mobility to/from non MBS-capable NG-RAN nodes, but otherwise optional.

- The network shall be able to support selection of 5GC Shared MBS traffic delivery method or 5GC Individual MBS traffic delivery method based on criteria of whether RAN node supports 5MBS or not.

- MB-UPF acts as the MBS session anchor when 5GC shared MBS traffic delivery method is used, and UPF acts as the unicast session anchor when 5GC individual MBS traffic delivery method is used. MBSF-U acts as the media entry point for the 5GS when MBSF is used.

Editor's note: The following is ffs: If 5GC individual MBS traffic delivery method is used, the (MB-)UPF receives MBS traffic over N9 or N6 interface.

- Establishment of the associated PDU Session for 5GC Individual MBS traffic delivery method is based on service requirements, networking configuration, local policy, etc.

Editor's note: When and whether to establish or update the associated PDU session for 5GC individual MBS traffic delivery is ffs.

- It shall be possible to establish an Associated PDU session for cases, if not exists, where mobility to non-5GMBS-supporting cells happens.

- It shall be possible to update the associated PDU session with associated QoS flows when the UE joins the MBS Session.



Figure 8.2.2.2-1: MBS session model

NOTE 1a: The model above needs clarification for its application on UE, 5GC and RAN side, this will be part of normative work.

NOTE 2: When the MBS Session is deactivated, whether the multicast flow need be removed from the MBS Session context is to be decided in normative phase.

- The following multicast session states and transition procedures are defined:

- **Configured multicast session**: No multicast data are transmitted. Information about the multicast session is configured, but no resources are reserved. No UEs are allowed to join.

- **Active multicast session**: Multicast data are transmitted to UEs that joined the multicast session. Corresponding Radio resources are reserved depending on participating UE locations. UEs that joined the multicast session are in CM CONNECTED state. UEs are allowed to join the multicast session (subject to authorization check).

- **Inactive multicast session**: No multicast data are transmitted. No Radio resources are reserved. UEs that joined the multicast session may be in CM CONNECTED or CM IDLE state. UEs are allowed to join the multicast session (subject to authorization check).

- **Multicast Session configuration**: The AF can provide information about the multicast session and/or request the allocation of an TMGI. The configuration may be combined with establishment and activation.

- **Multicast Session Establishment**: 5GC resources for the multicast session are reserved. Multicast session establishment can be combined with Multicast session configuration and/or activation. If the establishment is not combined with the activation. the multicast session is inactive after the establishment.

- **Multicast Session Activation**: State transition from inactive to active multicast session. CM IDLE UEs that joined the multicast session are paged. Radio resources are reserved.

- **Multicast Session Deactivation**: State transition from active to inactive multicast session. Radio resources are released.

- **Multicast Session Release**: All resources for the multicast session are released in an irreversible manner in both 5GC nodes and RAN nodes, UEs the joined the multicast session are notified. The release is possible for an active or inactive multicast session. The Release may be combined with the deconfiguration of a multicast session

- **Multicast Session Deconfiguration**: All information about the multicast session is removed from the 5GC and TMGIs are deallocated.



Figure 8.2.2.2-2: Multicast session states and state transitions

- For multicast session establishment/join/leave/release:

- A multicast session may be established upon a request from an AF, based on configuration, or when a UE requests to join the multicast session.

- A multicast session may be released upon a request from an AF, based on configuration, or when the last UE requests to leave the multicast session.

- The UE may request to join or leave a multicast session., The 5GC shall support multicast session join/leave operation for a UE.

- UE shall support multicast session join/leave operation via CP (NAS signalling for SM procedure)

Editor's note: UP Join is FFS.

- The UE shall indicate leaving an MBS session regardless of CM or RRC state the UE is in.

- The 5GC shall be able to reject a UE joining a multicast session when the multicast session is not established.

- ROHC for MBS traffic is supported by the 5GS, e.g based on AF request.

- MBSF-C and MBSF-U functionality is supported based on A.3.

Editor's note: Coordination with SA4 is required to determine MBSF-C and MBSF-U functionality.

- The network shall support selection of MB-SMF or SMF at session join.

- The (MB-)SMF decides whether to accept join requests, which may be based on input from NEF/MBSF-C if MBSF is used, and stores that the served UE is participating in a multicast session.

- The PDU session which is used to send the join is the same as the associated PDU Session which is for 5GC Individual MBS traffic delivery.

- The AMF shall select an SMF that supports 5MBS for multicast session join during PDU session establishment, which is used for sending join (i.e. handling of join requests for 5MBS and/or fallback to individual delivery).

Editor's note: RAN and/or SA3 is assumed to determine the handling of the security for MBS traffic.

- For N3 transport of the 5GC Shared MBS traffic delivery method, GTP-U tunnelling using a transport layer IP multicast method and shared N3 (GTP-U) Point-to-Point tunnel shall be supported with support for QoS.

- For N3 transport of the 5GC Shared MBS traffic delivery method, for unicast transport there shall be 1-1 mapping between MBS Session and GTP-U tunnel towards a RAN node, and for multicast transport there shall be 1-1 mapping between MBS Session and the GTP-U tunnel.

- For N9 transport of the 5GC Shared MBS traffic delivery method, GTP-U tunnelling using a transport layer IP multicast method and shared N9 (GTP-U) Point-to-Point tunnel shall be supported.

- For N9 transport of the 5GC Shared MBS traffic delivery method, for unicast transport there shall be 1-1 mapping between MBS Session and GTP-U tunnel towards a UPF, and for multicast transport there shall be 1-1 mapping between MBS Session and the GTP-U tunnel.

- The network supports indicating of N6 tunnel information for receiving traffic of a MBS session to the AF or MBSF(and to MBSF-U).

- 5GC provides information of MBS sessions/groups (e.g. TMGI) and QoS requirements of a MBS service to RAN for MBS AN resources handling.

- For multicast service parameters storage, the UDR shall be able to store the AF provisioned or preconfigured service parameters per MBS session.

- The PCF shall be able to provide policy and QoS requirement per MBS session to the MB-SMF

- For UE receiving MBS traffic moving from one RAN node to another in CM-CONNECTED and RRC-CONNECTED state, handover procedure with MB context shall be supported by UE and network.

- When MBS session is released, the N3 transport of the 5GC shared MBS delivery method is released and the radio resource associated with the MBS QoS Flows are released, or the N3/N9 transport of the 5GC Individual MBS traffic delivery method is released and the radio resource associated with the QoS Flows are released.

- MB-UPF is used as the MBS Session anchor for the 5GC shared MBS delivery.

- Interactions between the MBSF-C and MBSF-U will be defined in coordination with 3GPP SA4.

- The 5GC shall be able to trigger NG-RAN nodes to notify activation of an MBS session to IDLE UEs.

NOTE Y: How NG-RAN noded notify session activation to UEs relies on RAN WG feedback.

- When an MBS session is established upon AF request, it may be immediately activated (i.e. one AF request combining of session announcement and session activation). If an application requires to allow UEs to join prior to the activation of the multicast transmission, the AF may interact with the NEF separately to establish the multicast session in inactive state and subsequently to activate the multicast session.

- If a UE joins prior to the activation of the multicast session, the network indicates to the UE that the session is not yet activated.

- The MBS Session may be deactivated upon AF request or when the MB-UPF detects no multicast data for a configurable period. The MB-SMF sends a non-UE associated deactivation message via AMF towards NG-RAN nodes to which it performs shared delivery. When the MBS Session is deactivated by 5GC, the MBS Session context is kept in 5GC, but the radio resource to transmit the multicast session are released. The N3 tunnel for 5GC Shared MBS delivery method shall not be released as long as the RAN node serves CM CONNECTED UEs within the multicast session. UEs that have joined that multicast session can become IDLE:

NOTE X: If the MBS session is deactivated because the MB-UPF detects no multicast data for a configurable period, the AF will not be aware.

- The MBS Session may be activated when the MB-UPF detects multicast data. When the MBS Session needs to be activated, the MB-UPF sends message to the MB-SMF. When the MB-SMF starts the MBS session activation for establishing the transmission resources, the MB-SMF notifies the session activation to NG-RANs via SMFs/AMFs serving UEs within the multicast session. UEs are notified by NG-RAN about the session activation.

- The MBS Session may be activated upon AF request or when the MB-UPF detects multicast data. When the MB-UPF detects multicast data, the MB-UPF sends message to the MB-SMF. The MB-SMF notifies all SMFs within the multicast session about the session activation. The SMFs identify the UEs with deactivated PDU sessions within the multicast session that they serve, and if group paging is supported by RAN, sends an activation request with a list of those UEs to the AMFs serving them to initiate the group paging or otherwise request PDU session establishment which triggers individual paging at the AMFs..

NOTE Z: Coordination with RAN WGs are needed in the normative phase, in particular relating to group paging.

**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Next Change \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***

8.2.3 Call flows

The call flow in this clause are for information to better understand the principles in clause 8.2.2.

Editor's note: Call flow in this clause depends on the discussion in S2-2008609 for KI#1 Conclusion of MBS Session Management. and need to be aligned with clause 8.2.2.



Figure 8.2.3-1: PDU Session modification for multicast

1. The content provider may send a request to register and reserve resources for a multicast group to the NEF and communicate the related multicast address as detailed in Figure 8.2.3-2.

The content provider may invoke the services provided by the NEF to provision the multicast information. The multicast information is used to identify (e.g., IP Address of multicast data) and reserve resources for the multicast. The NEF selects MB-SMF controlling an MB-UPF serving as ingress point for the multicast data and creates a multicast context and stores related information including the SMF ID in the UDR. The MB-SMF may request the MB-UPF to allocate an IP address and Port for ingress multicast traffic, which is then provided to the content provider via NEF.

NOTE 1: The request to reserve resources for the corresponding multicast session is optional and can be replaced by configured data based on commercial agreements. If IP multicast is used in the external network, the content provider does not require information where to send the multicast data.

NOTE 2: SMF and MB-SMF can be identical.

2. The UE registers in the PLMN (see clause 4.2.2.2 of TS 23.502 [8]) and request the establishment of a PDU session (see clause 4.3.2.2 of TS 23.502 [8]). The UE also indicates its capability to receive multicast data over the radio. The AMF obtains information from the UDM whether the UE can join multicast sessions as part of the SMF Selection Subscription data. If so, for direct discovery, the AMF selects an SMF capable of handling multicast sessions based on locally configured data or a corresponding SMF capability stored in the NRF and also indicates the UE's capability to receive multicast data over the radio to the SMF.

3. The content provider announces the availability of multicast using higher layers (e.g., application layer). The announcement includes at least the multicast address of a multicast group that UE can join.

4. To join the multicast group, the UE sends the PDU Session Establishment/Modification Request either upon a request from higher layers or upon a detection by lower layers of UE joining a multicast group (i.e., detection of IGMP or MLR and detection of the change of content of these messages). The PDU Session Modification Request shall include information about multicast group, which UE wants to join, such as multicast addresses listed in the IGMP and MLR messages. This information is needed for configuration of the UPF with appropriate packet filters.

5. The AMF invokes Nsmf\_PDUSession\_UpdateSMContext (SM Context ID, N1 SM container (PDU Session Modification Request with the multicast information)).

6. The SMF may check whether the UE is authorized to join the multicast session. The SMF may interact with PCF, UDR or NEF for that purpose. See Figure 8.2.3-3

7. If SMF has no information about the multicast context for the indicated multicast group, SMF checks at the UDR whether a multicast context for the multicast group (address) exists in the system. If the multicast context for the multicast group does not exist, then SMF creates it when the first UE joins the multicast group, stores the multicast context including itself as multicast controlling SMF in the UDR, and configures the UPF to handle the multicast data distribution (SMF and MB-SMF, and UPF and MB-UPF in this flow are then identical). If it is the first UE joining the multicast group, the MB-UPF may also have to join the multicast tree towards the content provider; the MB-SMF should request the MB-UPF to join the multicast tree when configuring the MB-UPF, see e.g. Step 15 and 26. If a multicast context already exists in the UDR, the SMF retrieves the related information, including information related to MB-SMF controlling the multicast ingress point.

Editor's note: How the SMF obtains MB-SMF ID is ffs, It is also ffs if SMF interacts with UDR via PCF,

Editor's note: More consideration on how to prevent denial of service attack type situation when first UE joining the multicast group, triggers the MB- to join the multicast tree towards the content provider is ffs.

8-9.: If SMF has no information about the multicast context for the indicated multicast group, SMF interacts with MB SMF to retrieve QoS information of the multicast QoS flow(s).

10. SMF requests the AMF to transfer a message to the RAN node using the Namf\_N1N2MessageTransfer service (N2 SM information (PDU Session ID, Multicast Context ID, MB-SMF ID, multicast QoS flow information), N1 SM container (PDU Session Modification Command (PDU Session ID, multicast information (Multicast Context ID, multicast QoS flow information, multicast address)) to:

- create a multicast context in the RAN, if it does not exist already; and

- inform about the relation between the multicast context and the UE's PDU session.

Based on operator policy, if the SMF is configured to prepare for unicast fall-back, the SMF maps the received QoS information of the multicast QoS flow into unicast QoS flow information of the PDU Session, and includes the information of the unicast QoS flows and the information about the association between those unicast QoS flows and the multicast QoS flows in the N2 SM information. If dedicated unicast QoS flows are required, the information includes the one about those dedicated unicast QoS flows. SMF also includes information about those unicast QoS flows in the N1 SM container.

Editor's note: Providing associated unicast QoS flows at this stage needs to be confirmed.

11. The N2 session modification request is sent to the RAN. The request is sent in the UE context using the PDU Session Resource Modify Request message enhanced with multicast related information, which includes a multicast group identity (e.g., multicast address), Multicast Session context ID, and multicast flow information such as multicast QoS Flow ID and associating QoS information. The RAN uses the multicast group identity to determine that the session modification procedures corresponds to one multicast group. In other words, the RAN learns what UEs are receiving the same multicast data from the multicast group identity. When the RAN receives a session modification request for previously unknown multicast group identity, the RAN configures resources to serve this multicast group.

12. The N1 SM container (PDU Session Modification Command) is provided to the UE.

13. The RAN performs the necessary access network resource modification such as configuration of PTP or PTM bearers. RAN node checks whether the user plane for the multicast group/context distribution is already established towards the RAN node. If RAN supports MBS, RAN configures the UE for receiving the multicast data via multicast session.

NOTE 3: The details of access network resource modification should be studied in the RAN WGs.

14. RAN nodes selects the AMF to reach MB-SMF and signals a request towards AMF [MB-SMF ID, Multicast context/group ID]. If the RAN node is configured to use a unicast transport for multicast distribution sessions, it allocates a downlink tunnel ID (an IP address and a GTP-U TEID) for the reception of the multicast distribution session and indicates the downlink tunnel information in the request.

15. AMF forwards the request towards the MB-SMF

16. For unicast transport of the multicast distribution session, MB-SMF configures MB-UPF to transmit the multicast distribution session towards RAN (using the received IP address and a GTP-U TEID).

17. MB-SMF sends a multicast distribution session response to AMF. For multicast transport of the multicast distribution, it indicates in the downlink tunnel information the transport multicast address for the multicast session.

18. AMF forwards multicast distribution session response to RAN node.

19. The RAN sends the session modification response, which does not include the unicast tunnel information.

20. The AMF transfers the session modification response received in step 18 to the SMF. The SMF determines that the shared tunnel is used for multicast packet transferring and the interaction with UPF is not needed.

21. MB-UPF receives multicast PDUs, either directly from the content provider or via the MBSF-U that can manipulate the data.

22. MB-UPF sends multicast PDUs in the N3/N9 tunnel associated to the multicast distribution session to the RAN. There is only one tunnel per multicast distribution session and RAN node, i.e., all associated PDU sessions share this tunnel.

23. The RAN selects PTM or PTP radio bearers to deliver the multicast PDUs to UEs that joined the multicast group.

24. The RAN performs the transmission using the selected bearer.

Configuration of a multicast group in the 5GC can occur:

- when the first UE joins the multicast group;

- based on static configuration;

- Triggered by an AF request via the NEF.

At service layer, the MSF can manage an MBS service, and apply related NEF procedures to configure a multicast group.

Figure 8.2.3-2: Multicast session establishment via NEF

1. AF of content provider may request the establishment of a multicast session for which it provides contents at the NEF. The AF may provide a source specific multicast address or it may request that the network allocates a an identifier for the multicast session (TMGI or source specific multicast address). Multicast information may further include media type information (e.g., audio, video…), QoS requirements, UE authorization information (e.g. a GPSI or an External Group Id or a UE ID to identify UEs authorized to join the multicast service), service area identifying the service scope, and the state (active or inactive), in which the session shall be established, and a release time for the multicast session. If the multicast session is established in the inactive state, the AF may also include an activation time for the multicast session. The AF may also request the allocation of an ingress transport address where to send tunnelled multicast data.

2. NEF/MBSF-C checks authorization of content provider. NEF/MBSF-C selects MB-SMF as ingress control node, possibly based on location area.

Editor's note: The 5GC network entity for TMGI allocation needs to be clarified.

3,4. NEF/MBSF-C requests storage of multicast session context at UDR and provides multicast group ID and selected MB-SMF ID.

5. NEF/MBSF-C requests MB-SMF to reserve ingress resources for a multicast distribution session and provides Multicast group ID. It also indicates if the allocation of an ingress transport address is requested.

6. The MB-SMF sends SM MBS Policy Association Request to MB-PCF with the Multicast group ID, AF Identifier, and the QoS requirements.

7. The MB-PCF registers at the BSF that it handles the multicast session. It provides an identifier that the policy association is for multicast and the multicast group ID, it own PCF ID and optionally its PCF set ID.

8. The MB-PCF may query the UDR for policy input related to the multicast session.

9. The MB-PCF responds with SM MBS Policy Association Response with policies for the Multicast group ID.

In addition, determines whether the request is authorized and notifies the NEF if the request is not authorized.

If the request is authorized, the PCF derives the required QoS parameters based on the information provided by the NEF and determines whether this QoS is allowed (according to the PCF configuration for this AF), and notifies the result to the MB-SMF. The PCF notifies the MB-SMF whether the transmission resources corresponding to the QoS request are established or not.

If the request is not authorized, the required QoS is not allowed, or transmission resources are not established, MB-SMF responds to the NEF in step 12 with a Result value indicating the failure cause, and NEF further notifies AF in step 13.

10. MB-SMF selects the MB-UPF and requests it to reserve user plane ingress resources. If multicast transport of the multicast data towards RAN nodes is to be used, the MB-SMF also request the MB-UPF to reserve for the outgoing data a tunnel endpoint and the related identifiers (source IP address, source specific multicast address and GTP Tunnel ID) and to forward data received at the user plane ingress resource using that tunnel endpoint.

11. If requested, MB-UPF selects an ingress address (IP address and port) and a tunnel endpoint for the outgoing data and provides it to MB-SMF

12. MB-SMF indicates the possibly allocated ingress address to the NEF/MBSF-C. It also indicates the success or failure of reserving transmission resources.

13. The NEF/MBSF-C indicates the possibly allocated ingress address to the AF.



Figure 8.2.3-3: Multicast session activation triggered by AF

1. AF of content provider may request the activation of a previously established multicast session at the NEF. The AF provides a multicast session identifier.

2. NEF/MBSF-C requests MB-SMF to activate the multicast session.

3. The MB-SMF determines the SMFs that previously subscribed to notifications about the multicast session.

4. The MB-SMF notifies those SMFs about the activation of the multicast session.

The subsequent steps are performed by each SMF

5. The SMF determines the UEs it serves that joined the multicast session and have an inactive PDU session.

6. The SMF request the activation of the multicast session

7. The AMF performs group paging for the multicast session in the radio area where the indicated UEs are residing.

The subsequent steps are performed for each UE

8. The UE responds with a service request

9. The AMF requests the activation of the PDU session.

10.-12. The PDU session is activated.



Figure 8.2.3-4: UE authorization check

1. Steps 1 to 4 in Figure 8.2.3-2 apply. In step 1 the AF may provide UE authorization information (e.g. a GPSI or an External Group Id or a UE ID to identify UEs authorized to join the multicast service).

2. If the AF provided authorization information, the NEF maps the UE authorization information (e.g. a GPSI or an External Group Id or a UE ID to identify UEs authorized to join the multicast service) into SUPIs or internal group IDs and stores information about UEs allowed to join the multicast group in the UDR. This may be combined with step 3 in Figure 8.2.3-2 if the multicast session context is used to store the information.

NOTE 1: Details of the UDR storage format will be determined during the normative work.

NOTE 2: Steps 1 and 2 can be omitted if UE authorization information for multicast sessions is configured in the UDR.

3. A UE requests to join a multicast group. Steps 4 and 5 in Figure 8.2.3-1 are executed.

4. The SMF queries at the UDR whether the UE is authorized to join the multicast session.

NOTE 3: If policy control for the UE joining authorization is required, the PCF subscribes to notifications when a UE joins a multicast group and the SMF sends a SM Policy Association Modification to PCF after step 3. Steps 4 is then executed by the PCF. The PCF then indicates in the SM Policy Association Modification Response to the SMF whether the UE is authorized to join the multicast session.

Editor's note: Possible AF interactions to authorize the join request are ffs and depend on key issue 3 conclusions.