**3GPP TSG-WG SA2 Meeting #144E e-meeting *S2-210XXXX***

**Elbonia, 12 - 16 April, 2021 (revision of S2-210xxxx)**

**Source: Huawei, HiSilicon**

**Title: Mobility Procedures for 5MBS**

**Document for: Approval**

**Agenda Item: 8.9**

**Work Item / Release: 5MBS / Rel-17**

*Abstract: This document adds Mobility Procedure for 5MBS to the new TS. This include the mobility among the homogenous and non-homogenous 5MBS capability NG-RAN node.*

# Background and Introduction

This contribution proposes the related procedures as per the conclusion in clause 8.7 of TR 23.757.

# Proposal

It is proposed to capture the following changes vs. TS23.247.

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

7.1.5 Mobility Procedures for 5MBS

7.1.5.1 General

UE may move from one NG-RAN node to another NG-RAN node after UE has joined the MB Session. Depending on whether the NG-RAN node support 5G MBS, the following scenarios are possible:

* Both source and target NG-RAN support 5G MBS.
* Source NG-RAN supports 5G MBS, target NG-RAN does not support 5G MBS.
* Source NG-RAN does not support 5G MBS, target NG-RAN supports 5G MBS.
* Both source and target NG-RAN don’t support 5G MBS.

When the UE moves from a NG-RAN node that supports 5G MBS to a NG-RAN node that does not support 5G MBS, during the handover procedure the delivery method is switched from 5GC Shared MBS traffic delivery method to 5GC Individual MBS traffic delivery method.

When the UE moves from a NG-RAN node that does not support 5G MBS to a NG-RAN node that supports 5G MBS, during the handover procedure the delivery method is kept as the 5GC Individual MBS traffic delivery. After the handover procedure, the delivery method is switched from 5GC Individual MBS traffic delivery method to 5GC Shared MBS traffic delivery method.

7.1.5.2 Xn based handover with MBS Session

This clause describes the Xn based handover with the MBS Session established at the source NG-RAN side.

Figure 7.15.2-1: Xn based handover with MBS SessionCompared with the existing Xn based handover procedure (see TS 23.502 [X]), the following enhancements apply:

0. Handover Preparation phase.

 The source NG RAN notify the MBS Session information and the unicast PDU Session information (including the associated mapping PDU session information) to the target NG RAN. The mapping PDU Session information is the information of the mapping unicast QoS flows correlated with the MBS session.

Based on the received the MBS Session information and its associated unicast PDU Session information:

* If the target NG-RAN does not support 5G MBS, the target NG-RAN proceeds with the unicast PDU Session information.

If the target NG-RAN supports 5G MBS, the target NG-RAN proceed with the MBS session information. If the indicated MBS Session has already been established in target NG-RAN , minimization of data loss may be supported, e.g. by data forwarding, see clause 7.1.5.4. If the indicated MBS Session has not been established in Target NG-RAN, the Target NG-RAN may allocate the shared downlink tunnel information for receiving the MBS data from 5GC.1. Target NG-RAN to AMF: the Target NG-RAN sends N2 Path Switch Request to AMF. The N2 Path Switch Request includes N2 SM message for each active PDU Session including the MBS Session information if it is accepted in the Target NG-RAN.

Based on the received N2 SM message, the SMF can differentiate two cases:

Case A) The Target NG-RAN supports 5G MBS. Step 3 applies and steps 4~8 are skipped.

1. SMF to UPF: The SMF invokes N4 Session Modification procedure with the UPF (PSA) only for unicast PDU Session. The SMF instructs the UPF to send the end market packet towards the source NG-RAN.

Case B) The Target NG-RAN does not support 5G MBS and the UPF is not yet configured to forward multicast data via unicast, steps 4 to 8 apply.

1. SMF to UPF: The SMF invokes N4 Session Modification procedure with UPF (PSA) to instruct the UPF to forward multicast data within the unicast PDU(i.e., 5GC Individual MBS traffic delivery method will be used). If delivery of the multicast data from MB-UPF to UPF needs to be configured, and unicast transport is to be used, the SMF also instructs the UPF to allocate a tunnel endpoint for reception of multicast data from the MB-UPF.

If delivery of the multicast data from MB-UPF to UPF needs to be configured, steps 5 to 8 apply.

1. SMF to MB-SMF: The SMF invokes a Nmbsmf\_MBSSession\_Update (MBS session ID, SMF ID, DL tunnel info) request service operation to MB-SMF to establish the shared tunnel between the UPF(PSA) and MB-UPF.
2. MB-SMF to MB-UPF: If multicast data are transported via unicast PDU Session, the MB-SMF updates the multicast session context identified by the MBS session ID and configures the MB-UPF to sends multicast data to the received tunnel endpoint..
3. MB-SMF to SMF: The MB-SMF responds to SMF through Nmbsmf\_MBSSession\_Update response. If multicast data are transported via multicast, the MB-SMF provides endpoint information including the transport multicast address.
4. SMF to UPF: The SMF invokes an N4 Session Modification procedure with the UPF (PSA). If multicast data are transported via multicast, the SMF provides endpoint information including the transport multicast address to the UPF. The SMF instructs the UPF to send subsequent packets towards the target NG-RAN within the unicast PDU Session.
5. UPF to Source NG-RAN: The Source NG-RAN forwards the end marker to Target NG-RAN. The target NG-RAN starts to send the buffered packets for the PDU Session including buffered MBS data if any to the UE.

If the Source NG-RAN previously received the MBS session data from MB-UPF but does no longer require them because no other served UEs participate in the MBS session steps 11 to 15 apply:

1. Source NG-RAN to AMF: Source NG-RAN sends an N2 Message (MBS session ID) to signal a request to terminate multicast distribution towards AMF.
2. AMF to MB-SMF: AMF invokes Nmbsmf\_MBS Session\_Release Request (MBS session ID) service operation to the MB-SMF to release the shared downlink tunnel resource.
3. MB-SMF to MB-UPF: For unicast transport of the multicast distribution session, MB-SMF initiate the N4 Session Modification procedure to request the MB-UPF release the corresponding shared downlink tunnel resource towards the source NG-RAN.
4. MB-SMF to AMF: MB-SMF responds to AMF through Nmbsmf\_MBS Session\_Release Response.
5. AMF to Source NG-RAN: AMF notify NG-RAN node to release the shared downlink tunnel resource.

7.1.5.3 N2 based handover with MBS Session

This clause describes the N2 based handover with the MBS Session established at the source NG-RAN side.

Figure 7.15.3-1: N2 based handover with MBS Session

Compared with the existing N2 based handover procedure (see TS 23.502 [8] clause 4.9.1.3), the following enhancements apply:

1. Source NG-RAN to S-AMF: Handover Required (RAN container (unicast PDU session information, [MBS session information])).

The RAN container contains both the MBS Session information and the unicast PDU Session information. The unicast PDU session information includes the mapping PDU Session information, which is the information of the mapping unicast QoS flows correlated with the MBS session.

1. SMF to T-AMF: The SMF includes both MBS Session information including the associated MBS Session identifier and unicast PDU Session information to the Target NG-RAN.

An indication of whether forwarding is possible is also included in the N2 SM message.

1. T-AMF to Target NG-RAN: The Target NG-RAN prepares the radio resource based on the received information.
* If the Target NG-RAN does not support 5G MBS, the MBS Session information is not used. The Target NG-RAN uses the unicast PDU Session information to allocate resource to deliver MBS data. The MBS data are transmitted as one of the QoS flows within the unicast PDU Session.
* If the Target NG-RAN supports 5G MBS, the Target NG-RAN use the MBS Session information allocate resource to deliver the MBS data. The corresponding QoS flow part information in the unicast PDU Session information is not used.

If Target NG-RAN support 5G MBS and the MBS delivery for the indicated MBS Session has not been established towards Target NG-RAN, the Target NG-RAN allocates the shared downlink tunnel information for receiving the MBS data from 5GC and steps 6 to 10 apply:

1. Target NG-RAN to AMF: Target NG-RAN node selects the AMF to reach MB-SMF and signals a multicast session distribution request towards AMF via the N2 Message (MB-SMF ID, MBS Session 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.
2. AMF to MB-SMF: AMF invokes the Nmbsmf\_MBSSession\_Create Request (MBS session ID, [DL tunnel info]) Request towards the MB-SMF.
3. MB-SMF to MB-UPF: MB-SMF invokes the N4 Session Modification procedure with MB-UPF. For unicast transport of the multicast distribution session, MB-SMF configures MB-UPF to transmit the multicast distribution session towards Target NG-RAN node (using the received IP address and a GTP-U TEID).
4. MB-SMF to AMF: MB-SMF responds to AMF through the Nmbsmf\_MBSSession\_Create Response. For multicast transport of the multicast distribution, it indicates in the downlink tunnel information the transport multicast address for the multicast session.
5. AMF to Target NG-RAN: AMF notify multicast session distribution response to Target NG-RAN node via the N2 Message.
6. Target NG-RAN to T-AMF: The Target NG-RAN sends handover request Ack to T-AMF, includes N2 SM message for each accepted PDU Session and MBS Session (if need and accept) as allocated at the step 5.
7. SMF to UPF: If the Target NG-RAN does not support MBS, and indirect forwarding is needed, the forwarding tunnel for unicast PDU Session is used for the MBS data. The indirect forwarding tunnel is established as in existing N2 based handover procedure in TS 23.502 [8].
8. Source NG-RAN to Target NG-RAN: The source NG-RAN forwards data to the target NG-RAN either directly or indirectly via the UPF.

If the Target NG-RAN does not support MBS, the source NG-RAN copies the MBS data received from 5GC, and forwards the packet(s) via the unicast PDU session forwarding tunnel to Target NG-RAN.

1. T-AMF to SMF: The AMF invokes Nsmf\_PDUSession\_UpdateSMContext request towards SMF, the message includes the received N2 SM message.

Based on the received N2 SM message, the SMF can differentiate two cases:

Case A) The Target NG-RAN supports 5G MBS. Step 22 applies and steps 23~29 are skipped.

1. SMF to UPF: The SMF invokes N4 Session Modification procedure with the UPF (PSA) only for unicast PDU Session. The SMF instructs the UPF to send the end market packet towards the source NG-RAN and to send subsequent packets towards the target NG-RAN within the unicast PDU Session.

Case B) The Target NG-RAN does not support 5G MBS. If the UPF is not yet configured to forward multicast data via unicast, steps 23 to 29 apply.

1. SMF to UPF: The SMF invokes N4 Session Modification procedure with UPF (PSA) to instruct the UPF to forward multicast data within the unicast PDU(i.e., 5GC Individual MBS traffic delivery method will be used). If delivery of the multicast data from MB-UPF to UPF needs to be configured, and unicast transport is to be used, the SMF also instructs the UPF to allocate a tunnel endpoint for reception of multicast data from the MB-UPF.

If delivery of the multicast data from MB-UPF to UPF needs to be configured, steps 24 to 27 apply.

1. SMF to MB-SMF: The SMF invokes a Nmbsmf\_MBSSession\_Update (MBS session ID, DL tunnel info) request service operation to MB-SMF to establish the shared tunnel between the UPF(PSA) and MB-UPF.
2. MB-SMF to MB-UPF: If multicast data are transported via unicast PDU Session, the MB-SMF configures the MB-UPF to send the multicast data to the received tunnel endpoint.
3. MB-SMF to SMF: The MB-SMF responds to SMF through Nmbsmf\_MBSSession\_Update response. If multicast data are transported via multicast, the MB-SMF provides endpoint information including the transport multicast address.
4. SMF to UPF: The SMF invokes an N4 Session Modification procedure with the UPF (PSA). If multicast data are transported via multicast, the SMF provides endpoint information including the transport multicast address to the UPF. The SMF instructs the UPF to send subsequent packets towards the target NG-RAN within the unicast PDU Session.
5. UPF to Source NG-RAN: The UPF sends the end marker packet(s) for the specific UE via old path of the PDU session to the Source NG-RAN.
6. Source NG-RAN to Target NG-RAN: The Source NG-RAN forwards the end marker to Target NG-RAN via the PDU session.

If the Source NG-RAN node previously received the MBS session data from MB-UPF but does no longer require them because no other served UEs participate in the MBS session steps 30 to 34 apply:

1. Source NG-RAN to AMF: Source NG-RAN sends an N2 Message (MBS session ID) to signal a request to terminate multicast distribution towards AMF.
2. AMF to MB-SMF: AMF invokes the Nmbsmf\_MBS Session\_Release (MBS session ID) Request service operation to MB-SMF to release the shared downlink tunnel resource.
3. MB-SMF to MB-UPF: For unicast transport of the multicast distribution session, MB-SMF initiate the N4 Session Modification procedure to request the MB-UPF release the corresponding shared downlink tunnel resource towards the source NG-RAN.
4. MB-SMF to AMF: MB-SMF responds to AMF through Nmbsmf\_MBS Session\_Release Response.
5. AMF to Source NG-RAN: AMF notify NG-RAN node to release the shared downlink tunnel resource.

7.1.5.3 X2/N2 based handover without MBS Session

If the 5GC Individual MBS traffic delivery method is used at the source NG-RAN node for the MBS Session, the existing X2 /N2 based handover procedure defined in TS23.502[X] is used to support the UE move to Target NG-RAN node.

After the handover completion, if the target NG-RAN supports 5G MBS, the MBS Traffic delivery mothed is switched from 5GC Individual MBS traffic delivery method to 5GC Shared MBS traffic delivery method.

7.1.5.4 Lossless packet transferring

For the inter supporting MBS NG-RAN node handover, the lossless packet transferring need to be supported.

* The MBS Session packets are forwarded to the Target RAN, a sequence number is inserted in each data packet of the MBS session by MB-UPF and forwarded to NG-RAN.
* During the handover procedure, the Target NG-RAN compares the packet sequence number of the forwarded MBS data from Source NG-RAN and the packet sequence number of the MBS data received directly from 5GC. Based on the comparison the Target NG-RAN determines when to sends the MBS data received directly from 5GC to the UE. For example, when the packet sequence number of the forwarded MBS data from Source gNB is equal to the packet sequence number of the MBS data received directly from 5GC, the Target NG-RAN switches to send the MBS data received directly from 5GC to the UE.

For the source NG-RAN supporting MBS and the target NG-RAN not supporting MBS, the lossless handover with data forwarding will be supported.

* The MBS data is sent to Target gNB as unicast PDU Session from MB-UPF via the UPF. SMF set a timer to hold the MBS data packet at the UPF. When the timer expires, the SMF enable the MBS data sent from UPF to Target gNB.

Editor’s Note: Details for how to achieve the lossless packets transfer between the source NG-RAN node and the target NG-RAN node should be aligned with 3GPP RAN WG.

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