**3GPP TSG-WG SA2 Meeting #162 *S2-2404099***

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**Source: Huawei, HiSilicon**

**Title: KI#1: Update of Solution#2**

**Document for: Approval**

**Agenda Item: 19.6**

**Work Item / Release: FS\_VMR\_Ph2/ Rel-19**

*Abstract: Update of Solution#2 is proposed.*

# 1. Introduction

This contribution proposes the following changes:

1. Addressing the Editor’s Note about N3 over BH PDU session
2. Update of N2 over BH PDU session

# 2. Text Proposal

It is proposed to capture the following changes in TR 23.700-06.

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

## 6.2 Solution #2: MWAB architecture and procedures

### 6.2.1 General

The solution provides methods for architectural enhancements for the support of a MWAB, which is based on the support of MWAB architecture as specified in clause 4.1 with the following high-level descriptions according to the different usages of PDU sessions(s) of the MWAB-UE:

- Connection with OAM server over IP connectivity provided by the PDU session of MWAB-UE.

- N2 interface with AMF over the IP connectivity provided by the PDU session of MWAB-UE.

- N3 interface with UPF over the IP connectivity provided by the PDU session of MWAB-UE.

### 6.2.2 Functional descriptions

#### 6.2.2.1 Connection with OAM server over PDU session

When a PDU session is used for the MWAB to access the OAM server, the MWAB-UE establishes a dedicated PDU session for the OAM traffic. Additionally, the OAM server address can be configured per PLMN ID, the MWAB selects the OAM server address of the respective PLMN ID for which it wants to act as NG-RAN.

The MWAB-UE is configured dedicated DNN/S-NSSAI for the PDU session for backhaul link to the OAM server, or the AMF provides it when the MWAB-UE attempts to establish the PDU session in the slice where the OAM service is (e.g a default DNN/S-NSSAI can be used).

The MWAB-gNB accesses the OAM server and the OAM server can then configure the MWAB-gNB additional information for N2 or N3 connectivity. The MWAB-gNB requests the establishment of the N2 or N3 based on the configuration, which may trigger establishment of additional BH PDU sessions by the MWAB-UE, e.g. based on Local Configuration or URSP rules. The N2 connection is established on a BH PDU sessions as per the received configuration.

#### 6.2.2.2 N2 connection over BH PDU session

The N2 connection with AMF for the MWAB-gNB:

- The BH PDU session’s PSA routes the N2 message between the MWAB-gNB and AMF based on the IP address.

- The N2 connection with AMF set over BH PDU session is described in the Figure 6.2.2.2-1.

- The MWAB-UE is configured with dedicated DNN/S-NSSAI for the PDU session for backhaul link to be used by the MWAB-gNB. When MWAB-UE establishes the PDU session to access the OAM server, the address of the AMF(s) for the MWAB-gNB to connect to can be configured by the OAM based on MWAB’s location.

NOTE 1: Considering the mobility of MWAB-gNB, the AMF change may happen because of the regional deployment of AMF. the N2 connection change during MWAB-gNB mobility will be co-ordinated with the mobility aspects of key issue#4.

NOTE 2: In order to avoid the backhaul link failure of N2/N3 connection, the IP connection of N2/N3 should be kept reachable.

UE#1

UE#2

MWAB

gNB

UE

**AMF set**

**BH PDU Session**

AMF

AMF

AMF

AMF

BH-gNB

BH-UPF

N2 of UE

Figure 6.2.2.2-1: N2 connection over BH PDU session

#### 6.2.2.3 N3 over BH PDU session

Solution 3 describes the handling of the QoS and slicing aspects over the BH PDU sessions in details.

The N3 connection with UPF for the MWAB-gNB:

- The BH PDU session’s PSA routes the N3 message between the MWAB-gNB and UPF based on the IP address.

 During the PDU Session Establishment procedure of UE, the MWAB-gNB receives the N3 CN tunnel corresponding to the PDU Session. Then the BH PDU session for N3 connection is established.

- The MWAB-UE provides the allocated IP address for the BH PDU Session to the MWAB-gNB. This IP address is provided by the MWAB-gNB to the UE SMF as the N3 AN tunnel information during PDU Session Establishment procedure of UE.

#### 6.2.2.4 Xn over BH PDU session

The MWAB-gNB's Xn, if enabled based on configuration by OAM, may share the same PDU session of N2/N3 or different PDU session. When the respective PDU session providing IP connectivity is established, IP connectivity is also used to connect with another NG-RAN (using the Xn interface). The Xn interface, if supported by an MWAB, and if enabled by the operator, would be carried over the BH PDU session used to support the MWAB gNB's N2 interface.

Editor’s Note: It is FFS whether or not to support Xn connection over BH PDU Session and need the coordination with RAN WG3.

#### 6.2.2.5 Handling of NG establishment with respect to the topic of multi-hop handling

Editor’s Note: Whether and how to avoid multi-hop handing needs to coordination with RAN WG3.

The MWAB need to avoid multi-hop (until RAN WGs agree otherwise). A solution is provided to ensure this is possible without requiring new impacts on MWAB-UE and the deployed NG-RAN (except in the event of Xn handover)

The MWAB-gNB includes in the NG SETUP REQUEST message to the AMFs that it is configured to establish NG with an indication that it is a MWAB-gNB. The AMF stores this information.

If a MWAB-UE attempts to register at another MWAB cell, the AMFs that receives the registration request from the MWAB-UE can based on the received information and not accept the registration.

When there is a N2 handover of a MWAB-UE, the AMF can indicate in the Handover Request that it is handing over a MWAB-UE. If the target gNB is a MWAB-gNB, the MWAB-gNB can reject the handover based on its policy and the information received.

Editor’s Note: The feasibility of this N2 handover solution will be evaluated later in the evaluation phase.

When there is a Xn handover of a MWAB-UE, the Source RAN node can indicate in the Handover Required that it is handing over a MWAB-UE. If the target gNB is an MWAB-gNB the MWAB-gNB can reject the handover based on its policy and the information received.

NOTE: It is assumed that the support of this in Xn case, will require the AMF to provide this information to NG-RAN in the MWAB-UE context and also a new Xn IE to be included by a gNB. Hence, for example, in a PLMN where no NG-RAN upgrade is desired to support MWABs, the MWABs can be configured to not establish Xn to other gNBs.

Editor’s Note: The feasibility of this Xn handover solution will be evaluated later in the evaluation phase.

### 6.2.3 Procedures

#### 6.2.3.1 Connection with OAM server over PDU session

The MWAB-UE may be configured dedicated DNN/S-NSSAI for the PDU session for backhaul link to the OAM server (e.g. Local Configuration or URSP rules) or network serving the MWAB-UE may determine a default DNN/S-NSSAI for it based on subscription.

#### 6.2.3.2 N2 connection over BH PDU session

The N2 message routing over BH PDU session is described in the Figure 6.2.3.2-1.

gNB

UE

**MWAB**

BH gNB

MWAB-UE AMF

MWAB-UE SMF

MWAB-UE UPF

**BH 5GC**

AMF

OAM

1. a dedicated PDU session for the OAM traffic

2. BH PDU session for N2 connection

3. Generates the UL N2 message (Source IP: MWAB-UE IP address, Destination IP: AMF address)

4. UL data via BH PDU session (payload (N2 message))

IP routing based on the destination IP address

5. payload (N2 message)

6. Generates the DL N2 message (Source IP: AMF address, Destination IP: MWAB-UE IP address)

7. payload (N2 message)

8. DL data via BH PDU session (payload (N2 message))

Figure 6.2.3.2-1: N2 message routing over BH PDU session

1. When MWAB-UE establishes the PDU session to access the OAM server, the address(es) of the AMF(s) for the MWAB-gNB to connect to can be configured by the OAM based on MWAB’s location. Details of the configuration of the MWAB-gNB are to be defined by RAN3/SA5.
2. The MWAB-gNB requests the connection towards the AMF(s) for N2 backhaul link via the interface with the MWAB-UE, and this triggers the establishment of a PDU session with a dedicated DNN/S-NSSAI based on Local Configuration or URSP rules of the MWAB-UE.
3. The MWAB generates the UL N2 message (e.g. NG SETUP REQUEST message) whose source IP address is the IP address associated with the N2 connection provided by the of MWAB-UE and destination IP address is the AMF address.
4. The UL N2 message as the UL traffic is routed to the PSA of the BH PDU session.
5. The PSA of the BH PDU session routes the N2 message to the AMF.
6. The AMF generates the DL N2 message (e.g. NG SETUP RESPONSE message) whose source IP address is the AMF address and destination IP address is the IP address of MWAB-UE.
7. The DL N2 message is routed to the PSA of the BH PDU session.
8. The PSA of the BH PDU session routes the DL N2 message to the MWAB.

#### 6.2.3.3 N3 connection over BH PDU session

##### 6.2.3.3.1 BH PDU Session Establishment for N3 connection

More details on QoS and slicing aspects are in solution 3.



Figure 6.2.3.3-1: BH PDU Session Establishment for N3 connection

1. MWAB triggers registration towards the selected PLMN and authorization of the MWAB operation is performed as defined in Key issue#2.

The MWAB establishes BH PDU Session for N2 connection and initiates NG setup procedure.

1. The MWAB initiates the service towards UE. The UE registers with network via MWAB.
2. The UE requests PDU Session Establishment.
3. The UE AMF selects a suitable SMF for PDU Session and invokes Nsmf\_PDUSession\_CreateSMContext Request.
4. The UE SMF sends an N4 Session Establishment Request to the UPF.
5. The UE SMF invokes Namf\_Communication\_N1N2MessageTransfer including N2 SM information. The N2 SM information includes UPF address and TEID of the N3 CN tunnel corresponding to the PDU Session.
6. The UE AMF forward N2 SM information to the MWAB-gNB.
7. The MWAB-UE requests BH PDU Session Establishment for N3 connection or BH PDU Session Modification if the existing BH PDU Session for N2 connection can be reused. (Details see solution 3)

NOTE 1: To maintain an efficient user plane path, the BH UPF might be selected/reselected considering the UPF the MWAB-gNB is connecting to, and the MWAB-UE may include the UPF address of the N3 tunnel in the PDU Session Establishment/Modification Request.

NOTE: the interface between MWAB-gNB and MWAB-UE is out of SA2 scope.

1. The MWAB-gNB forwards the NAS message (PDU Session ID, N1 SM container (PDU Session Establishment Accept)) provided in step 6 to the UE.
2. The MWAB-gNB sends N2 PDU Session Response including MWAB-gNB’s address and TEID of the N3 AN tunnel corresponding to the PDU Session. The MWAB-gNB’s address is same as the IP address for the BH PDU Session allocated for MWAB-UE in step 7.
3. The PDU Session Establishment procedure for UE continues.

##### 6.2.3.3.2 N3 message routing over BH PDU session



Figure 6.2.3.3-2: N3 message routing over BH PDU session

1. The UE sends UL traffic data to the MWAB.
2. The MWAB-gNB generates the UL N3 GTP-U message whose source IP address is the MWAB-gNB’s address of the N3 tunnel and destination IP address is the UPF address of the N3 tunnel corresponding to the UE’s PDU Session. The TEID of CN tunnel information is encapsulated in the GTP-U header. The MWAB-gNB sends the N3 GTP-U message to MWAB-UE.
3. The MWAB-UE determines the PDU Session ID of BH PDU Session based on the N3 tunnel information of UE’s PDU session. The UL N3 GTP-U message is routed to the PSA of the BH PDU session.
4. The PSA of the BH PDU session routes the N3 message to the UPF corresponding to the UE’s PDU Session.
5. The N3 UPF receives the N3 GTP-U message and determines the UE’s PDU Session based on the N3 tunnel information.
6. The N3 UPF generates the DL N3 GTP-U message whose source IP address is the UPF address of the N3 tunnel and destination IP address is the MWAB-gNB’s address of the N3 tunnel. The TEID of AN tunnel information is encapsulated in the GTP-U header

The DL N3 GTP-U message is routed to the PSA of the BH PDU session.

1. The PSA of the BH PDU session routes the DL N3 GTP-U message to the MWAB
2. The MWAB-UE sends the N3 GTP-U message to MWAB-gNB.
3. The MWAB-gNB determines the UE’s PDU Session based on the N3 tunnel information and sends the DL traffic data to the UE.

##### 6.2.3.3.3 BH PDU Session Modification for the existing N3 connection



Figure 6.2.3.3-3: BH PDU Session Modification for the existing N3 connection

When the N3 UPF for UE’s PDU session changes (e.g UPF relocation or UL CL/BP insertion), the UE SMF provides the updated UPF address and updated TEID of the N3 tunnel corresponding to the UE’s PDU Session to the MWAB-gNB. In this case, the MWAB can decide whether to request BH PDU Session Modification based on the updated UPF address of the N3 tunnel. The MWAB-UE includes the new UPF address of the N3 tunnel in the PDU Session Modification Request so that a suitable UPF can be re-selected by the BH SMF.

#### 6.2.3.4 Xn connection over BH PDU session

Xn includes a UP and a CP aspect. The Xn connection in the user plane which routes the traffic from MWAB-gNB to another NG-RAN. The Xn messages routing over BH PDU session is similar as the Figure 6.2.3.2-1 with the difference that the peer is another NG-RAN node. The BH PDU sessions that the UP and CP of the Xn use, if Xn is supported and configured by a MWAB, is configured by OAM much in the same way as the N2 and N3 interfaces, and e.g., the UP and CP of Xn may e.g. share the BH PDU sessions with N3 and N2 respectively.

Editor's Note: Xn-C and Xn-U over BH PDU session will be coordinated with RAN WGs.

6.2.3.5 Alternative handling of N2 transmission by using dedicated IP address for MWAB-gNB

There might be following additional treatment and modifications for MWAB-gNB IP address on top of the procedure in clause 6.2.3.2:

- Step 1: OAM may also configure MWAB with MWAB-gNB IP address(es), which is/are used to establish N2 interface/N3 connection with the AMF/UE-UPF. MWAB-gNB may use the configured IP address to interact with AMF/UE-UPF regarding N2/N3.

- Step 3: The MWAB generates the UL N2 message (e.g. NG SETUP REQUEST message) whose source IP address is the MWAB-gNB IP address allocated by OAM and destination IP address is the AMF address.

- Step 7: the DL N2 message is routed to the PSA of the BH PDU session. It is assumed that MWAB-UE-SMF selects MWAB-UE-UPF, which provides the connection to the PLMN2’s AMF and UPF. In addition, it is assumed that MWAB-UE-UPF is pre-configured with an IP range of PLMN2, which is reserved to be allocated to MWAB-gNB by PLMN 2’s OAM. Alternatively, MWAB-UE-SMF may identifies that the MWAB-gNB IP address does not belong to the IP domain managed by MWAB-UE-UPF. MWAB-UE-SMF may notifies the gateway the MWAB-UE-UPF is connecting that the MWAB-gNB IP address is now managed by MWAB-UE-UPF. In this way, the MWAB-gNB IP address configured by PLMN 2’s OAM is routable via the PLMN 1’s MWAB-UE-UPF.

#### 6.2.3.6 MWAB NG-establishment

Editor's Note: The procedure is only for information, and details need to be further coordinated with RAN WGs.



Figure 6.2.3.6-1: MWAB NG connection establishment including additional information for MWAB

The MWAB NG establishment is augmented with additional information the AMF stores to later decide what to do for MWAB UEs that attempt to register.

#### 6.2.3.7 MWAB-UE registration over other MWAB-gNB



Figure 6.2.3.7-1: MWAB-UE registration and multi-hop handling.

The MWAB-UE of MWAB 2 attempts to register over a MWAB-gNB of MWAB 1. The AMF rejects the Registration or accepts the registration without authorizing the MWAB-UE to operate as MWAB.

#### 6.2.3.8 MWAB-UE N2 handover and multi-hop handling

The MWAB-gNB is a normal gNB so N2 handover procedures are expected to be reused with the exception of some parameters like the one proposed in this clause to avoid the existence of a multi-hop chain of MWABs.

Editor's Note: The procedure is only for information, and details need to be further coordinated with RAN WGs.



Figure 6.2.3.8-1: MWAB-UE N2 handover successful

In figure 6.2.3.8-1 the AMF indicates that the UE being handed over is a MWAB UE. The target RAN node is not a MWAB so it does not interpret any of this information, so the handover is successful (there is no multi-hop).



Figure 6.2.3.8-2: MWAB-UE N2 handover successful

In figure 6.2.3.8-2 the AMF indicates that the UE being handed over is a MWAB UE. The target RAN node is a MWAB and rejects the handover.

#### 6.2.3.9 MWAB-UE Xn handover and multi-hop handling

The MWAB-gNB is a normal gNB so Xn handover procedures are expected to be reused with the exception of some parameters like the one proposed in this clause to avoid the existence of a multi-hop chain of MWABs.

Editor's Note: The procedure is only for information, and details need to be further coordinated with RAN WGs.



Figure 6.2.3.9-1: MWAB-UE N2 handover successful

In figure 6.2.3.9-1 the source NG-RAN node indicates that the UE being handed over is a MWAB UE. The target RAN node is not a MWAB, so it does not interpret any of this information, so the handover is successful (there is no multi-hop).



Figure 6.2.3.9-2: MWAB-UE Xn handover successful

In figure 6.2.3.9-2 the source NG-RAN node indicates that the UE being handed over is a MWAB UE. The target RAN node is an MWAB and rejects the handover. Note there is impact on the source NG-RAN. If a PLMN does not desire to upgrade the NG-RAN, it can e.g., disable the Xn establishment for MWABs to prevent Xn handovers to an MWAB.

As an additional option is illustrated in figure 6.2.3.9-3: the PLMN may support Xn for MWABs without any enhancement in the NG RAN but when the MWAB gNB performs a Path Switch Request the AMF evaluates whether the UE being handed over by the MWAB gNB is a MWAB and if this is that case the MWAB gNB receives a Path Switch Request Failure message causing the handover failure. The Cause code in Path Switch Request Unsuccessful Transfer IE is then populated with a new value indicating the issue is "MWAB multi-hop not allowed".

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**Figure 6.2.3.9-3: Path switch procedure.**

### 6.2.4 Impacts on services, entities, and interfaces

MWAB:

- may be configured with dedicated DNN/S-NSSAI for the PDU session for backhaul link.

- OAM configures MWAB-gNB with the PDUs session information to be used for the N2/N3.

- MWAB-gNB triggers PDU sessions establishment/modification for the BH link based on obtained configuration and uses related address(es) for N2/N3, OAM interactions.

- the address of the AMF for the MWAB-gNB to connect to can be configured by the OAM based on MWAB’s location.

- Support Multi-hop prevention feature as detailed above.

AMF:

- support identification of an NG connection as related to a MWAB and the multi-hop prevention procedures as outlined above.

OAM:

- Configuration of MWAB with BH PDU sessions information and AMF address information (and other information related to MWAB-gNB operation.

RAN:

- Xn/N2 enhancements as per the description in clause 6.2.3.4, 6.2.3.6 – 6.2.3.9.

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