**3GPP TSG-RAN WG3 Meeting #125R3-244745**

**Maastricht, The Netherlands, August 19th – 23rd 2024**

Agenda Item: 12.2

Source: Ericsson

Title: (TP for TR 38.799): Agreements and SI conclusions for WAB

Document for: Agreement

# TP for TR 38.799

-------------------------------------------Start of changes-------------------------------------------

4 Wireless Access Backhaul (WAB)

4.1 General

The study is based on the following requirements:

- The WAB-node includes a gNB component (WAB-gNB) and an MT component (WAB-MT).

- The WAB-gNB is based on the gNB functionality specified in TS 38.300 [x] and TS 38.401 [y].

- The CU-DU split of the WAB-gNB is not considered in this study.

- The WAB-MT supports at least a subset of UE functionalities.

- The NR Uu is used for the radio link between WAB-gNB and the served UEs.

- The NR Uu radio link between the WAB-gNB and the served UEs does not use NTN.

- The study focuses on NR-Uu backhaul.

- In-band scenario for access and backhaul is not precluded to be studied.

- The study precludes the scenario where the access and the backhaul are in-band while the backhaul uses NTN.

- The study focuses on the use of WAB-MT´s PDU session via NR Uu as backhaul of WAB-gNB. Other options for the backhaul (including non-3GPP radio technology) are not precluded but are not a part of the study.

- A WAB-gNB cannot serve WAB-MT(s).

- The study includes a scenario where the WAB-gNB and the WAB-MT connect to the same PLMN or to different PLMNs.

- The WAB-MT may connect to a public PLMN or an SNPN.

- The WAB-gNB may connect to a public PLMN or an SNPN.

- Legacy UEs can connect to the WAB-gNB. There are no WAB-specific enhancements for UEs that connect to the WAB-gNB.

4.2 WAB Architecture

Figure 4.2-1 shows an example of WAB architecture for 5GS when the WAB-gNB’s NG traffic is transported via PDU session backhaul.

****

**Figure 4.2-1: The WAB architecture example for 5GS when the WAB-gNB traffic is transported via PDU session backhaul**

The neighbour NG-RAN node can be a BH-RAN-node, or a surrounding NG-RAN node. The WAB-gNB’s OAM traffic can also be transferred over the BH PDU session(s).

Figure 4.2-2 shows an example of WAB architecture for 5GS when the WAB-gNB’s NG traffic is transported via non-3GPP backhaul:

****

**Figure 4.2-2: The WAB architecture example for 5GS when the WAB-gNB traffic is transported via non-3GPP backhaul**

Figure 4.2-3 shows protocol stack examples of NG Control plane and User plane transport for a UE connected to the network via a WAB-node.

****

**Figure 4.2-3: Protocol stack examples of NG Control plane and User plane transport for a UE connected via WAB-node**

Figure 4.2-4 shows protocol stack examples of Xn Control plane and User plane transport for WAB-node.

****

**Figure 4.2-4: Protocol stack examples of Xn Control plane and User plane transport**

Figure 4.2-5 shows an example of WAB architecture for using a L2TP tunnel gateway (LNS) for WAB-gNB’s traffic over the BH PDU session(s).

****

**Figure 4.2-5: The WAB architecture example for 5GS using L2TP gateway to convey the WAB-gNB’s traffic over the BH PDU session(s)**

Figure 4.2-6 shows protocol stack examples for NG Control plane and User plane transport using a L2TP tunnel.

****

**Figure 4.2-6: The protocol stack for NG-U and NG-C transport using L2TP tunnel over BH PDU session(s)**

The solutions using L2TP shown in Figures 4.2-5 and 4.2-6 do not guarantee inter-vendor interoperability since support of L2TP is not mandated for NG and Xn. Therefore, these solutions are out-of-scope of this study.

4.3 Operational aspects

4.3.1 WAB-node integration procedure

****

**Figure 4.3.1-1 WAB-node integration procedure**

**Phase 1: WAB-MT setup.** The WAB-MT of a WAB-node connects to the network in the same way as a UE by performing RRC connection setup procedure with the BH-RAN-node. The WAB-MT then performs, authorization and authentication with the BH-5GC. After the WAB-MT is authorized, the WAB-MT can establish one or more PDU sessions for backhauling.

**Phase 2: WAB-gNB setup.** This phase includes the following 3 sub-phases:

**Phase 2-1: WAB-gNB initialization.** In this phase, the WAB-gNB is configured by the OAM (e.g., with the information of AMF(s) to serve the UE) and service-authorized by the SeGW or by the OAM.

**Phase 2-2: NG connection setup.** The WAB-gNB establishes NG connection(s) toward the AMF(s). This step may follow legacy procedures. After the NG is set up, the WAB-gNB can start serving UE(s).

**Phase 2-3: Xn connection setup.** If needed, the WAB-gNB may establish Xn connection(s) towards the BH-RAN-node and/or other NG-RAN node(s).

4.3.2 WAB authorization

WAB authorization includes the authorization of the WAB-MT and the service authorization of the WAB-gNB. The authorization of the WAB-MT is different from the service authorization/configuration/activation of the WAB-gNB.

Authorization of the WAB-MT provides the WAB-MT with the right to support backhauling the traffic of the co-located WAB-gNB via BH PDU session(s).

Authorization of the WAB-gNB provides the service authorization, i.e., the right to serve UEs. The service authorization of the WAB-gNB is performed by e.g., OAM/SeGW using legacy procedures.

The WAB-gNB’s service authorization status may change. In case the WAB-gNB’s service authorization status changes from “authorized” to “not authorized”, the UEs served by the WAB-gNB can either be handed over to other RAN nodes or they can be released, after which the NG and Xn connection(s) of the WAB-gNB can be removed.

4.3.3 Configuration of WAB-node

Certain configurations of the WAB-node may need to be updated as the node moves, e.g.:

- The parameters that enable the WAB-gNB to select and connect to the AMF(s) to serve the UE(s).

- The parameters that enable the WAB-gNB to connect to, and communicate with, the OAM system.

- The configuration parameters that the WAB-gNB should broadcast, e.g., the TAC(s), the cell ID(s), the RANAC(s).

A WAB-node may be provisioned with the parameters pertinent to different potential locations of the WAB-node.

Alternatively, the OAM can provision configuration parameters to the WAB-node based on the location of the node. In that case the continuity of OAM connectivity needs to be ensured as the WAB-node moves.

4.3.3.1 IP address configuration for WAB-gNB

A WAB-MT obtains IP address(es) for the PDU sessions in the same manner as a legacy UE.

The WAB-gNB can use the IP address(es) of the WAB-MT for the PDU sessions that backhaul the NG, Xn and OAM traffic. The WAB-gNB supports security protection of NG and Xn via IPsec, as defined by TS 33.501.

In case the WAB-gNB uses the IPsec tunnel mode to protect the OAM, NG and/or Xn traffic, the allocation of the inner tunnel IP address(es) is outside of 3GPP scope.

It is possible to transport OAM, NG or Xn traffic over other types of tunnel protocols on top of the WAB-MT’s PDU session(s), e.g., such as L2TP. In this case, the WAB-gNB uses different IP address(es) from WAB-MT. Since the support of these tunnel protocols is not defined for NG and/or Xn, such tunnel protocols are out-of-scope of this study.

4.3.3.2 TAC/RANAC (re-)configuration for WAB-gNB’s cell

The TAC/RANAC of WAB-gNB’s cell is configured by the OAM, and it can be reconfigured by the OAM during the mobility of WAB-node. The TAC/RANAC of the WAB-gNB’s cell may be the same as, or different than, the TAC/RANAC of the co-located WAB-MT’s serving cell. The TAC/RANAC broadcast by the WAB-gNB’s cell can be changed in order to reflect the WAB-node’s physical location.

4.3.4 Mobility handling

The following scenarios for WAB-node mobility are supported:

1. The UE´s AMF/UPF remains unchanged as the WAB-gNB moves.

2. The UE´s AMF/UPF changes as the WAB-gNB moves.

3. The BH-UPF/-AMF remains unchanged as the WAB-MT moves inside a PLMN.

4. The BH-UPF/-AMF changes as the WAB-MT moves inside a PLMN.

RAN3 assumes that the WAB-gNB does not change PLMN while the WAB-node moves across the network.

4.3.4.1 WAB-MT mobility

The WAB-MT reuses legacy mobility handover procedures for the UE as it moves throughout the BH-RAN.

4.3.4.1.1 The BH-UPF remains unchanged as the WAB-MT moves inside a PLMN.

In case the WAB-MT’s PSA UPF does not change during these mobility procedures, the IP addresses allocated for the WAB-MT’s PDU sessions do not change. Therefore, the NG and Xn connections of the WAB-gNB carried over the BH PDU session(s) remain unaffected.

4.3.4.1.2 BH-UPF changes as the WAB-MT moves inside a PLMN.

When the WAB-MT’s PSA UPF need to be changed due to WAB-MT’s mobility, new BH PDU session(s) need to be established reusing existing mechanisms defined in TS 23.501 [x]//TS 23.502 [y]/. In this case, the (outer) IP addresses used by the WAB-gNB for the transport of NG and Xn connections of the WAB-gNB will change.

4.3.4.1.3 Roaming of the WAB-MT

During WAB-node movement, the WAB-MT may connect to a PLMN different than its HPLMN.

4.3.4.2 WAB-gNB mobility

During WAB-node movement, establishment, and removal of the WAB-gNB’s NG and/or Xn connections may be needed.

Establishment of Xn connections of the WAB-gNB with BH-RAN nodes, as well as with surrounding RAN nodes, is supported, and it can follow legacy procedures.

4.3.4.2.1 WAB-gNB mobility without change of UE’s AMF(s)

During WAB-node movement, radio configuration parameters of the WAB-gNB may be changed (e.g., cell ID, PCI and/or TAC) without the change of the UE’s AMF(s). This change of radio configuration parameters may require the UE handling by means of, e.g., intra-gNB handover and/or Mobility Registration Update as defined in TS 23.502 [y].

4.3.4.2.2 WAB-gNB mobility with change of UE’s AMF(s)

Due to WAB-node movement, the change of UE’s AMF(s) may be needed, based on, e.g., WAB-node’s current location and/or additional criteria. The NG connection handling and WAB-gNB configuration update may affect the served UEs.

4.3.4.2.2.1 Solution with two logical WAB-gNBs

The steps for the solution with two logical WAB-gNBs are as follows:

1. The WAB-node may obtain the configuration parameters needed to establish the connection to the UE’s new AMF(s).

2. A new logical WAB-gNB is instantiated, and it establishes NG connection(s) towards one or more new AMF(s).

3. The new logical WAB-gNB may activate one or more new cells, with new cell configuration parameters related to the WAB-gNB’s current location. The new cells may broadcast the radio parameters configured for the new AMF(s), e.g., TAC, etc. The old cell(s) remain(s) active.

4. The UEs are handled as follows:

- A UE in RRC\_CONNECTED state is handed over between an old cell served by the old logical WAB-gNB and a new cell served by the new logical WAB-gNB via NG-based handover with AMF relocation, as defined in TS 23.502 [y]. When all UEs in RRC\_CONNECTED state have been handed over, the old cell(s) are removed from service.

- A UE in RRC\_IDLE or RRC\_INACTIVE state camping on the old cell(s) reselects a new cell, and legacy procedure (e.g., Mobility Registration Update procedure as defined in TS 23.502 [y]) is performed.

5. The NG connection(s) between the old logical WAB-gNB and the old AMF(s) are removed and the WAB-gNB is removed from service.

4.3.5 Resource multiplexing

In scenarios where WAB-node’s access link and backhaul link mutually interfere, resource coordination may be needed to facilitate the resource multiplexing of the WAB-node’s access links and backhaul link. For this purpose, the resource coordination mechanism introduced for IAB can be considered as the starting point. For resource coordination between the access link and backhaul link, the BH-gNB may need to discover co-location of the WAB-MT and the WAB-gNB.

4.4 Other

>>>>>>>>>>>>>>>>>>Unchanged parts are skipped<<<<<<<<<<<<<<<<<<

# 6 Conclusions

6.1 WAB

RAN3 confirms the feasibility of WAB functionality and recommends that a normative phase for WAB is pursued. The conclusions of the WAB part of the SI are as follows:

* The normative work for WAB should be based on the functionalities, terminology and requirements captured in the present TR. Addition of further details during normative phase is not precluded.
* The normative work should consider the following architectural aspects for WAB according to the present TR:
	+ Backhauling of the WAB-gNB’s NG, Xn and OAM traffic is conducted over the WAB-MT’s PDU session(s).
	+ WAB-gNBs can establish Xn interface(s) with the WAB-MT’s serving BH RAN node and with other surrounding gNBs.
	+ The interface between the WAB-MT and the co-located WAB-gNB is out-of-scope for the normative phase.
	+ Split architecture of the WAB-gNB is out-of-scope for the normative phase.
* Authorization procedures for the WAB-MT are out of RAN3 scope, and are expected to be handled by SA2. RAN3 should define the WAB-node behaviour in case the authorization status of the WAB-MT and/or WAB-gNB changes.
* The normative phase should define integration procedures for WAB nodes following the description in the present TR.
* Mobility procedures to be used for the UEs served by a WAB-gNB are legacy UE mobility procedures. Mobility of the WAB-MTs is based on legacy UE mobility procedures.
* During the normative phase, handling of WAB-gNB’s traffic (including Xn, NG and OAM traffic) during WAB-node mobility should be defined, including the case where the WAB-MT’s BH PDU session changes.
* During the normative phase, the procedure to support the UE’s AMF change for UEs connected to, or camped on, a WAB-gNB, should be defined in cooperation with SA2.
	+ Solutions for mobility will be further analysed during normative phase.
		- RAN3 concludes that the two-logical-gNB solution is feasible.
		- It remains to be verified, based on feedback from SA2/RAN2, whether the single-gNB solution is feasible and whether enhancements are needed.
* During the normative phase, enhancements to the UE’s ULI that reflect the WAB node’s location should be defined.
* During the normative phase, the handling of the following should be discussed and captured:
	+ PCI collision.
	+ Reconfiguration of TAC and RANAC on WAB-gNBs.
	+ Avoidance of multi-hop WAB topology.
	+ Radio-resource coordination between access and backhaul links.
* The normative phase should further discuss the following:
	+ Handling of backhaul link degradation by the backhaul network and the WAB-gNB.
	+ Xn connection management (e.g., potential avoidance of setting up Xn between WAB-gNBs, dynamic establishment/removal of Xn connectivity with BH-RAN-node and surrounding NG-RAN-nodes).
	+ NG connection management (e.g., procedures for NG connection removal/suspension).
	+ Handling of PDB and PER for traffic of UEs served by the WAB-gNB and QoS flow of WAB-MT.
	+ Handling of RRC\_INACTIVE UEs.

-------------------------------------------End of changes-------------------------------------------