3GPP TSG-RAN WG3 #125bis R3-245753

Hefei, China, 15th – 19th October, 2024

Agenda Item: 12.2

Source: NTTDOCOMO (moderator)

Title: Summary of Offline Discussion on WAB

Document for: Approval

# Introduction

This document provides a summary of the offline discussion on WAB.

**CB: # WAB**

* **Decide in which Stage 2 specs text reflecting the agreements shall be included**
* **Based on the agreements taken, draft stage 2 CRs**
* **Discuss solutions on multi hop WAB and down select, if possible**
* **Draft LS to SA2 on ULI. Reply LS in R3-245752 (Qualcomm)**

(Moderator - DoCoMo)

Summary of offline disc R3-245753

# Discussion

**RAN3 to consider the following RAN based solutions to avoid multi hop WAB:**

**Solution 1: The WAB-gNB uses dedicated frequencies and/or PCIs. FFS on any other legacy OTA parameters.**

**Solution 2: Use the slice dedicated for backhauling, i.e. use a list of S-NSSAIs in RRCsetupcomplete to do access control and/or use a list of S-NSSAIs in handover signalling. No involvement of 5GC is expected**

**Solution 3: WAB-gNB-cells broadcast a new indicator in SIB to bar WAB-MT, and the WAB-MT avoids (re)selection of cells broadcasting this indicator.**

**Solution4: BH-gNB broadcasts a new indicator “WAB allowed” in SIB. WAB-gNB does not broadcast “WAB allowed”.**

**Solution5: In case of handover for a WAB-node, the WAB-node indication is included in the HO request, then the target BH-RAN node can perform access control for this WAB-node.**

**To be continued…**

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| **solutions** | **Pros** | **Cons** |
| **Solution 1: The WAB-gNB uses dedicated frequencies and/or PCIs. FFS on any other legacy OTA parameters.** | **No stage3 impact.** | * **Since operators have limited Frequencies/PCI resources, it is difficult to realize it in reality.**
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| **Solution 2: Use the slice dedicated for backhauling, i.e. use a list of S-NSSAIs in RRCsetupcomplete to do access control and/or use a list of S-NSSAIs in handover signalling. No involvement of 5GC is expected** | **No stage3 impact.** | * **The operator may not want to reserve any slice dedicated to WAB, or WAB is also accessible to the default slice, then this solution is not valid anymore to prevent multi-hop.**
*
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| **Solution 3: WAB-gNB-cells broadcast a new indicator in SIB to bar WAB-MT. The WAB-MT avoids (re)selection and reporting measurement results of cells broadcasting this indicator.** | **This solution explicitly bar the WAB-MT, so it is a clean solution.****The enhancements are only limited to WAB-node itself.** | * **There is stage3 impact.**
* **Potentially, the connected WAB-MTs have to read SIB1 of neighbour cell during cell (re)selection and measurement.**
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| **Solution4: BH-gNB broadcasts a new indicator “WAB allowed” in SIB. WAB-gNB does not broadcast “WAB allowed”.** |  | * **There is stage3 impact.**
* **It requires legacy gNB to support new indicator in SIB. (i.e. legacy BH-RAN needs an upgrade)**
* **For handover, it is not workable.**
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| **Solution5: In case of handover for a WAB-node, the WAB-node indication is included in the HO request, then the target BH-RAN node can perform access control for this WAB-node.** |  | * **There is stage3 impact.**
* **This solution only works for handover case.**
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Q1: Please fill your companies views (Pros/Cons) for each solution (only add comments that are not reflected in the table above)

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| --- | --- |
| Company name | Comments |
| Huawei | For solution 2, if access control is performed by NG-RAN node, it definitely has stage 3 impact to RAN node behavior. For solution 4, the pros is it can cover both inband and outband WAB scenario, Considering the inband WAB should select a BH-gNB which supports resource multiplexing, Otherwise, the WAB may connects a legacy gNB which is not upgraded but suitable for the inband WAB. |
| **Ericsson** | **Solution 1:** We do not think that PCI space size and frequency availability are showstoppers for this option.**Solution 2:** Before continuing to discuss this option, it **needs to be clarified whether the CN is involved or not.****Solution 3:** @Moderator: why does this option not work for HO? It works essentially in the same way as Solution 1. **Solution 4:** Downside is that **legacy BH-RAN needs an upgrade**. Also why does the following part need to be mentioned: “**WAB-gNB does not broadcast “WAB allowed”.**”?**Solution 5:** Downside is that **there is a functional CN impact**, where the target BH-gNB will need to verify with the CN whether the WAB-MT is what it claims to be, i.e., a WAB-MT. Also, we need a solution that covers both access and HO, and this solution only applies to HO. |
| CATT | Solution 1 and solution 2 are very common configuration-based ways and thus already possible. However, the drawback is that the operator may not want to reserve the dedicated frequency/PCI/NSSAI for WAB usage.Solution 3 is a supplement way in case the configuration-based solutions not workable, the case where WAB-MTs are accessible to all network areas except WAB cells. Support of solution 4 would base on some mandatory enhancement for BH RAN node to support WAB. However, we don’t understand what the enhancement is at present. It’s justified to have the enhanced resource multiplexing in in-band scenario, but that doesn’t mean the gNB not supporting the specific resource multiplexing for WAB should be prohibit to serve WAB-MT, because the legacy gNB can still do the resource multiplexing by implementation.Solution 5 introduces the mandatory enhancement to BH RAN-node as solution 4. |
| Canon | Solution 2Agree with Huawei that having the NG-RAN node performing access control would create Stage 3 impact at NG-RAN node anyway.One drawback of solution 2 lies in the endless access attempts by a stationary WAB-MT. It is also unclear whether the AMF may need to be involved in the Access Control process at some point (in such case, solution 2 is no longer a RAN-based solution).Solution 3Benefit of solution 3 is that it guarantees that a WAB-MT would not attempt to connect to a WAB-gNB, hence ensuring that multi-hop can be prevented, while relying on simple and non-ambiguous signaling (limited stage 3 impact).Solution 5 can complement solution 3 on the handover aspects.Solution 4Benefit of solution 4 is that it would ensure that a WAB-MT would never connect to a WAB-gNB, hence ensuring that multi-hop can be prevented, while relying on RAN-based mechanisms. Drawback of solution 4 is that a WAB node cannot differentiate a WAB-gNB from a legacy RAN node (as none of them is sending the “WAB allowed” in SIB) and would therefore refrain to connect to a legacy BH RAN Node. Solution 4 would thus require all the RAN nodes to be upgraded as WAB-enabled RAN nodes (no legacy BH RAN node). FFS if such systematic RAN nodes upgrade is an issue.Solution 5Benefit of solution 5 is that it guarantees that a WAB-MT would not connect to a WAB-gNB in case of handover, while having limited stage 3 impact.Moreover, having the WAB indication sent through a UE capability would make Solution 5 applicable to both WAB-aware and legacy source BH RAN nodes.In case the WAB indication is an S-NSSAI, Solution 5 is similar to Solution 2 for handover (Solution 5 is actually a superset of solution 2 for handover). Solution 5 only applies to handover and is not relevant for the access control scenario.Solution 3 can complement solution 5 on the access control aspects. |
| **Qualcomm** | The solutions need to be assessed in the context of the severity of multi-hop WAB:* 1. Multi-hop WAB is unlikely to happen since WAB-gNB covers only a small area within the vehicle.
* 2. In case it happens, it doesn’t create major damage. The only thing that may happen is that the latency on the BH is a little larger.

In this light, the following can be concluded:**Solution 1:** This solution covers a large fraction of all use cases, and therefore, it sufficiently protects multi-hop WAB to occur. We should certainly capture this on stage-2 since it does not require any stage-3 change.**Solution 2:** This fully eliminates multi-hop WAB for both scenarios (initial access and handover) and it does not have any stage-3 impact. Here is how it works:* Initial access: WAB-gNB does not support WAB-specific slice ID. Therefore, WAB-gNB does not include WAB slice ID in the NG Setup message to AMF. When MT accesses the WAB-gNB using WAB slice ID, the AMF will reject this slice since it is not supported by the WAB-gNB.
* Handover: WAB-gNB rejects HO request including WAB-specific slice ID.

**Solution 3:** Only prevents from multi-hop WAB for initial access. Not for handover. Has stage-3 impact. It also has impact on the WAB-MT. This solution is not needed.**Solutions 4 and 5:** Have stage-3 impact on BH RAN and should therefore be avoided. These solutions are also not needed. |
| ZTE | For solution 2, the list of S-NSSAIs in RRCsetupcomplete messsage refers to the *s-NSSAI-List* IE, which means WAB-gNB can perform access control based on this IE. Specifically, WAB-gNB know that the UE sending this message is a WAB-MT. And then the WAB-gNB can release the RRC connection for the UE. In this way, this solution is a RAN-based solution without CN involved. **Solution 2: Use the slice dedicated for backhauling, i.e. use a list of S-NSSAIs in RRCsetupcomplete to do access control and/or use a list of S-NSSAIs in handover signalling. No involvement of 5GC is expected** |
| Nokia | **Solution 1**: ok, but it has restriction to the operator. Especially the frequency range limitation is a problem, considering that we need to provide as much flexibility as possible to make WAB a success. **Solution 2:** We do not understand the concerns, e.g. stage-3 impact from Solution 2. Even gNB does not reject the UE (i.e. WAB-MT in this case), it can still be rejected by CN via existing behavior. Please remember this is same as existing UE/Non-WAB case, a UE may try connection with a gNB not supporting the requested slice of the UE, and get rejected by RAN or by CN. It is same for WAB. As long as it is normal/existing CN behavior to reject a UE due to the reason of slicing, it can be reused for WAB. It does not matter whether you name it as a RAN only solution or CN-solution for Solution 2.We should not mandate Requested NSSAI in the RRCSetupComplete either. In case WAB-MT reports this in RRCSetupComplete, then AMF selection can take place. Otherwise, AMF redirection can happen after a wrong AMF is selected based on subscription information (this is what was discussed in SA2). Note that this does not require any RAN node upgrade.If the list is not supported by any AMF that RAN node has a connection with, then of course you need to release the WAB-MT but anyway this is logical to release.In case of handover of WAB-MT to a WAB-gNB, as the WAB-gNB will not support the slices dedicated for WAB-MT, anyway WAB-MT handover will be rejected. As seen above, there is no new impact to RAN.**Solution 3 and Solution 4: we have a strong concern on introducing any Uu enhancement, which will make WAB-MT different to a normal UE. Please remember the failure of IAB. A key point to make the WAB success is to reuse a commercial UE chipset for WAB-MT. Otherwise, WAB will be another “IAB”!**For ZTE rewording, there is no need to mention CN since it does not change CN behavior. The point is no CN enhancement for Solution 2. But NO need to restrict the CN to Not perform existing slicing related action also for WAB-MT. |
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Q2: which solutions are preferred? Please explain the reasons.

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| Company name | Comments |
| Huawei | For initial access, prefer Solution 3 and 4. The really RAN based solution will make sure the WAB-node selects suitable BH-gNB at early stage.For handover, prefer solution 5. |
| LGE | For initial access, we prefer solution 3. For initial access in solution 2, if AMF instructs the UE to never include NSSAI in the Access Stratum according to Clause 5.15.9 of TS 23.501, the WAB-gNB cannot initiate RRCRelease msg. For solution 4, it requires the enhancement of legacy gNB.For handover, we prefer solution 2. If target is WAB-gNB, it can reject the Handover Request for the WAB-MT based on S-NSSAI dedicated for backhauling. |
| **Ericsson** | We prefer the **RAN-based Solutions 1 and 3**, which work for both HO and initial access. |
| Samsung | Prefer solution 3 and 5.Because the above solutions are proposed to avoid multi-hop WAB, which is the relation between WAB nodes, the solution 3 is enough for initial access. In addition, solution 5 can be used for handover, which is similar with IAB. |
| Lenovo | For initial access control, we refer solution 3. Solution 1 has some limitations on deployment and solution 2 is a CN-based solution. For solutions 3 and 4, they are both workable, but solution need to update the legacy gNB.And in the handover case, we prefer solution 5. |
| CATT | Solution 1 and 2 are configuration based and already there. Solution 3 is presented to make up the drawback of solution 1 and 2. Solution 3 only impacts WAB-node itself and it will not introduce any enhancement to other RAN-node, thus WAB can work in legacy network.Solution 4 and 5 introduce mandatory enhancement to BH-RAN node, that WAB is impossible to work in legacy network.So, we choose **solution 3 as the spec-based solution for the supplement to solution 1 and 2.** |
| Canon | **For initial** **access control, preference for Solution 3**, as this would guarantee a RAN-based approach while having limited Stage 3 impact.**For handover, preference for Solution 5** as it has limited stage 3 impact while also relying on a true RAN-based approach. FFS on the format of the WAB indication, e.g., in UE capability.  |
| Qualcomm | Solutions 1 and 2 |
| ZTE | Solutions 1 and 2 since they don’t require any signaling enhancement and work well.  |
| Nokia | Solutions 1 and 2 |

Moderator Summary:

Solution1: Qualcomm, ZTE, Nokia

Solution2: Qualcomm, ZTE,LG, Nokia

Solution3: Huawei, LG, Ericsson, Samsung, Lenovo, CATT, Canon

Solution4: Huawei

Solution5: Huawei, Samsung, Lenovo, Canon

For multi-hop prevention, majority companies support solution2/3 (for initial access) and solution5 (for handover).

Moderator understands that solution5 is the superset of solution2. If dedicated S-NSSAIs are assigned to WAB-MT, then target gNB can reject handover request based on the dedicated S-NSSAIs in Handover request message. Given solution2 has less stage3 impact than solution5, it is suggested to down select to solution2.

For solution4, it needs operators to do upgrade on legacy gNBs, which is not preferable from easy introduction of WAB feature point of view.

For solution1, it is already feasible by legacy specification.

Therefore, for multi-hop prevention, it is proposed to down select to following three solutions.

**Solution 1: The WAB-gNB uses dedicated frequencies and/or PCIs. FFS on any other legacy OTA parameters.**

**Solution 2: Use the slice dedicated for backhauling, i.e. use a list of S-NSSAIs in RRCsetupcomplete to do access control and/or use a list of S-NSSAIs in handover signalling. No CN upgrade is needed.**

**Solution 3: WAB-gNB-cells broadcast a new indicator in SIB to bar WAB-MT, and the WAB-MT avoids (re)selection of cells broadcasting this indicator.**

# Conclusion, Recommendations

Proposal1: For multi-hop prevention, RAN3 to down select to following three solutions.

**Solution 1: The WAB-gNB uses dedicated frequencies and/or PCIs. FFS on any other legacy OTA parameters.**

**Solution 2: Use the slice dedicated for backhauling, i.e. use a list of S-NSSAIs in RRCsetupcomplete to do access control and/or use a list of S-NSSAIs in handover signalling. No involvement of 5GC is expected**

**Solution 3: WAB-gNB-cells broadcast a new indicator in SIB to bar WAB-MT, and the WAB-MT avoids (re)selection of cells broadcasting this indicator.**

# References

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| [R3-245402](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245402.zip) | Functional Aspects of WAB-Nodes (Ericsson) | discussion |
| [R3-245391](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245391.zip) | (TPs for TS 38.300/38.413) Architecture and Access control for WAB (Huawei) | other |
| [R3-245247](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245247.zip) | (draft Reply LS to SA2) Discussion on SA2 questions on multi-hop WAB and UE ULI (Qualcomm Inc.) | other |
| [R3-245175](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245175.zip) | (TP for TS 38.401) Discussion on high level aspects for WAB (Nokia, Nokia Shanghai Bell) | other |
| [R3-245176](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245176.zip) | (TP for TS 38.423) Discussion on WAB mobility (Nokia, Nokia Shanghai Bell) | other |
| [R3-245248](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245248.zip) | Discussion on assumptions and architecture for WAB (Qualcomm Inc.) | other |
| [R3-245252](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245252.zip) | Discussion on stage-2 aspects for WAB (CATT) | discussion |
| [R3-245253](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245253.zip) | Other issues for WAB (CATT) | discussion |
| [R3-245286](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245286.zip) | (TP to BL CR of 38.423 on WAB) Discussion on the reliability and mobility for WAB (NEC) | other |
| [R3-245381](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245381.zip) | Discussion on Wireless Access Backhaul (NTTDOCOMO, INC.) | discussion |
| [R3-245383](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245383.zip) | Discussion on enhancements for WAB (CANON Research Centre France) | discussion |
| [R3-245392](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245392.zip) | (TP for TS 38.300) Discussion on WAB related procedures (Huawei) | other |
| [R3-245155](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245155.zip) | Discussion on WAB mobility (Samsung) | discussion |
| [R3-245156](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245156.zip) | Discussion on other aspects for the support of WAB (Samsung) | discussion |
| [R3-245403](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245403.zip) | Reply to SA2 Regarding WAB-MT Access Control and Additional ULI for WAB-Nodes (Ericsson) | discussion |
| [R3-245446](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245446.zip) | Architecture and configuration for WAB-node (Lenovo) | discussion |
| [R3-245447](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245447.zip) | Integration and migration for WAB node (Lenovo) | discussion |
| [R3-245637](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245637.zip) | Access control and location information in WAB (LG Electronics) | discussion |
| [R3-245640](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245640.zip) | Discussion on RAN2 impact of WAB (China Telecom) | discussion |
| [R3-245641](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245641.zip) | On Xn and NG interface management (China Telecom) | discussion |
| [R3-245655](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245655.zip) | (TP to 38.300) Discussion on supporting WAB and the reply LS to SA2 (ZTE Corporation) | other |
| [R3-245656](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125-bis%5CDocs%5CR3-245656.zip) | (TP to 38.305 38.455) Support of location service involving WAB (ZTE Corporation) | other |