3GPP TSG-RAN WG2 #119-e R2-22xxxxx

Online, Aug 17 – 25, 2022

Agenda Item: 8.12.1

Source: Qualcomm Inc.

Title: [AT119-e][031][IAB18] (Qualcomm)

Document for: Discussion

# Introduction

This paper captures the following offline discussion:

* [AT119-e][031][IAB18] (Qualcomm)

Scope: Based on the input/proposals to this meeting, the WID, and the online discussion, the rapporteur is asked to carefully select a limited number of points / sub-topics that are interesting from R2 point of view Can discuss: whether there is a possible way forward, an issue that need to be resolved etc. If applicable can also identify points to ask other group(s) in an LS out.

Intended outcome: Report, identifying, possible agreements/ways forward, issues that need to be resolved, points to be excluded, with <= **5** proposals.

Deadline: In time for short CB W2 Friday

*Chair: Note that the bar is high for identifying FFSes, issues that need to be resolved for this WI. R2 should only work on core Uu functionality that is essential for this WI. After more R3 progress there will be plenty of concrete points to look at.*

The offline has the deadline: **Wednesday, 24th August, 2022, 23:59 UTC.**

# Discussion

## 2.1 Rel-18 UE cell (re-)selection

Multiple contributions propose to discuss enhancements to cell (re-)selection for Rel-18 UEs from/to/between mobile IAB-nodes.

**Qualcomm R2-2207283, Samsung R2-2207816, Vivo R2-2208459** propose to discuss cell (re-)selection criteria from/to mobile IAB cells for Rel-18s UEs.

**Apple R2-2207421, Interdigital R2-2208267** propose that the Rel-18 UE receives information on the mobile-IAB-node’s mobility state, potentially from SIB.

**Intel R2-220712, Lenovo R2-2207708** propose that the mobile IAB-node broadcasts its mobility attribute.

**Proposal 1: The mobile IAB-node to broadcast information related to the IAB-node’s mobility state, e.g., to aid Rel-18 UEs to perform cell (re-)selection. Details on this information are FFS.**

**Q1: Do you support this proposal. If not, please provide reasons/rewording.**

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| **Company** | **Yes/No** | **Comments** |
| Apple | Yes | Please note that NR Rel-17 TEI has introduced the feature of HSDN (High-Speed-Railway Dedicated Network) targeting for a similar scenario as mobile IAB. Specifically, NR HSDN specified a mobility state based cell reselection to optimize mobility performance of high-speed state UE within a High-Speed-Railway. In more details, NR HSDN introduced below spec changes:   * Introduce a HSDN bit (*hsdn-Cell-r17*) in SIB1 to indicate if a cell is a NR HSDN cell. And it is up to a HSDN-capable UE implementation to determine whether it is in High-mobility state. * When the HSDN capable UE is in High-mobility state, the UE shall always consider the HSDN cells to be the highest priority. When the HSDN capable UE is not in High-mobility state, the UE shall always consider HSDN cells to be the lowest priority.   We think reusing this specified solution as much as possible is the most straight forward solution with minimal spec, especially considering RAN2 has only 5.5 TU. With this simple solution, we can leave more time for more interesting topics (e.g. group mobility). |
| Lenovo | Yes | As comments by Apple. The same solution can be specified for mobile IAB.  For mobile IAB, the mobile IAB-node broadcasts the mobile attribute in SIB1 to assist the Rel-18 UEs to perform cell (re-)selection, especially for the onboard UEs. And the UE can determine whether it is onboard or surrounding based on implementation or other normative solutions if needed. |
| Kyocera | No | We think the existing method, i.e., based on the radio quality, still works well. For example, in case the mobile IAB-node is deployed on a train, the UE in the train moves together with the IAB-node and these are located nearby, so the radio quality between the UE and the mobile IAB-node is good and stable, while the radio quality between the UE and the outside cells is varied and worse. So, we think the UE in the train will continue to camp on the mobile IAB-node.  In addition, the WID clearly states that “*No optimizations for the targeting of surrounding UEs.*” We assume this restriction is applied to the cell reselection from/to the mobile IAB-node, especially for the case of cell reselection “to” the mobile IAB-node since these UEs are the surrounding UEs. |
| Ericsson | Yes | We are in principle fine with this, but our preference would be to not broadcast such information in SIB1 mainly for two reasons. The first is to not increase the size of SIB1 that is already quite big and the second one is due to the fact that multiple information may need to be broadcasted.  According to this, having a dedicated SIB for mobile IAB makes more sense for us. |
| Fujitsu | No | We share the same view as Kyocera.  For any UE (no matter on-broad UEs or UEs surrounding the mIAB), if the radio link between the UE and the cell which is selected at present by the UE is good enough, the UE will keep camping on the cell. Thus, no enhancement is needed. |
| Samsung | Yes but… | We agree that cell (re)selection criteria should be optimized/enhanced for on-board UEs. But we do have some sympathy for concerns expressed by Fujitsu and Kyocera on potential impact to surrounding UEs. If, for this proposal to work, it relies on UEs determining whether they are a surrounding UE or an on-board UE (e.g. based on mobility), this may require normative work potentially affecting all Rel-18 UEs. So some clarification of this matter would be useful in our view. |
| Huawei, HiSilicon | Maybe no | We are fine to broadcast some information of “mobile IAB cell indication”, with the assumption to left the **R18 UE behaviors as implementation** rather than specified.  It is not clear how UE can utilize this information without knowing it is “on-board”. Before specify any UE behaviors, we need to first discuss how to determine “on-board” at UE side.  Also, “**the IAB-node’s mobility state**” is not clear. If it is more than just “1 bits indication”, we don’t support such optimization considering the WID “*No optimizations for the targeting of surrounding UEs*” |
| Sony | Yes | Agree with Apple. And we think the assistance information e.g. mobility state can help UE to perform cell selection/re-selection. |
| ZTE | No | Actually, the relative mobility between mobile IAB node and UE is more important for the UE’s cell selection/re-selection. The mobile state information broadcast by mobile IAB node can not reflect the relative mobility. On the contrary, the UE may detect the relative mobility based on the change of RSRP measurements. |
| Interdigital | Yes | Information about IAB node’s mobility will help rel-18 UEs to perform cell re-selection in an optimal manner. For example, UEs that are avoid or deprioritize cell re-selection to a mobile IAB’s cell, and mobile UEs that are currently camping on the mobile IAB cell can avoid or deprioritize cell re-selection to other cells. |

## 2.2 IAB-node reports to CU

Multiple contributions propose that the mobile IAB-node reports mobility-related information to the network, e.g., so that the CU can include such information in UE handover decisions, to simplify some RRC procedures, to allow the network to create a mIAB mobility history, to avoid that the network selects the mobile IAB-node as a parent node in topology adaptation, etc.

**Intel R2-2207122, Lenovo R2-2207708, Qualcomm R2-2207283, Kyocera R2-2208291** propose that the mIAB-node reports its mobility predicate to the CU.

**Qualcomm R2-2207283** , **Sony R2-2207827** propose that the mIAB-node reports its location to the CU.

**Intel R2-2207122, Qualcomm R2-2207283** propose that the mIAB-node reports information on its velocity to the CU.

**Ericsson R2-2208103, Interdigital R2-2208267** propose that the UE obtains information on the mobile IAB’s mobility state, e.g., position, velocity, access class/category via dedicated signaling. This implies that the network receives this information from the mobile IAB-node before.

**Rapporteur: RAN3 agreed:** The donor CU should know that the IAB node is “mobile”.

**Proposal 2: The mobile IAB-node to report to the CU information related to its mobility state, e.g., its mobility predicate, location, velocity, etc. Details on this information are FFS.**

**Q2: Do you support this proposal. If not, please provide reasons/rewording.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Apple | Yes with modification. | We agree that the intention is clear, and the solution is reasonable. However, we think some info in e.g. need further discussion. For example of "mobility predicate", we have questions: how can 3GPP specify a reliable "mobility predicate" which can be trusted by CU? If not reliable enough, will it mislead CU? Or if it is reliable, what is its validity duration?  Thus, we disagree to directly add examples without any technique discussions. So, we suggest to remove the e.g part, i.e.  **Proposal 2: The mobile IAB-node to report to the CU information related to its mobility state~~, e.g., its mobility predicate, location, velocity, etc~~. Details on this information are FFS.**  Please note that FFS has covered the point that RAN2 can further discuss which info is necessary. |
| Lenovo | Yes | Share the same view with Apple.  **Proposal 2: The mobile IAB-node to report to the CU information related to its mobility state~~, e.g., its mobility predicate, location, velocity, etc~~. Details on this information are FFS.** |
| Kyocera | Maybe No | We assume an “Mobile IAB-node Indication” in Msg5, which is similar to the existing IAB Node Indication in Msg5. But we think it’s useful especially in case the mobile IAB-node is only allowed to connect with the IAB-donor. RAN2 already agreed the mobile IAB-node can also connect with the stationary/intermediate IAB-node, so the Indication has a limited benefit, e.g., for the identification which is a different context from the discussion for mobile IAB-node migration (i.e., this email discussion).  For the location and velocity for predictive migration, we think the donor-CU can configure the IAB-MT with the immediate MDT, if needed. So, we wonder what needs to be discussed in RAN2. |
| Ericsson | Yes with comments | We think that probably is a bit premature now to agree on this proposal even if we have some sympathy for it. Before discussing this it would be good to understand how the overall group mobility procedure would work. |
| Fujitsu | Yes | And we think no harm to list the possible candidates which are presently identified by companies, although further study is needed. |
| Samsung | Needs further clarification | First of all, rewording by Apple is definitely needed in our view. But even with that rewording, current measurement report message already includes the location info field with detailed information including speed estimate. Therefore we feel legacy signaling may be enough. It’s only if we need information on top of that available in legacy signaling, that we need to study this further. |
| Huawei, HiSilicon | No | The mobility of mobile-IAB-MT has no difference with legacy UE. So, no enhancement is needed. The location/velocity information is not useful compared to the legacy RRM measurement for mobility.  UE reporting of location/velocity information are already supported in current spec (see CommonLocationInfo-r16). It is not clear what the additional impact from this proposal is for mobile IAB-MT. |
| Sony | Yes | We support to provide mobility information and we can discuss the details e.g. what information and its signalling in next stage. |
| ZTE | No | We think the mobile IAB-MT may indicate that it is an mobile IAB node in the RRC setup procedure so the RAN-node may select AMF which support mobile IAB for the mobile IAB-MT. This information can also be used to avoid that the network selects the mobile IAB-node as a parent node in topology adaptation, etc. We see no extra benefits for the support of mobility predicate, location, velocity, etc. |
| Interdigital | Needs further discussion | RAN3 has already agreed that donor CU is informed whether the IAB node is mobile or not. Whether that information is sufficient or more detailed information (e.g., location, velocity, etc.,) is needed is something that should be decided based on discussion on how such information can be used by the network. |

## 2.3 Differentiation of source and target cells during full migration

The discussion on full migration of stationary IAB started in Rel-17. RAN3 proposed a solution, where the UE hands over between cells of logical DUs. They asked RAN2 if these cells could share the same physical resources and/or the same PCIs (LS in R2-2106950). Based on this LS, RAN2 agreed:

* R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.

For mobile IAB, this prior discussion is presently revisited in RAN3. In the same manner, RAN2 needs to revisit the agreements from Rel-17, e.g., considering that full migration may become a rather frequent event for mobile IAB. The following contributions have addressed this issue:

**Intel R2-2207122** proposes that UEs hand over between logical cells during full migration.

**Huawei R2-2207129** proposes that these cells use separate physical resources, which may co-exist at the same time during full migration, so that the handovers can occur gradual. The authors believe that the implementation of these “separate physical resources” should be clarified by RAN1.

**Lenovo R2-2207709** proposes that the cells operate in the same frequency band.

**Rapporteur: RAN3 agreed:**

The UEs connected to the mobile IAB-node are handed over from the cell of the logical mobile IAB-DU (i.e., the source logical mobile IAB-DU) that has an F1AP association with the source CU to the cell of the logical mobile IAB-DU (i.e., the target logical mobile IAB-DU) that has an F1AP association with the target CU.

**RAN3 chair further noted:**

**Whether source and target logical cells should appear to the UE as distinguishable cells on layer 1 is discussed in other WGs and pending progress communication from them.**

**Proposal 3: RAN2 to discuss how the UE can differentiate the source cell and target cell on the IAB-node during full migration, e.g., based on PCI, frequency, etc.**

**Q3: Do you support this proposal. If not, please provide reasons/rewording.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Apple | Yes | We think this proposal makes sense, and it is an essential issue to address. |
| Lenovo | Yes |  |
| Kyocera | Maybe | We think the mobile IAB-node shall anyway support legacy UEs, so the legacy handover should be the baseline, i.e., the traditional HO Command or Conditional Reconfiguration. In this case, the UE just follows the serving cell’s instruction during the handover.  We assume it’s the simplest way and the baseline that the source cell and the target cell are operated on different frequencies, and it’s FFS and possibly up to RAN3 whether these cells will be operated on the same frequency. In addition, we assume different PCIs are assigned to the source cell and the target cell respectively. |
| Ericsson | Wait RAN3 progresses | We think that we need to wait RAN3 progresses on this matter before taking any agreement or assumption. |
| Fujitsu | No, see comment | We believe the scenario that the same frequency resource shared between the cells on two logical DUs is necessary and important for the operators.  And we doubt about the motivation of this proposal since UE does not need to differentiate the source cell and target cell on the IAB-node during full migration. UE just follows the network instruction for changing PCI, reconfiguring other cell level parameters (e.g., NCGI) or updating the security key. Even in legacy handover, UE just know some cell parameters are changed rather than which is source cell or which is target cell, i.e., UE does not need to know what happens exactly on the network side. |
| Samsung | Yes |  |
| Huawei, HiSilicon | Yes | Maybe we can reformulate it like  **Proposal 3: UE observers the source cell and target cell on the mobile IAB-node as different cell during full migration. FFS on how to differentiate, e.g., based on PCI, frequency, etc.** |
| Sony | Yes |  |
| ZTE | Yes |  |
| Interdigital | Yes |  |

## 2.4 PCI collision avoidance

The following contributions propose to investigate PCI collision issues due to mobile IAB:

**Intel R2-2207122, Qualcomm R2-2207284, Sharp R2-2208251, Nokia R2-2208343, Apple R2-2207422, Vivo R2-2208459** propose to discuss solutions to PCI collision.

**Samsung R2-2207627** proposes to wait for RAN3 feedback. RAN2 to study impact on UEs.

**Huawei R2-2207129** proposes an explicit solution to PCI change to avoid collision

**Sony R2-2207827** proposes that IAB-node reports its location to detect PCI collision

**Ericsson R2-228104** proposes that existing mechanisms should be considered.

The rapporteur sees the following issues:

* PCI partitioning, e.g., via network planning mechanisms, can be used. This approach may not scale very well to large number of mIAB-nodes since there are only 1008 PCI values available.
* Dynamic mechanisms could be applied where the PCI of the IAB-node is changed based on information on actual or potential PCI collision. Such PCI change procedures need to be defined by RAN3.
* RAN2 could define mechanisms to obtain information on actual or potential PCI collisions from information that is available on the RAN, e.g., UE and/or IAB-MT measurements report, the mIAB-node’s mobility information or location history, route prediction, etc.. Such information may have benefit for PCI planning as well as for dynamic PCI-change procedures.

**Proposal 4: RAN2 to discuss mechanism for the RAN to obtain information on actual or potential PCI collisions.**

**Q4: Do you support this proposal. If not, please provide reasons/rewording.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Apple | Yes with modification (we disagree original wording) | 1. We are fine if RAN2 to discuss a solution that UE can report potential PCI collision to NW to prevent PCI collision. However, we suggest to make it clear it is within RAN2 scope, i.e., **it is UE to report** the potential PCI collision (which is within RAN2 scoping) rather than via inter-node signaling (which is RAN3 scoping and old RAN3 topic). Meanwhile, please note that MT reporting is not in scoping of this release due to the note in WID objective (The mobile IAB-node should have no descendent IAB-nodes, i.e., it serves only UEs**)**.  2. We don't think the UE can detect actual PCI collisions without RAN1 spec change. In our understanding, with current procedure specified in TS 38.213, it is impossible for a UE to differential two Cells' NCGI which have same PCI and in same frequency. Please note that it is not mandate UE to acquire SIB1 for neighbor cells.  Thus, based above analysis, we suggest below changes:  **Proposal 4: RAN2 to discuss mechanism for the RAN to obtain information on ~~actual or~~ potential PCI collisions from UE.** |
| Lenovo | No | PCI collision can be avoided via OAM in most cases of mobile IAB scenario. And the PCI Optimization Function can be applied as a supplement if PCI suffers collision in some other cases. |
| Kyocera | Maybe | As other possibility, we wonder if a network-based solution can be considered. For example, F1 SETUP REQUEST already contains Served Cell Information, so the donor-CU may check via Xn if the mobile IAB-node’s PCIs makes a collision at the neighbour gNBs.  So, we tend to think RAN2 may wait for RAN3’s progress for now. |
| Ericsson | No | We believe existing mechanism address the scenario of a PCI collision. Further, we think that 1008 PCI values are a lot, considering that partitioning can be applied on top of it and that the OAM may assign the same PCI range to two different CU that are e.g., far away to each other’s.  If we want to do some enhancement on the PCI collision, we need to motivate in which scenarios the existing mechanism we have do not work (at all). |
| Fujitsu | Yes | We believe present mechanism for optimization of PCI collision is not sufficient for mIAB case and we are fine with RAN2 to discuss further enhancement to PCI collision detection.  RAN2 can study the mechanisms to obtain information on PCI collisions which is listed by rapporteur, e.g., UE and/or IAB-MT measurements report and the mIAB-node’s location. |
| Samsung | Yes | With regards to changes proposed by Apple, we do not think we should rule out MT reports (which help CU detect PCI collisions). |
| Huawei, HiSilicon | With update | Maybe we can indeed assume the PCI update, if needed, is RAN3 issue.  Therefore, we propose reformulation for RAN2 to investigate if anything needs to done in RAN2 on the detection:  **Proposal 4: RAN2 to investigate if any enhancement/impact is need to handle the PCI collision detection and avoidance.** |
| Sony | Yes | We can discuss RAN2 based more timely manner solutions, to mitigate PCI collision. |
| ZTE | See comments | According to the current spec, the UE may report the PCI and corresponding NCGI of neighboring cells to gNB. And gNB may detect the potential PCI collision based on that. IAB-MT may follow a similar behavior if needed. And we don’t see any enhancement needed on detection of PCI collision from RAN2 perspective as of now. But we are ok to discuss this issue in RAN2. For proposal 4, we think “information on actual or potential PCI collisions” is confusing. And we suggest the following rewording to P4:  **Proposal 4: RAN2 to discuss mechanism for the RAN to ~~obtain information on actual or~~ detect potential PCI collisions.** |
| Interdigital | Yes | Though network can avoid the PCI collision to some extent via PCI by proper planning/partitioning, it is not optimal to completely rely on this as this will put a limitation on flexibility of deployment and scalability. |

## 2.5 RACH resource collision avoidance

**Huawei: R2-2207129, Lenovo R2-2207709, Ericsson R2-228104** discuss RACH collision issues related to mobile IAB. Generally, there is the feeling that the existing mechanisms may be sufficient. The contributions further propose sending an LS to RAN1 and ask if they anticipate any RACH collision issues for mobile IAB.

**Rapp: RAN3 agreed:**

From RAN3 perspective, no enhancements are needed for RACH collision avoidance unless requested by other WGs.

**Proposal 5: Send LS to RAN1 to ask if they see RACH collision issues for mobile IAB.**

**Q5: Do you support this proposal. If not, please provide reasons/rewording.**

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| **Company** | **Yes/No** | **Comments** |
| Apple | No | 1. We think it is premature to send LS to RAN1. If sending LS is necessary, RAN2 should at least include the typical UE number for group handover and IAB node's typical speed in the LS. Otherwise, we don't think RAN1 can make any progress. However, we don't think RAN2 can achieve consensus on these typical number within this week.  2. RAN2 has agreed to consider RACH-less HO. If RACH-less is agreed, why do we need RAN1's input?  3. In our understanding, if without RACH-less HO, RACH collision can happen only if UE group handover happens before MT migration (i.e. NW needs to send handover command to all UEs within a short duration). With another alternative, if UE group handover happens after inter-donor DU switch, we don't think the RACH collision can happen because target CU can send dedicated handover command to all UEs just like legacy handover. However, the decision should be made by RAN3. |
| Lenovo | Yes | RACH-less HO can avoid the RAHC collision. However, the UE needs to support the HO with RACH as baseline and RACH-less HO is just an optimization.  For the UE perform HO together with mobile IAB-node full migration, RAN2 only to consider the RACH collision avoidance if the RACH collision issue has been identified by RAN1. |
| Kyocera | Yes | We think RAN1 is the suitable WG to evaluate RACH collisions, e.g., PRACH interference, RAR from wrong cell, etc. due to RACH resource collision. |
| Ericsson | Yes with comment | We think that for the RACH collision we have the same discussion as for the PCI collision and thus existing mechanism can be reused. However, we are fine to double check with RAN1 if they see any scenario where a RACH collision happen and if this is a problem. |
| Fujitsu | Yes | Whether RACH-less can be applied to UE handover need further discussion. Up to now, RACH-less HO is only studied in intra-CU mobility enhancement in RAN2. RACH-less HO has not been considered in inter-CU mobility in which case the security key should change and PDCP has to be re-established. Obviously, it is inter-CU handover for the UEs connected to the cell on mIAB-DU that RACH-less HO cannot be used normally.  For the evaluation of RACH resource collision, RAN2 can send LS to RAN1. |
| Samsung | Yes | We’re not sure why Apple is suggesting we wait until RAN2 agrees IAB node’s typical speed. Why is this issue solely within RAN2’s remit? RAN1 may have their own view on this.  If Apple wants to highlight the fact that scenarios have not been firmed up yet, and that they should be, then we actually agree and would support further work on this asap, but this is a cross-WG issue. In any case we agree with sending this LS. |
| Huawei, HiSilicon | Yes, with clarification | It seems companies has different view on this term of “RACH collision”.  The so-called RACH-less related issue, i.e. the RACH resource congestion issue, is not R1 issue. No LS is needed.  The RACH collision issue, we may need R1 discussion, is the RACH collision between mobile-IAB cell and neighbor cell.  Then, the proposal can be:  **Proposal 5: Send LS to RAN1 to ask if they see RACH resource/configuration (or any other physical resource) collision issues between mobile-IAB cell and neighbor cells** |
| Sony | Yes |  |
| ZTE | No | Two issues on RACH collision were under discussion in RAN3 (i.e. Issue 1: conflict of the RACH resource configuration; Issue 2: collision of UE RACH attempts), we need to make clear which issue does the RACH collision issue in proposal 5 refer to.  In our view, issue 1 is in RAN3 scope and is under discussion in RAN3. For issue 2, we think even if RAN2 agree to use RACH less CHO, it is suggested to double check with RAN1 on its feasibility. However, RACH collision due to UE RACH attempts occurs only when inter-topology transport is not supported during full migration. If inter-topology transport is supported, UEs could be handed over to target cell gradually thus there is no RACH collision issue in this situation. So we prefer to wait for the RAN3 progress on full migration procedure, e.g., whether inter-topology transport is supported. |
| Interdigital | Maybe | From RAN2 point of view, we can look into the application of RACH-less HO for the mobile IAB case (i.e., apply it even in inter-CU scenario). It could be beneficial to have some progress on the HO signaling in RAN2/RAN3 before sending an LS to RAN1, to make sure that we are asking the right questions. |

# Conclusion

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