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.**

|  |  |  |
| --- | --- | --- |
| **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. |
| Nokia | No | We believe there are more critical impacts to RAN brought by the moving mobile-IAB node. Guiding surrounding UEs on how to perform cell re-selection based on a potentially new indicator on IAB-node mobility state seems to go beyond primary and baseline objectives of the WI.  We agree, the relevance of the existing broadcast information (such as HSDN information or IAB-support) needs to be identified for mobile-IAB operations in the course of the WI, but the proposal with the concrete solution on mobility state is too premature.  Suggestion to reword the proposal:  Proposal 1: RAN2 identifies the relevance of the existing broadcast information (e.g., HSDN information or IAB-support) to mobile-IAB operations. |
| LGE | No, see comments | Before discussing a detailed solution, RAN2 should clearly identify and understand what problem we want to address by the considered solution. From our understanding, the issues addressed by the papers mentioned above are not same, hence it is unclear what RAN2 are really trying to solve. For instance,   * Does the solution intend to suppress cell reselections of on-board UEs to other cells? Or * Does the solution intend to suppress cell reselection of non-on-board UEs to the mobile node? * Or something else? * Or all above?   Currently RAN2 have not discussed if the problem (whichever is considered) cannot be solved by existing solutions. That is, we cannot decide if a new solution is really necessary and what aspect of the problem should be most importantly addressed by the solution.  Due to the ambiguity of the problem, it is already ambiguous what the mobility status here exactly means. Does it mean that the cell “can” move (not necessarily now) or does it mean that the cell is currently on the move or moving beyond a certain mobility speed or does it mean something else?  We want RAN2 to spend some time to better understand what problem we need to solve, before agreeing to a certain solution direction prematurely. Even though we do think cell reselection enhancement is essential for mobile IAB WI, we are fine with discussing it in a more focused and systematic manner. So we propose to reword the proposal:  **Proposal Alt: Discuss if cell (re-)selections should be enhanced to reduce unnecessary cell reselection of UEs (on-board UEs and surrounding UEs).** |
| Xiaomi | With comments | Firstly we understand this question to be about a distinct mobility state indication (varying) and not mobile IAB capability, so sent in SIB maybe questionable.  (unconvinced) we share a similar concern expressed by Huawei, in that the benefits of mobility state compared to establishing on-board status are not evident from these proposals. Also existing radio measurements plus some understanding of relative mobility between UE and mIAB are possibly sufficient.  We note the mobility of these nodes is quite different from HS trains in that they can be stuck in slow moving as well as various different degrees of moving traffic so the number of levels of mobility as indicated in [R2-2207421] that are need to ensure reliable performance for on-board UEs over surrounding UEs is unclear.  We remain open for more discussion on this of course. |
| Intel | Yes | We think introducing IAB-node mobility related information could be beneficial for the onboard UEs to not perform unnecessary cell reselection after it connects to a mobile IAB-node, as well as switching from/to a stationary gNB when it is getting on/off of the vehicle.  Moreover, the proposed IAB node’s mobility state information could also be beneficial to the served UEs in RRC\_CONNECTED mode. |
| MITRE | Need clarification | We realize there is some benefit in the additional SIB information. However, the security aspects of this SIB will also need to be studied. A mobile IAB can be more vulnerable because it is not housed in safe/monitored premises. |
| Qualcomm | Yes, see comment | An indicator for cell mobility should be included in SIB. Together with this indicator and RF measurements, the UE could identify its relative speed with respect to the mobile IAB-node vs. to the stationary network. This can be left up to implementation.  Information such as velocity and location should not be included in SIB it is dynamic in nature and idle/inactive UEs would have to continuously re-read SIB. |

**Summary:**

**7 companies: Yes**

* **Apple, Lenovo, Ericsson, Interdigital, Sony, Intel, Qualcomm**

**6 companies: Open to discussion**

* **Samsung:** Need to discuss if UEs do not have to determine if they are onboard or not.
* **Huawei:** Not more than one bit of info and only if UE behavior is up to implementation
* **Xiaomi:** Open to further discussion. Not clear about the benefits, e.g., if UE does not know if it is onboard.
* **LGE:** The purpose and benefits need to be identified. Further, cell is mobile vs. moving needs to be clarified. UE reselect to/from mobile IAB, etc. Proposal Alt: Discuss if cell (re-)selections should be enhanced to reduce unnecessary cell reselection of UEs (on-board UEs and surrounding UEs).
* **Nokia:** Proposal 1: RAN2 identifies the relevance of the existing broadcast information (e.g., HSDN information or IAB-support) to mobile-IAB operations.
* **MITRE:** Security issues need to be considered

**3 companies: No**

* **Kyocera, Fujitsu:** Existing RF-based cell (re-)selection is sufficient
* **ZTE:** Relative mobility is more important and that can be obtained from RF

**Rapporteur’s view:**

There was a 13:3 majority in favor of further discussing the matter. We are certainly not at the stage where we can agree on any information to be carried in SIB. However, the feedback indicates that companies want to identify the scenarios where mobile-IAB broadcast enhancements can have benefits to the cell (re-)selection considering the UE’s limited information whether it is onboard of the vehicle, or what its speed is with respect to the mobile IAB-node vs. the stationary network.

**Proposal 1: RAN2 to discuss scenarios, where enhancements to mobile IAB-node broadcast can benefit cell (re-)selection to/from the mobile IAB-node, including how the UE could determine its relative speed with respect to the vehicle vs. the stationary network, and/or whether it is onboard of the vehicle.**

## 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. |
| Nokia | No | It seems too premature to decide the indication ‘on mobility state’ is sent, while it not known what the meaning and content of such indication is. A straightforward approach to distinguish mobile-IAB nodes in the CU, could be to rely on a simpler indication that determines the IAB-node is mobile-IAB (e.g., capability). If this isn’t sufficient, one could think on further optimizations e.g., on how quickly is the mobile-IAB moving.  Nokia\_[after RAN3 agreements review]:  It turns out to be RAN3 specific proposal. RAN3 has already made an agreement, according to which “mobile” is an indication that the node is a mobile IAB-node, not about its mobile state/velocity.  No need to have such specific proposal in RAN2. |
| LGE | No | It should be clear what problem we really need to solve by the considered solution and how exactly the proposed information can be useful. Furthermore, the mobility status information itself is quite unclear. More discussion is definitely needed before diving into a certain solution direction.  As other companies already comments, donor-CU (i.e., network) can identify real-time mobility state of each mobile IAB node based on measurement reports of the mobile IAB node. If the donor-CU also utilizes measurement reports of UEs connected to the IAB nodes and combines the reporting with its knowledge of the topology and/or local map information, if available, it can also predict near-future mobility state of the mobile IAB. So, we are not sure which enhancement is needed for this proposal. |
| Xiaomi | With comments | We think assistance to the CU-CP could be beneficial particularly in regards to group mobility for descendant UEs, but prefer further discussion on details including whether existing measurement signaling is sufficient. |
| Intel | Yes | In general, we agree with the proposal that the mobile IAB-node can report some mobility related information to IAB-donor. For example, by knowing mobility state related information, IAB-donor CU can decide not to configure the served UEs not to perform measurement report, hence reducing the power consumption at UE side, as well as singaling overhead. |
| MITRE | Yes (static only) | It is fine for the mobile IAB node to indicate its mobile nature to CU statically (similar to iab-NodeIndication-r16 in RRCSetupComplete). This may help with some CU algorithms optimization. However no dynamic protocol enhancements are needed. For stationary IAB-MT, CU does the measurement configuration to perform discovery, measurement and measurement reporting of candidate donor nodes. That should also work for mobile IAB-MT. As in legacy solution, location/velocity can be part of those measurement reports. |
| Qualcomm | Yes | At least the mobile-IAB indication should be sent to the donor-CU. Some companies claim that MDT could be used to determine the IAB-MT’s velocity and location. This is certainly true, but is may also cause a lot of overhead, especially if there are a lot of mobile IAB-nodes out there. |

**Summary:**

**Apple, Lenovo:** Need to determine how the RAN can reliably confirm the IAB-node’s mobility report. 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, LGE, Samsung, Huawei:** CU can obtain measurement reports form mobile IAB-MT and configure MDT if it wants.

**Ericsson:** Further discussion should be dependent on the outcome of group-mobility discussion

**ZTE, Nokia, MITRE, Qualcomm:** Mobile-IAB indicator sufficient.

**InterDigital:** Discuss how this information can be used by network.

**Fujitsu, Sony, Intel:** Yes

**Rapporteur’s view:**

Most companies agree that the IAB-node should send a mobile-IAB indication, or they propose solutions that imply that the CU has received such indication.

Many companies believe that the CU can already obtain mobility information from the IAB-node, e.g., via MDT. Obviously, for this it would have to receive the node’s mobile-IAB indication.

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

Based on this, RAN2 could agree that the mobile IAB-MT sends a mobile-IAB indication to the IAB-donor-CU.

**Proposal 2: The mobile IAB-MT to send a mobile-IAB indication to the IAB-donor-CU.**

## 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 |  |
| Nokia | See comment | We agree with Kyocera assessment, that legacy UEs should need to be intentionally supported. Thus, target to rely on the existing radio procedures to select target cell should be the baseline. From the UE and radio perspective, the target node selection should be architecture-agnostic (full or partial migration approach wont be known to the UE).  Nokia [after RAN3 agreements review]:  RAN2 could consider the RAN3 red text:  **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.**  Which would lead to the following proposal:  Proposal 3: RAN2 to discuss how the UE can differentiate the source and target logical mobile IAB-DU cells (e.g. different carriers, different resources within a carrier, resource sharing, etc.) |
| LGE | No | The intention of proposal is a bit unclear to us.  In particular, if we consider necessary HO support for on-board legacy UEs, we agree with Kyocera and Nokia’s analysis. Existing HO mechanisms should be applied for those UEs, meaning that target cell must be physically differentiated from the source cell. Given that, we do not clearly understand what the proposal wants to discuss. More clarification is needed. |
| Xiaomi | Yes |  |
| Intel | Yes | For the same PCI/frequency, it can also be supported by intra-cell handover. |
| MITRE | Yes |  |
| Qualcomm | See comment | RAN2 agreed in Rel-17, that for full migration, the UE should see the two logical cells as separate physical cells. RAN2 needs to rediscuss this aspect.  In case the UE sees the two cells as separate physical cells, the UE has to perform a legacy handover. It is up to RAN1 to decide how the UE differentiates the two physical cells. AT&T had a nice contribution in Rel-17, where the cells use separate PCI at the same frequency by TDMing radio resources. In any case, this is all RAN1.  In case the UE sees the two cells as the same physical cell, RAN2 needs more discussion. We still need an RRC Reconfiguration with resync for the security update. Also NCGI has to be changed for both, connected and idle/inactive UEs. This raises the question if there is a big difference in the signaling between both scenarios. |

**Summary:**

**Apple, Lenovo, Huawei, Samsung, Sony, ZTE, InterDigital, Xiaomi, Intel, MITRE, Qualcomm** agree to discuss this matter.

**Kyocera, Ericsson** want to wait for RAN3 progress. In the meantime, RAN3 has made progress and moved the issue to RAN2.

**Kyocera, Nokia** want to focus on legacy UEs. The rapporteur agrees that legacy UEs need to be discussed with higher priority.

**Kyocera, Nokia, Intel** believe that the UE should see the logical cells as same physical cell (i.e., use same PCI/frequency):

**Huawei, LGE** believe that the UE should see the logical cells as separate physical cells:

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 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.**

**Rapporteur’s view:**

Based on this feedback and RAN3 agreement, it seems RAN2 needs to discuss whether the legacy UE should see the two logical cells as separate vs. same physical cell(s), and what procedure the UE needs to perform in either case.

**Proposal 3: For DU migration, RAN2 to discuss whether the legacy UE should see the two logical cells as separate or same physical cell(s), and what procedure(s) the legacy UE needs to perform in either case.**

## 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. |
| Nokia | No | We confirm the PCI collision issue should be investigated. For instance, a potential change of PCI as a remedy of a collision should not result in a side-issue to UEs connected to the mobile IAB-node such as service interruption or RLFs if the procedure for the PCI change would not be fast enough.  Though, making the assumption that RAN “needs to obtain” the information on actual or potential collisions has RAN3 dependency. RAN3 assumptions might play an important role and should be respected to not introduce alternate solutions for the same problem.  Nokia [after RAN3 agreements review]:  Given the relevant agreements from RAN3:  From RAN3 perspective, existing mechanism can be used for PCI collision detection in mobile IAB scenario. Further enhancement is FFS.  RAN3 to discuss whether mobile IAB needs any enhancements to the existing mechanisms for PCI collision avoidance and/or optimization.  We believe it would be more appropriate to wait for RAN3 progress. |
| LGE | No | Considering the following RAN3 agreements, it would be better to wait further RAN3 progress on this issue for now.  PCI space partitioning via OAM configuration can be used in some cases for avoidance of PCI collisions.  From RAN3 perspective, existing mechanism can be used for PCI collision detection in mobile IAB scenario. Further enhancement is FFS.  RAN3 to discuss whether mobile IAB needs any enhancements to the existing mechanisms for PCI collision avoidance and/or optimization. |
| Xiaomi | Yes | We also support that IAB-MT reports should be included in scope of discussions, in order to inform the CU. |
| Intel | See comment | In general, we agree with the intention that the network can use information from UE (e.g. measurement reports, mobility history, etc) to avoid potential PCI collision, especially for the vehicles (e.g. bus) that follow the same route everyday. However, those information are already supported by existing mechanism/procedure. We are not sure about the need for additional specified solutions to detect PCI collision. |
| MITRE | Maybe | OK to wait on RAN3 progress. |
| Qualcomm | See comment | RAN2 should certainly assess if PCI portioning by itself is sufficient to address the PCI collision issue for mobile IAB. We believe that 1008 PCI values and static configuration does not scale sufficiently well. E.g., if we set aside half of them for mobile IAB, we could only support 504 mobile IAB-nodes.  We believe that the present PCI collision detection mechanisms provide a solid baseline. We do not believe RAN2 should spend too much time discussing enhancements. |

**Summary:**

**Apple, Kyocera, Fujitsu, Samsung, ZTE, InterDigital, Xiaomi, Sony**, **Qualcomm** agree to discuss the matter.

**Intel, ZTE:** Existing means to detect (pending) PCI collision are sufficient

**Kyocera, LGE, Nokia, MITRE**: should wait for RAN3 progress.

**Lenovo, Ericsson**: PCI collision can be sufficiently well handled via PCI partitioning

RAN3 agreed:

**PCI space partitioning via OAM configuration can be used in some cases for avoidance of PCI collisions.**

**From RAN3 perspective, existing mechanism can be used for PCI collision detection in mobile IAB scenario. Further enhancement is FFS.**

**RAN3 to discuss whether mobile IAB needs any enhancements to the existing mechanisms for PCI collision avoidance and/or optimization.**

**Rapporteur’s view:**

The question asked by the Rapporteur was admittedly a little narrow. The Rapporteur believes that PCI collision due to cell mobility is a novel aspect of mobile IAB, and that it is within both RAN2’s and RAN3’s scope. The feedback confirms that a large number of companies want to discuss the matter. From the feedback, the following questions can be derived:

* Does RAN2 believe that PCI partitioning alone is a suitable solution to avoid PCI collisions for all mobile IAB deployment scenarios or would RAN2 like to see a dynamic mechanism supported for PCI change? Based on the feedback, only 2/16 companies believe that PCI partitioning is sufficient. RAN3 presently keeps its options open. If considered necessary, RAN2 can always ask RAN3 to discuss such a dynamic mechanism.
* Are the present mechanism to detect PCI collision sufficient to allow for PCI collision avoidance, either through PCI reconfiguration or via dynamic PCI change procedures? Only 2/16 companies believe the present mechanisms are sufficient. At least 9/16 companies are open to further discussion.

Based on the feedback, the Rapporteur believes that RAN2 should further discuss these questions.

**Proposal 4: RAN2 to discuss whether PCI partitioning is suitable to avoid PCI collisions for all mobile IAB deployment scenarios or whether a dynamic PCI change mechanism is needed, and whether enhancements are necessary to improve PCI collision detection.**

## 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.**

|  |  |  |
| --- | --- | --- |
| **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. |
| Nokia | Maybe | Agree that RAN1 insight would be helpful, but since the issue is under RAN3 discussions, RAN3 conclusions should be taken into account too. |
| LGE | Maybe | We think that RACH collision can be avoided by the existing mechanism and proper RACH resource configuration by RAN3. Given RAN3 agreement “From RAN3 perspective, no enhancements are needed for RACH collision avoidance unless requested by other WGs.”, it would be good to final check whether there is RACH collision issues for mobile IAB from RAN1 perspective. |
| Xiaomi | Maybe | Clearly RAN1 are the group to confirm RACH collision issues. However, we should avoid asking open ended question e.g. what scenarios they see a problem under?, as such further RAN2/RAN3 progress could be considered first. |
| Intel | Yes | It’s ok to send LS to RAN1 and check if there’s any RACH collision issue for mobile IAB. However, since there’s no TU in RAN1 for Rel-18 mIAB, we are wondering, if any issue identified, RAN1 may not have time to work on the solution. |
| MITRE | Yes | RAN3 has deferred it to other WGs, RAN2 should take it up with RAN1. |
| Qualcomm | Yes | We believe that from RAN2 perspective, the existing mechanisms to mitigate RACH collision hold up to IAB-node mobility within a stationary network.  RAN2 should ask RAN1 if they see any issues. |

**Summary:**

The feedback indicated that companies see two different areas where RACH collision may occur:

1. RACH during DU migration

* **Apple, Lenovo, Fujitsu, ZTE, InterDigital,**

2. RACH collision between mobile IAB and stationary network

* **Kyocera, Ericsson, Huawei, ZTE, LGE, Qualcomm**

Views on sending an LS to RAN1:

**11 out of 16 companies: Yes**

* **Lenovo, Kyocera, Ericsson, Fujitsu, Samsung, LGE, Huawei, Sony, Intel, MITRE**

**2 out of 15 companies: No**

* **Apple, ZTE**

**3 out of 15 companies: Later, i.e, after more progress in RAN2 and/or RAN3**

* **InterDigital, Nokia, Xiaomi**

**The Rapporteur’s view:**

The Rapporteur believes that RACH collision during DU migration is still pending on the details on of the DU migration procedure.

For RACH collision between mobile IAB and stationary network, RAN3 does not see a problem. In RAN2, not all companies have considered this type of RACH collision in this offline. For that reason, we may want to converge if RAN2 sees an issue for this type of RACH collision, and/or whether RAN2 should ask RAN1 to consider RAN1-related aspects.

**Proposal 5: RAN2 to discuss whether there is a problem of RACH collision between mobile IAB and stationary network from RAN2 perspective and/or whether RAN2 should ask RAN1 to consider RAN1-related aspects.**

# Conclusion

The following proposals have derived from companies’ feedback and comments:

**Proposal 1: RAN2 to discuss scenarios, where enhancements to mobile IAB-node broadcast can benefit cell (re-)selection to/from the mobile IAB-node, including how the UE could determine its relative speed with respect to the vehicle vs. the stationary network, and/or whether it is onboard of the vehicle.**

**Proposal 2: The mobile IAB-MT to send a mobile-IAB indication to the IAB-donor-CU.**

**Proposal 3: For DU migration, RAN2 to discuss whether the legacy UE should see the two logical cells as separate or same physical cell(s), and what procedure(s) the legacy UE needs to perform in either case.**

**Proposal 4: RAN2 to discuss whether PCI partitioning is suitable to avoid PCI collisions for all mobile IAB deployment scenarios or whether a dynamic PCI change mechanism is needed, and whether enhancements are necessary to improve PCI collision detection.**

**Proposal 5: RAN2 to discuss whether there is a problem of RACH collision between mobile IAB and stationary network from RAN2 perspective and/or whether RAN2 should ask RAN1 to consider RAN1-related aspects.**