3GPP TSG-RAN WG3 #117bis-e R3-225980

Online, 10th -18th October, 2022

Agenda Item: 13.3

Source: Huawei (moderator)

Title: Summary of CB: # IAB3\_MobEnh

Document for: Approval

# Introduction

This paper is for the following offline discussion:

|  |
| --- |
| **CB: # IAB3\_MobEnh**  **- Discuss whether mIAB-node configurations should be stored at the mIAB node, e.g.:**   * **multiple F1- and BAP-related configurations, corresponding to different target donors, that can be activated upon fulfilment of certain condition(s)** * **PCI list, IP address, IAB-DU cell configuration and F1 association, BH configuration**   **- Discussion on procedures for group mobility, including**   * **signalling of mobility information for group of UEs** * **whether the benefits are clear** * **whether the focus should be on enhancements to reduce signalling** * **Which interface should be impacted?** * **Is there any dependency with work in RAN2?**   **- Discuss identification of onboard UEs**   * **Should Idle/Inactive UEs be also considered?** * **Is there dependency with progress in RAN2?** * **Can it be done by implementation?**   **- Discuss whether there is a need to change broadcast information for mIAB-nodes during mIAB node mobility**  **- Discuss issues concerning user location information and whether to consider the case where it does not match the real user location (e.g. during partial migration)**  (HW - moderator)  Summary of offline disc [R3-225938](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\z00377060\ReceiveFile\Inbox\R3-225938.zip) |

The following papers will be covered as assigned by the chair:

|  |  |  |
| --- | --- | --- |
| [R3-225346](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225346.zip) | Enhancements for IAB-Node Mobility (Ericsson) | discussion |
| [R3-225360](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225360.zip) | Enhancements for mobility of IAB-node and its served UEs (Qualcomm Inc.) | discussion |
| [R3-225436](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225436.zip) | Discussion on IAB-node mobility together with served UEs (Fujitsu) | discussion |
| [R3-225440](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225440.zip) | Discussion on enhancements to UE migration in mobile IAB scenario (ZTE) | discussion |
| [R3-225441](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225441.zip) | Discussion on mobility enhancement for mobile IAB (ZTE) | discussion |
| [R3-225455](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225455.zip) | Discussion on mobility enhancements (Nokia, Nokia Shanghai Bell) | discussion |
| [R3-225490](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225490.zip) | Mobility enhancements for mobile IAB-node and its served UE (Lenovo) | discussion |
| [R3-225491](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225491.zip) | (TP to TS 38.401) Support for group mobility of mobile IAB-node (Lenovo) | other |
| [R3-225682](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225682.zip) | Group mobility for mobile IAB (Huawei) | discussion |
| [R3-225683](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225683.zip) | Preconfiguration and information sharing for mobile IAB (Huawei) | discussion |
| [R3-225716](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225716.zip) | Discussion on mobility enhancements (Samsung) | discussion |
| [R3-225753](file:///C:\Users\z00377060\AppData\Roaming\eSpace_Desktop\UserData\会议硬盘\TSGR3_117bis-e\Docs\R3-225753.zip) | Discussion on mobility enhancement (Xiaomi) | discussion |

Please give your feedback before Wednesday, 12 October, 2022, 11:59 UTC. This is to allow we can discuss the summary for this CB in the mobile IAB online session.

Please give your feedback for round 2 before

# For the Chairman’s Notes

To capture the following proposal as agreements

**Proposal a:**

**The Following proposals for round 1 will be removed since has been handled in online session.**

**Proposal 1: After baseline procedures have been established, RAN3 to discuss the benefit and whether to support signaling of information related to multiple UE contexts in a single message for UE handover preparation, path switch, and context release procedures.**

**Proposal 2a: As the baseline, F1 establishment and configuration of the new logical DU follows legacy procedures.**

**Proposal 2b: RAN3 to discuss whether and which information can be shared between two logical DUs in case of IAB-DU migration.**

**Proposal 3: RAN3 to discuss which of the OAM-configured and network-configured parameters can be pre-configured at a mobile IAB-node, after a baseline procedure for IAB-DU migration is developed.**

**Proposal 4-1: Source donor CU of mobile IAB-MT informs the target donor CU of mobile IAB-MT that the migrating node is a mobile IAB-node, via explicit indication in XnAP HO Request message.**

**Proposal 4-2: RAN3 to discuss whether source donor should know about mobile-IAB cells under the target donor’s control.**

**Proposal 6-1: The NCGI of the mobile IAB-DU cell shall contain the gNB ID of the F1-terminating donor CU, and it is only changed when the F1-terminating donor CU of the IAB-DU is changed..**

**Proposal 6-2: RAN3 assumes the TAC/RANAC for the mobile IAB cell is changeable and should reflect the physical location** **when it moves. RAN3 to investigate whether it is feasible to use static TAC/RANAC for mobile IAB in a limited area.**

# Discussion

## Group signaling

The RAN3#117-e has the following agreement related to UE group signalling:

**For group mobility enhancement, RAN3 to discuss the benefit and whether to support signaling of information related to multiple UE contexts in a single message, during e.g. the handover preparation, path switch, and context release procedures.**

[R3-225346 E///], [R3-225490 Len], [R3-225682 HW] [R3-225753 Xiaomi] indicates that the UE group signaling is beneficial from the signaling reduction (especially for saving the F1AP signaling for BH configuring along the target path), admission control for the group of UEs served by the mobile IAB. And the following procedures are mentioned in the above papers to consider the group signaling:

* XnAP and NGAP group handovers
* Path switch on NGAP
* Context release on XnAP
* Handover execution phase [R3-225753 Xiaomi]

As we discussed in last meeting, the handover execution phase for each UE needs to be performed separately, since the RRCReconfiguration for each UE is delivered separately.

In addition, [R3-225436 Fujitsu] states: In case the handover preparation of UEs is performed before or together with that of the mobile IAB-MT, e.g., in gradual bottom-up or nested procedure, the signal of IAB Transport Migration Management procedure can be saved since the Handover Request messages for UEs have already carried the traffic QoS information. [R3-225682 HW] states: Xn HO preparation procedure for mobile-IAB can indicate some context of its serving UEs (e.g. the identifiers of the connected UEs), it will be helpful for the target CU to determine whether to accept them all.

[R3-225360 QC] suggests that the group signalling can be considered as optimization after the baseline procedures have been defined. [R3-225455 Nok] states that the group signaling is not helpful for signaling load reduction, latency and admission control, so it proposes to not introduce group handover and just reuse the current separate handover procedure for UEs.

Companies are invited to provide your comments on the following questions:

**Q1-1): Do you agree that RAN3 can study group signalling which allow information of multiple UEs served by a mobile IAB-node be included in one message, as optimization for the following procedure:**

* **Handover preparation on XnAP/NGAP.**
* **Path switch on NGAP.**
* **Context release on XnAP.**

**Q1-2): Do you agree that the Handover preparation of UEs can be carried out together with that of mobile IAB-node?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Reasons/Comments** |
| **Huawei** | Q1-1): Yes  Q1-2): Yes | We believe the mobile IAB and all UEs moving with it should be treated as a “group” when perform admission control at the target side and provide configuration along the target BH links. And we admit that the group signalling is optimization for the mobility procedure. |
| Nokia | Q1-1): No.  Q1-2): No | As discussed in R3-225455, there is **no clear benefit for the group signaling**.  \* It does not reduce signaling, since it is still the same UE context to be transferred over NG/Xn interface.  \* It does not reduce the latency, since it is still the same number of UEs to be handled in target Donor. It actually delay the HO preparation since the single Group HO message can only be handled by one VM after the completed reception of the super large group HO message, while the current per UE based HO signaling can be distributed over the multiple VMs.  \* it does not help the admission control. If target donor has to reject some UEs due to lack of resource, it is still same even with group HO. via current HO signaling, source donor can also know the UEs is rejected during the HO preparation procedure.  The group HO actually has some issues, e.g. **cause sudden overload in target donor, less efficient in transport layer since it has to transmit a super large group HO message, cause head-of-line blocking in target donor**, etc. So please clarify the benefit for group signaling.  If the purpose is to inform target donor that a HO is for a UE connected with mobile IAB, source donor can simply include IAB’s ID in the HO signaling for UE, but not require a new group signaling. |
| Xiaomi | Q1-1): Yes  Q1-2): see comment | For Q1-2), we think it depends on the stage2 sequence of full migration. If the IAB-MT handover is performed first, and then DU migration is performed, the Handover preparation of UEs cannot be carried together with IAB-MT handover preparation. But we have some sympathy with HW’s comment on admission control, in our understanding, no matter whether the Handover preparation of UEs can be carried out together with that of IAB-MT or not, the group UE admission control should be considered at the beginning of the migration procedure. |
| Qualcomm | Q1-1: See comments  Q1-2: Benefits not clear. See comments. | Q1-1: This is an optimization. We can discuss this after we have established a baseline procedure.  **P1-1: After baseline procedures have been established, RAN3 to discuss signaling of information related to multiple UE contexts in a single message for UE handover preparation, path switch, and context release procedures.**  Q1-2: This question is not about “bundling of UE messages” (which was point Q1-1), but it is about the bundling of UE HO preparation with MT HO preparation. We further should use the term “bundling” rather than “carried out together”. The latter would still allow separate messages to be used for UE and MT.  Opposed to UE group mobility in Q1-1, the MT/UE bundling introduces new problems, e.g., how the target cell in the UE HO preparation message can be known before IAB-MT and IAB-DU have migrated over. Further, why would we want to do MT/UE bundling? What are the benefits? The proponents of Q1-2 have a complete full migration solution in mind, where it all fits together. We need to discuss this end-to-end procedure to understand the benefits rather than individual pieces. For that reason, we do not support Q1-2. |
| MITRE | Q1-1): Yes  Q1-2): Unsure | Agree with Qualcomm comments. |
| Fujitsu | Q1-1): Yes  Q1-2): Yes, but can be considered after baseline | Bundling handover request UEs together with that of the mobile IAB-node can make the target CU know the UEs will be handed over between two logical DUs which are collocated with the IAB-MT, that it is beneficial on further optimizations, such as access control, UE context sharing between two logical DUs and signalling reduction. For example, the target cell of UEs need not be indicated in the handover request.  Regarding the baseline is under discussion, we propose to delay this topic after the baseline procedure. |
| Lenovo | Q1-1): Yes  Q1-2): see comments | For Q1-2, if the IAB-DU has set up F1 connection to the target IAB-donor-CU in advanced of IAB-MT HO, we can also bundle all the onboard UEs with the mobile IAB-MT to perform group mobility. |
| **Ericsson** | **Q1-1): See comments**  **Q1-2): No** | **We should anyway address this only after we have a sketch of the mIAB migration procedure.** |
| Samsung | Q1-1): Yes  Q1-2): see comments | If source IAB donor CU decides to perform full migration, handover preparation of UEs can be carried out together with that of mobile IAB-node; otherwise, we cannot see obvious benefit. |
| Deutsche Telekom | Q1-1): see comments  Q1-2): see comments | For Q1-1, we have the impression from an operator’s perspective that benefits for group mobility are seen still controversial. Based on that, it may be useful to follow QC’s proposal to first establish a baseline procedure and then to discuss that topic as possible follow-up optimization step with a clear listing of pros and cons.  For Q1-2, we also share QC’s view that first the E2E procedure has to be clarified. |
| ZTE | Q1-1): Yes  Q1-2): see comment | Q1-1: We think message bundling is beneficial to reduce implementation complexity at network. And we are ok to discuss group signaling as a optimization based on baseline migration procedure.  Q1-2: The term “carried out together” needs to be clarified. If it means message bundling of UE and MT migration, the benefit is not clear yet. And whether it’s feasible needs further check as commented by Qualcomm. |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary：**

11 companies replied this question.

For Q1-1), 7 companies think there is benefit for UE group signaling and answered yes, 1 company think there is no benefit, 3 other companies think the group can be discussed after we have baseline procedure.

For Q1-2), 4 companies think the group/bundling of HO preparation for UEs and IAB-MTs are beneficial for some scenarios, e.g. the IAB-DU establish F1 to the target donor CU before the IAB-MT’s HO. Other 7 companies have some concerns on the beneficial and/or the E2E procedure.

The moderator tries to give the following proposal based on the feedback:

**Proposal 1: After baseline procedures have been established, RAN3 to discuss signaling of information related to multiple UE contexts in a single message for UE handover preparation, path switch, and context release procedures.**

## Information sharing between two logical DUs .

[[R3-225455](file:///D:\会议硬盘\TSGR3_117-e\Docs\R3-224378.zip) Nok] [R3-225436 Fujitsu] [R3-225440 ZTE] [R3-225683 HW] and [R3-225716 SS] have common understanding that for the IAB-DU migration, the co-located source DU and target DU can share some configuration and/or UE context considering they are co-located, such information sharing can reduce signaling for Xn and/or F1 interface, and also for the Uu interface if the UE’s target cell can be determined without UE’s measurement report.

Based on the common understanding from the above papers, Companies are invited to give your view on the following questions:

**Q2-1): Do you agree that the information sharing among two co-located logical DUs in the mobile IAB-node provides beneficial in case of IAB-DU migration?**

**Q2-2): Do you think RAN3 can investigate the following info for information sharing between two logical DUs in case of IAB-DU migration: UE context, cell configuration, low layer configuration?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Reasons/Comments** |
| **Huawei** | Q2-1): Yes  Q2-2): Yes | Some cell configurations can be shared between the two logical DUs. Based on the sharing of cell configurations, the network can acquire the UE’s target cell without the measurement report. |
| Nokia | Q2-1): Yes  Q2-2): Yes | DUs serving the same UEs withing the same coverage area (e.g.) inside a vehicle, could utilize the same configurations. Details can be further discussed. |
| Xiaomi | Q2-1): Yes  Q2-2): Yes |  |
| **Qualcomm** | Q2-1): No  Q2-2): No | Let’s get this straight:  How would the target CU learn about context the new DU has copied from the old DU (e.g., UE context)? Would the DU signal this context to the target CU? Would the target CU obtain it from the source CU? What is the underlying procedure? We need to converge on this procedure first.  As the baseline, it may be best to assume there are no such optimizations and the new DU establishes F1 using legacy procedure and is configured by the target CU using legacy procedures. Using this baseline, we can identify if there is any benefit of inter-DU information sharing and how all this would work.  **Proposal: As the baseline, F1 establishment and configuration of the new logical DU follows legacy procedures. Using this baseline, RAN3 to discuss benefits of information sharing between the two logical DUs.** |
| MITRE | Unsure | Share Qualcomm concerns. |
| Fujitsu | Q2-1): Yes  Q2-2): Yes | We think following information which is exchanged via the traditional F1 procedure for UE Context Setup can be shared between two logical DUs or be shared between two CUs:   * gNB-DU UE F1AP ID (DU->CU) * C-RNTI (can be shared if not changed by target logical-DU) (DU->CU) * NCGI of serving cell (can be shared if not changed in target logical-DU) (CU->DU) * RLC configuration for SRB/DRB (CU->DU) * QoS of DRB and QoS of traffic mapped to DRB (CU->DU) * DL UP TNL address for DRB (DU->CU)   The information which configured by the source CU (CU->DU) can be shared and copied from the source logical DU to the target logical DU within the DU device. The information which configured by the source logical DU (DU-> CU) can be shared and delivered by the source CU to the target CU. Thus, the F1 signalling can be significantly reduced for UE Context Setup procedure. |
| Lenovo | Q2-1): Yes  Q2-2): Yes | Two logical DUs are co-located, some configurations of the two logical DUs can be shared. |
| **Ericsson** | **Same view as QC.** | We would like to analyse how much this diverges from the normal way pf setting up F1. |
| Samsung | Q2-1): Yes  Q2-2): Yes | It is helpful for reducing signalling overhead via Xn interface if information sharing among two co-located logical DUs are supported. |
| Deutsche Telekom | Q2-1): Yes, but  Q2-2): Yes, but | We acknowledge the benefits information sharing stated by several companies in papers/feedbacks, but we also share QC’s concerns to describe the baseline procedure first before going to that optimization step. |
| ZTE | Q2-1): partially yes  Q2-2): partially yes | As we can see, at least three kinds of information sharing options were proposed by companies, i.e. UE context, cell configuration, low layer configuration. We need to discuss the three options separately.  We think it’s beneficial to share the UE context between the two logical DUs, so that delta configuration of UE context could be used between target CU and mIAB-DU.  For the other two options, we feel that information sharing of cell configuration and lower layer configuration is related to the cell resource configuration of the two logical DUs, e.g. whether the two logical DUs use the same or separate physical cell resources. This issue is under discussion currently in RAN2. We can wait for the progress. |
|  |  |  |
|  |  |  |

**Summary：**

11 companies replied.

8 out of the 11 support the information sharing. 3 companies have some concerns but think we should first clarify the baseline, and discuss the information sharing after the baseline. Then the following proposal is suggested:

**Proposal 2: As the baseline, F1 establishment and configuration of the new logical DU follows legacy procedures. Using this baseline, RAN3 investigate the following info for information sharing between two logical DUs in case of IAB-DU migration: UE context, cell configuration, low layer configuration.**

## Pre-storing the F1 and BAP configurations

At last RAN3 meeting, the following was agreed with respect to pre-storing of configurations at mobile IAB-nodes:

**RAN3 to discuss whether a mobile IAB node may be configured with multiple configurations, each corresponding to a different target donor, that can be activated upon fulfillment of certain condition(s). The details of the configurations are FFS.**

[R3-225346 E///] proposes that a mobile IAB node may be configured with multiple F1- and BAP-related configurations, and suggests RAN3 to investigate the following configurations for pre-storing:

* BAP configurations for the mobile IAB-MT.
* BH RLC Channel configurations for the mobile IAB-MT.
* Configurations for setting up the F1 connection.
* Configurations for setting up the SCTP connection and IPsec tunnel(s).
* TNL addresses of the mIAB-node and the new donor.
* Configurations of cells to be served by the mobile IAB-DU.
* gNB-DU system information.

[R3-225683 HW] also suggests that the PCI list, IP address, default BH configuration, IAB-DU cell configuration and F1 association related configuration can be pre-configured to the mobile IAB node.

Companies are invited to provide feedback on the following question:

**Q3-1): Do you agree RAN3 to study the following as optimization: a mobile IAB node may be configured with multiple F1- and BAP-related configurations that can be activated upon fulfilment of certain condition(s)?**

**Q3-2): If your answer to Q3-1 is YES, do you think the following configurations can be pre-configured to a mobile IAB-node?**

* BAP configurations for the mobile IAB-MT.
* BH RLC Channel configurations for the mobile IAB-MT.
* Configurations for setting up the F1 connection.
* Configurations for setting up the SCTP connection and IPsec tunnel(s).
* TNL addresses of the mIAB-node and the new donor.
* Configurations of cells to be served by the mobile IAB-DU.
* gNB-DU system information.
* PCI list.
* Default BAP configuration.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Reasons/Comments** |
| Huawei | Q3-1) Yes  Q3-2) Yes, but with comments | For Q3-2): The BH configuration is transmitted to the mobile IAB-node, it means the whole transmission path should be ready, and the resource is reserved in each hop of the IAB-node between the mobile IAB-node and the donor. So, for the BH configuration of F1-U, reserving the resource to all F1-U traffic in all possible target paths is resource consuming. In addition, the UP traffic served by the mobile IAB-node may change a lot during the moving of the vehicle, and such traffic change is not predictable, then the reserved resource along the target path may not suitable any more when the mobile IAB node activate the corresponding pre-configurations. Alternatively, we see that the default BH configuration which to be used by the non F1-U traffic, may be pre-configured, since the resource reserved for the default BH configuration is not large, and the QoS info for the non-UP traffic is stable.  We are not sure which detail will included in the following two bullets, maybe Ericsson can provide more explanation when providing input in this table:   * Configurations for setting up the F1 connection. * Configurations for setting up the SCTP connection and IPsec tunnel(s).     Currently, we prefer the pre-configuration can contains the following:   * TNL addresses of the mIAB-node and the new donor. * Configurations of cells to be served by the mobile IAB-DU. * gNB-DU system information. * PCI list. * Default BAP configuration. |
| **Nokia** | Q3-1) Not now, see comment  Q3-2) See comment | Q3-1): Pre-configurations could be usable only in certain use cases, particularly in cases where the movement of the vehicle in known (e.g. train, bus, ..). However, RAN3 should first specify a generic solution that could be applied in all deployment scenarios. In general, this should be low-priority issue.  Q3-2): the pre-configured parameter seems include 2 parts: 1) the IAB-DU related parameter, which is OAM configured. Pre-configuration is an implementation issue. 2) the IAB-MT related parameters, which is in RAN2 scope.   * BAP configurations for the mobile IAB-MT. RAN2 scope * BH RLC Channel configurations for the mobile IAB-MT. RAN2 scope * Configurations for setting up the F1 connection. OAM scope. * Configurations for setting up the SCTP connection and IPsec tunnel(s). this is not possible. SCTP/IPSec need to be “refresh” * TNL addresses of the mIAB-node and the new donor. OAM scope * Configurations of cells to be served by the mobile IAB-DU. OAM scope. * gNB-DU system information. OAM scope * PCI list. OAM scope * Default BAP configuration. RAN2 scope.   So what is the impact to RAN3? |
| **Xiaomi** | Q3-1) Yes with comment  Q3-2) see comment | For Q3-1) we agree to have some pre-configurations, but we should firstly be aware of what kind of certain condition(s) we’re talking about here, then we can discuss the details. Does this condition mean the execution of the full migration? Or others?  For Q3-2), to be honest, what information can be preconfigured in IAB-node is not in RAN3 scope, our understanding of the intension here is to discuss what pre-configuration information should be provided to IAB-donor from IAB-node in advance for saving procedures and signalling during IAB-node mobility. At least, we think the following information can be provided from IAB-node to IAB-donor-CU:   * TNL addresses of the mIAB-node and the new donor. * PCI list. * Default BAP configuration. |
| **Qualcomm** | **Q3-1: No**  **Q3-2: No** | Before we discuss pre-emptive configuration, we need to discuss where configuration needs to be different for mobile vs. stationary IAB-nodes, i.e., which OAM-configurations for stationary IAB need to become network-configurions for mobile IAB.  **OAM-configured parameters:** These parameters include served cell info and CU-CP’s TNL address. These parameters can be pre-emptively configured on a a stationary IAB-node since they are not expected to change. We are not certain if they can be preconfigured on the mobile IAB-node for all potential gNBs this mobile IAB-node is going to visit.   * Do we expect that the mIAB-node on a bus stores all CU-CP IP addresses and all NCGI/PCI values it may have to use throughout the entire PLMN network? * Do we expect that all mIAB-nodes are updated in case a single CU obtains a new IP address? This is what we need to discuss first!   Therefore, we propose the following:  **Proposal: RAN3 to discuss, which of the OAM-configured parameters of a stationary IAB-node may be supported via network configuration for a mobile IAB-node.**  **RRC-configured** **parameters**: BAP address, default route, IAB-node’s IP address. Why can’t these parameters be included in the HO/CHO command? What is the benefit to pre-emptively configure them when the CU still needs to send the handover command? How would the CU even know the IAB-node’s pre-configuration unless the IAB-node report it in an RRC message? What do we gain here?  **F1AP-configured parameters**: All UE-associated F1AP configurations are dynamic and cannot be preconfigured. The “interface-related” configurations by the CU (e.g., F1 Setup response) include CU-UP TNL info, CU system info, PLMN info update, donor-DU BAP address, IAB STC Info, etc. This info is network-configured since it may be semi-static or dynamic. If the mIAB-node is preconfigured with this information, it would need to share it with the CU so that the CU can determine if it is outdated. This is exactly what the present F1 setup procedure does, nothing else is needed. Further, to reduce latency, the IAB-node could perform the F1 setup procedure early, i.e., via the source path. |
| MITRE | Q3-1) No  Q3-2) See comment | We agree with Nokia/Qualcomm. Pre-storing configurations can be problematic under dynamic traffic conditions. |
| Fujitsu | Q3-1) Yes  Q3-2) See comments | At present, we think the information that can be obtained via handover preparation procedure for the mobile IAB-MT can be adopted, i.e., **TNL addresses and default BAP configuration**, which are necessary when the mobile IAB-node switches to a new parent node and consume limited resource on the new path. The exact usage and justification for other information is not clear now and it can be FFS. |
| Lenovo | Q3-1) No  Q3-2) No | For Q3-1, pre-stored the F1 related configuration may be not needed since this can be realized by second IAB-DU setup F1 to target CU in advance. As for the BAP-related configuration, this can be realized by the legacy HO or CHO procedure. |
| **Ericsson** | Q3-1) Yes  Q3-2) Yes, to most of these | Please note that **the intention is to preconfigure the parameters that are static and semi-static.** The configurations for setting up the F1 connection, SCTP connection and IPsec tunnel(s) may include, for example, the parameters needed for the mIAB-DU to initiate the setup of these connections to the target donor, such as TNL addresses of the target donor. These configurations are not dynamic, so they will not become outdated.  The mIAB-node could store the configurations pertaining to different donors, and, depending on the chose target donor, the right configuration would be activated.  To Huawei: we want to clarify that the pre-storing refers to the configurations at the mIAB-node, it **does not mean reserving the resources in all potential target**s. So, this is to help mIAB-node to its part of migration faster.  To Xiaomi: the conditions could be, for example, that the mIAB-node entered an area under control of the target donor, but we can discuss these events later.  QC mentions CHO – if mIAB-MT an mIAB-DU are migrated together and to the same target, shouldn’t the CHO apply to both the RRC and F1 connection? Then, for F1 setup, at least the candidate CU TNL addresses should be pre-stored.  To **wrap up:**   * Some of these parameters can be OAM-configured, some are network-configured, but the point is to **pre-store the parameters that are static or semi-static.** * The intention is to **pre-store pertaining to the donors that may potentially serve the node further ahead, not for the entire path** – the goal is to make smoother the next few migrations. Then, as the node moves, the pre-storing can be done multiple times, if needed, to cover the potential next x donors. If the route is known in advance, even better.   Our proposal is (reworded QC proposal):  **Proposal: RAN3 to discuss which of the OAM-configured and network-configured parameters can be pre-configured at a mobile IAB-node and activated based on the target donor that the mobile IAB-node connects to.** |
| **Samsung** | Q3-1) Yes  Q3-2) Yes | The following configurations can be pre-configured to a mobile IAB-node:  • BAP configurations for the mobile IAB-MT.  • BH RLC Channel configurations for the mobile IAB-MT.  • Configurations for setting up the F1 connection.  • Configurations for setting up the SCTP connection and IPsec tunnel(s).  • TNL addresses of the mIAB-node and the new donor.  • Configurations of cells to be served by the mobile IAB-DU.  • gNB-DU system information.  • PCI list.  • Default BAP configuration.  • Associated target cell of IAB-MT of mIAB node |
| ZTE | Q3-1) No  Q3-2) No | Agree with Nokia/Qualcomm, for RRC related parameters, what’s the additional benefit considering that RRCreconfiguration message is always needed to be sent to the mobile IAB-MT? For F1-related parameters, these parameters are supposed to be configured via OAM. So, it’s up to implementation. |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary：**

10 companies replied.

5 companies think the pre-configuration has benefits and answer YES to the Q3-1), while other 5 companies still have concern. Based on the rewording provided by QC and Ericsson, the moderator suggests the following:

**Proposal 3: RAN3 to discuss which of the OAM-configured and network-configured parameters can be pre-configured at a mobile IAB-node and activated based on the target donor that the mobile IAB-node connects to, after we have established a baseline procedure.**

## Mobile IAB indication

At last RAN3 meeting, the following was agreed with respect tothe mobile IAB indication:

**The donor CU should know that the IAB node is “mobile”.**

**RAN3 to discuss whether the target IAB-donor should know the migrating IAB-node is “mobile IAB-node” from the source IAB-donor.**

[R3-225682 HW] thinks the above agreement is unclear, and expect RAN3 to clarify whether the “mobile” means the node type is mobile IAB or the moving status of the node, considering that an Rel-18 mobile IAB-node may also serve as stationary R16/17 IAB-node if not moves. Based on the agreements, many papers e.g. [R3-225346 E///] [R3-225360 QC] [R3-225441 ZTE] and [R3-225490 Len] propose that the IAB-MT send mobile IAB indication to the donor CU via RRC message. And [R3-225346 E///] also suggest to send LS asking RAN2 to include the “mobile IAB-node” indicating in RRC signalling used during IAB-node integration. Based on the moderator’s understanding, in these papers, the “mobile” indication send to the donor CU is for the device type rather than the moving status. [R3-225753 Xiaomi] states that the IAB-donor can know whether the IAB-node is mobile by the location info of the IAB-MT.

Regarding the second agreements, [R3-225682 HW] [R3-225346 E///] [R3-225360 QC] [R3-225441 ZTE] and [R3-225490 Len] has common understanding that the source donor informs the target donor via XnAP that the migrating node is a mobile IAB-node. [R3-225455 Nok] think the source donor transfer the “mobile IAB” indication to target donor during the handover preparation procedure for the mobile IAB-node, but the indication can be sent to target donor as part of the RRC container and there may be no further changes to XnAP in case it is part of the RRC Context. [R3-225753 Xiaomi] states that the target donor can also know the IAB-node is mobile by the location info of the IAB-MT, and no need to transfer the mobile IAB-node indication from the source IAB-donor to the target IAB-donor.

[R3-225455 Nok] also proposes that RAN3 to discuss whether the source donor should know about mobile-IAB cells under the target donor’s control to avoid, or minimize, Handover Requests for IAB nodes indicating a mobile-IAB cell as target cell.

Companies are invited to provide feedback on the following questions.

**Q4-1): Do you agree the mobile IAB-node indication is device type rather than the moving status?**

**Q4-2): Do you agree that the mobile IAB-node indication is sent by the IAB-MT to the donor CU during integration procedure via RRC?**

**Q4-3): Do you agree the source donor informs the target donor via XnAP that the migrating node is a mobile IAB-node?**

**Q4-4) If your answer to Q4-3) is YES, which way do you prefer?**

* **Option 1: Explicit mobile IAB-node indication in the XnAP HO request message.**
* **Option2: Using RRC container to carry mobile IAB-node indication without impact to XnAP.**

**Q4-5): Do you think the source donor should know about mobile-IAB cells under the target donor’s control to avoid, or minimize, Handover Requests for IAB nodes indicating a mobile-IAB cell as target cell.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Reasons/Comments** |
| Huawei | Q4-1) Yes  Q4-2) Yes  Q4-3) Yes  Q4-4) Option 1  Q4-5) not sure | For Q4-4): We prefer explicit indicator, similar as R16/17.  For Q4-5): We understand the motivation, but it seems there is not such mechanism to let the source donor know whether the target cell is “iab-support” or not in R16 and R17, so similar as Rel 16/17, maybe such optimization is not necessary in Rel-18. |
| **Nokia** | Q4-1) Yes  Q4-2) Yes, but RAN2  Q4-3) Yes  Q4-4) see comment  Q4-5) maybe | On Q4-4: this needs to wait for RAN2 discussion.  On Q4-5, we think in Rel.16-17 the “IAB supported” typically does, or does not, apply to the whole target gNB. Mobile IAB nodes not supporting child nodes will change this. |
| **Xiaomi** | **Q4-1) clarification is needed.**  **Q4-2) depends on Q4-1**  **Q4-3) depends on Q4-1**  **Q4-5) Later** | For Q4-1), in our understanding, a vehicle with IAB function can be stationary or moving, if it’s stationary for a long time (we don’t mean stopped at a bus stop/train station, we mean parked up and deployed), why not we use it as R16/R17 IAB-node? e.g. emergency communication vehicle for some special events, with this scenario in mind, we think it’s more related to moving status (or we can say “service status”) instead of device type.  For Q4-2) and Q4-3), if mobile IAB indication is related to moving/serving status, it can be known by IAB-donor-CU by the location information of IAB-MT or serving status.  For Q4-5) we think it’s kind of optimization and can be considered later. |
| **Qualcomm** | **Q4-1: Yes**  **Q4-2: Yes**  **Q4-3: Yes**  **Q4-4: Option 1**  **Q4-5: Yes**  **See comments** | On Q4-1 and Q4-2: Have been agreed by RAN2 on Tue.  Q4-2/4-3: There are other ways to do this. The IAB-DU, for instance, includes SIB1 in the F1 setup request to the CU, which may include the mobile-IAB indicator. However, this SIB1 report is optional. Further, in case of partial migration, the IAB-MT’s target donor would not know the mobile-IAB status.  Q4-4: Option 2 does not make sense since the RRC container is supposed to carry information for the IAB-MT. The IAB-MT does not have to be informed that it is mobile.  Q4-5: Yes. It would be useful for the source donor to know that the target cell for a UE HO is on a mIAB-node. This can be achieved by adding the mobile-IAB status to the cell info in the NRT. |
| MITRE | Q4-1) Yes  Q4-2) Yes  Q4-3) Yes  Q4-4) Option 1  Q4-5) unsure |  |
| Fujitsu | Q4-1) RAN2 scope  Q4-2) RAN2 scope  Q4-3) Yes, but mobility status may also be useful  Q4-4) Option 1  Q4-5) not sure | Regarding Q4-3, mobility status (e.g., high/low speed) may be useful to control the access of UEs to the mobile IAB-DU. For example, the mIAB node’s speed can be used to determine whether the cell on the mobile IAB-DU can be the target cell for surrounding UEs. |
| Lenovo | Q4-1) Yes  Q4-2) Yes  Q4-3) Yes  Q4-4) Option 1  Q4-5) No strong view | Q4-2) Similar to the IAB-node indication in MSG5.  Q4-4) Similar to the explicit IAB-node indication in XnAP.  Q4-5) It’s beneficial for the source IAB-donor to know the info when perform mobile IAB-node migration. But it’s an optimization and we may consider it later. |
| **Ericsson** | **Q4-1: Yes**  **Q4-2: Yes**– why diverge from the Rel16/17 principle?  **Q4-3: Yes** – why diverge from the Rel16/17 principle?  **Q4-4: Option 1** – why diverge from the Rel16/17 principle?  **Q4-5: Let us discuss this later** |  |
| **Samsung** | Q4-1) Yes  Q4-2) Yes  Q4-3) see comments  Q4-4) see comments  Q4-5) see comments | For Q4-3): We suggest to discuss the issue that which entity decides the IAB-MT HO in multiple partial migration first. If target donor (i.e. donor CU serving IAB-MT decides) decides IAB-MT HO, source donor (i.e. F1-terminating donor CU) should send indication to target donor. If source donor decides IAB-MT HO, it is unnecessary to send indication to target donor, because target donor will know the IAB node is mobile IAB node when it receives handover request for full migration or multiple partial migration from source donor.  For Q4-4): If donor CU serving IAB-MT decides IAB-MT HO, we prefer explicit indicator.  For Q4-5): Similar view with Huawei. The issue is valid, but we need to discuss whether this optimization is necessary. |
| Deutsche Telekom | Q4-1) Yes  Q4-2) Yes, but in RAN2 scope  Q4-3) Yes  Q4-4) Option 1  Q4-5) Maybe | With respect to Q4-5, we see that as an optimization step that may be considered in a later phase. |
| ZTE | Q4-1: Yes  Q4-2: Yes  Q4-3: Yes  Q4-4: Option 1  Q4-5: Yes | Q4-3): The same mechanism is used as in R17 partial migration procedure.  Q4-4) option 1 is more straight forward and simple.  Q4-5) we think the source donor should be able to differentiate mobile IAB cell and non mobile IAB cell in order to determine the target cell of the mobile IAB-MT. And it should be discussed whether the source donor obtain the mobile IAB cell info from the target donor or from the UE. |
|  |  |  |
|  |  |  |

**Summary：**

11 companies replied.

10 companies answer YES to Q4-1), Q4-2), and Q4-3). While one company think the “mobile” refers to the moving status. 9 companies prefer option 1 to Q4-4), 1 company prefer to wait for RAN2 decision, and 1 company provides solution if the “mobile” means the moving status. Since RAN2 has conclusion on the first two issues and confirmed that the “mobile” is about the device type, so no proposals are needed here. Q4-3) and Q4-4) are RAN3 scope, based on majority support, the moderator proposes the following:

**Proposal 4-1: Source donor CU of IAB-MT informs the target donor CU that the migrating node is a mobile IAB-node, via explicit indication in XnAP HO Request message.**

For Q4-5), majority companies think this issue can be discussed at later stage. So, the following proposal is suggested:

**Proposal 4-2: RAN3 to discuss whether source donor should know about mobile-IAB cells under the target donor’s control.**

## Identifying on-board UEs

At last RAN3 meeting, the following was agreed with respect tothe onboard UE identification:

**RAN3 to discuss whether to support means to identify onboard UEs.**

About this issue, [R3-225346 E///] suggests that the support for identifying onboard UEs is up to implementation. [R3-225360 QC] suggests that the mobile IAB-DU to report to the network for each cell if it aims to serve onboard UEs. [R3-225441 ZTE] proposes that the mobile IAB cell only allow the access of UE which is authorized or subscribed to this mobile IAB node, and the CAG mechanism in PNI-NPN may be leveraged for the on-board UE identification. [R3-225753 Xiaomi] states that the IAB-donor should be aware of the on-board UE. The means provided by these papers are diversified and there is no clear common understanding.

In addition, [R3-225682 HW] and [[R3-225455](file:///D:\会议硬盘\TSGR3_117-e\Docs\R3-224378.zip) Nok] pointed out that how to identify the on-board UE is RAN2 issue, and RAN3 should wait RAN2 progress on this issue.

Companies are invited to provide feedback on the following questions.

**Q5: Do you agree that RAN3 should wait RAN2 on how to identify the on-board UEs?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Reasons/Comments** |
| Huawei | Yes | This issue is discussed in RAN2 now, we can wait their progress. |
| Nokia | Yes |  |
| **Xiaomi** | **No** | RAN3 agreed to discuss whether to support means to identify onboard UEs, at least RAN3 can discuss network-based means, e.g. the IAB-donor can evaluate whether the relative location of UE and the IAB-node is stable or not by knowing the location info of UE and IAB-node, and this can be done based on current mechanism. |
| Qualcomm | No | RAN3 can decide that the IAB-node reports which of its cells aims to target onboard UEs. This is not in RAN2 scope. This is a RAN3 issue! |
| MITRE | No |  |
| Fujitsu | Yes | We believe that the IAB-donor being aware of on-board UEs can be helpful to avoid the UE’s unnecessary HO. We can wait for RAN2’s progress on how to identify on-board UEs. |
| Lenovo | Yes |  |
| **Ericsson** | **Nothing for RAN3 to do here** | * RAN2 is discussing this. * This can be done per implementation. * This is precluded in the WID.   Do we really want to have two solutions for everything, one from RAN2 and one from RAN3? |
| **Samsung** | **Yes** |  |
| Deutsche Telekom | Yes |  |
| **ZTE** | **No** | RAN2 only reach the following observation: “RAN2 observes that a UE could potentially consider itself on-board of a mobile-IAB cell, if the UE camps on/connects to a mobile IAB cell during a long period (i.e. the UE then need to know that this is such a cell). FFS the time. FFS if this is needed. “  However, we think the long period is ambiguous for the on-board determination. There may be some UEs on other vehicles which have a similar speed and camped on the mobile IAB node. These UEs are actually surrounding UEs instead of on-board UE for this vehicle. After a while, these surrounding UEs may be far away from the mobile IAB node since the trajectory of these vehicles are not the same.  In order to accurately differentiate the on-board UE from surrounding UE, it is suggested to consider the on-board UE identification based on UE authorization or subscription information. |
|  |  |  |
|  |  |  |

**Summary：**11 companies replied.

7 companies think it is RAN2 scope to discuss on how to identify the on-board UEs. 4 companies replied no and propose different solutions. It is worth noting that RAN2 is working on this issue and have some progress in RAN2-119bis e-meeting. No need any proposal here.

## TAC/NCGI/RANAC of mobile IAB-DU cell

A lot of papers discuss the location information for mobile IAB cells. But different companies have different views. [R3-225346 E///] proposes to discuss only the static TAC solution in RAN3, dynamic TAC impact RAN2.

[R3-225441 ZTE] and [R3-225684 HW] think the TAC/RANAC should be changeable, and reflect the real UE location. [R3-225441 ZTE] also proposes that the UE may replace the old NCGI with new NCGI of mobile IAB-node-DU’s cell for the cells included in the RNA configuration, if the UE RAN area is configured with a list of NCGIs.

[R3-225360 QC]: After partial migration, the NCGI and TAC broadcast by the mobile IAB-DU’s cell may not represent the UE’s geographical location. During mobile IAB-DU migration, RAN3 to discuss support for TAC following the outside network vs. TAC remaining unchanged.

[R3-225360 QC], [R3-225441 ZTE] and [R3-225684 HW] has common understanding that the NCGI of the mobile IAB-DU cell should be updated when the F1-terminating donor changes, since the NCGI needs to reflect the identifier of the target donor CU.

[R3-225436 Fujitsu]: F1-terminating donor-CU reconfigures the Cell ID/TAC for the serving cell of mobile IAB-DU based on the Cell ID/TAC for the access cell of mobile IAB-MT.

Companies are invited to provide feedback on the following question about the location information.

**Q6-1): Do you think that the NCGI of the mobile IAB-DU cell should be updated when the F1-terminating donor changes?**

**Q6-2): Which option do you prefer for the TAC and RANAC of the mobile IAB?**

* **Option 1: TAC/RANAC for the mobile IAB cell is changeable and should reflect the physical location** **when it moves.**
* **Option 2: Static TAC/RANAC for the mobile IAB cell, not change when it moves.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Answer** | **Reasons/Comments** |
| Huawei | Q6-1): Yes  Q6-2): option 1 | For the NCGI, it includes the gNB ID, which corresponds to the F1-terminating CU.  The TAC/RANAC will be used for CN/RAN paging UE, and should reflect the actual location of the UE. So, we think the RANAC should using same principle as the TAC for mobile IAB-node.  For mobile scenarios, so it is straightforward that the TAC/RANAC broadcast by the mobile cell should be updated to match current geographic location. Otherwise, there will be some impact in CN if using static TAC, and we should check with SA2 on the impact. |
| Nokia | Q6-1); yes  Q6-2): see comments | For Q6-2), we think this is a deployment/configuration issue, and both should be supported.  For RANAC, in case the NCGI need to be changed, RANAC should use RAN area ID, rather NCGI. But this may be an implementation/configuration issue. |
| **Xiaomi** | Q6-1): Yes  Q6-2): option 1 | Share similar view with HW |
| **Qualcomm** | **Q6-1: Incorrect description!**  **Q6-2: Option 1 AND Option 2** | On 6-1: Gino captured this in Rel-17 in RED: *Common understanding that when the IAB-DU migrates to the new IAB-donor, the NCI of the IAB-DU’s cell reflect the identifiers of the new donor*  During “DU migration”, we do not update the NCGI. Instead, we introduce a new cell with a new NCGI.  On 6-2: We should support both options. For small vehicles, with a few UEs, Option 1 is much more scalable. For large vehicle, e.g., extended train, Option 2 is better since it avoids signal burst due to location updates. |
| MITRE | Q6-1): Yes  Q6-2): See comments | We prefer Option 1 with additional requirement that un-necessary UE TAU/RAUs should be avoided with optimization. We can discuss further what these optimizations are. |
| **Fujitsu** | Q6-1): Yes  Q6-2): option 1 | Changing the TAC/RANAC broadcasted by the mobile IAB-DU should be supported, otherwise there is impact on access of UE in idle/inactive mode. We agree with HW that the TAC/RANAC reflecting and being aligned with the actual location is beneficial. |
| Lenovo | Q6-1): Yes  Q6-2): option 1 |  |
| **Ericsson** | **Q6-1: Yes, with rewording**  **Q6-2: Option 2** | **Q6-1:** The statement should say:  “**The NCGI of a cell served by the mIAB-DU reflects the identifiers of the donor serving the mIAB-DU.**”  **Q6-2: RAN3 can only discuss Option 2** because **Option 1 is in RAN2 scope.** |
| **Samsung** | Q6-1): Yes  Q6-2): option 1 |  |
| Deutsche Telekom | Q6-1) Yes, but  Q6-2) See comments | On Q6-1, QC’s feedback should be considered.  On Q6-2, it seems that more discussion is needed if only one of the options is useful/has to be selected or, as QC proposed, to have a choice between the 2 options dependent on usage scenario (which certainly does not simply the deployment and operation of mobile IAB nodes). |
| **ZTE** | Q6-1): Yes  Q6-2): option 1 | Q6-1): The NCGI which includes the gNB ID should be changed to align with the F1-terminating CU.  Q6-2): It is beneficial to ensure the Earth-stationary TA/RNA concept and change the TAC /RANAC values that are broadcast in a mobile IAB cell's system information as the mobile IAB moves. |
|  |  |  |
|  |  |  |
|  |  |  |

**Summary：11 companies replied**

For Q6-1), 10 out of 11 replied yes. And two companies provide rewording regarding the “NCGI update”.

For Q6-2), 7 companies prefer option 1, 1 company prefers option 2, and think option 1 is RAN2 scope. 1 company suggest to discuss whether to select one option or support different option for different scenario, 2 companies prefer both options should be supported, and one of them tend to think this is implementation issue.

Option 1 is acceptable for clear majority companies, while option 2 has less proponents and RAN3 can continue discuss this option later.

Based on the feedback, the moderator proposes the following:

**Proposal 6-1: The NCGI of the mobile IAB-DU cell should contains the gNB ID of the F1-terminating donor CU.**

**Proposal 6-2：As baseline, the TAC/RANAC for the mobile IAB cell is changeable and should reflect the physical location** **when it moves. FFS on whether it is feasible to use static TAC/RANAC for mobile IAB in a limited area.**

# Discussion for Round 2

## TAC/RANAC issue

Based on the online discussion, there is no consensus on the TAC/RANAC issue, companies are invited to share your view on the following proposals:

**Proposal 1: RAN3 to further discuss the following options for TAC/RANAC issue, and also depends on SA2:**

* **Option 1: The TAC/RANAC for the mobile IAB cell can be changes and should reflect the physical location** **when the mobile IAB-node moves.**
* **Option 2: Using static TAC/RANAC for mobile IAB when it moves.**

**Q1: Do you agree Proposal 1 above?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Answer** | **Reasons/Comments** |
| Huawei | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

## Mobile IAB-node indication

RAN3 agrees the following in the online discussion, the CR R3-22xxxx is to reflect the specification change regarding to this agreement. Companies please check the CR draft and share your comments.

**Source donor CU of mobile IAB-MT informs the target donor CU of mobile IAB-MT that the migrating node is a mobile IAB-node, via explicit indication in XnAP HO Request message.**

**Q2: Do you agree the CR R3-22xxxx uploaded in the phase 2 folder?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Answer** | **Reasons/Comments** |
| Huawei | Agree |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |