3GPP TSG-RAN WG2 #114-e electronic R2-210xxxx

Electronic Meeting, 19th – 27th May, 2021

Agenda Item: 8.17.2

Source: Samsung

Title: [AT114-e][036][feMIMO] InterCell mTRP and L1/L2 mobility (Samsung)

Document for: Report and Decision

# 1 Introduction

This contribution summarizes the following discussion:

* [AT114-e][036][feMIMO] InterCell mTRP and L1/L2 mobility (Samsung)

 Scope: Continue discussion, based on R2-2106314 (and other submitted tdocs if applicable). Try to agree on replies to R1 LS questions. If possible take a step back and elaborate P1 and P2 into agreeable R2 assumptions, identify FFSes, identify questions to ask to RAN1.

 Intended outcome: Report, Draft LS out

 Deadline: Monday May 24 for on-line CB (if possible, backup time is Thu May 27).

Contact person for each participating company:

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| --- | --- | --- |
| Company | Name | Email Address |
| Samsung | Seungri Jin | seungri.jin@samsung.com |
| Qualcomm | Ozcan Ozturk | oozturk@qti.qualcomm.com |
| OPPO | Zhongda Du |  duzhongda@oppo.com |
| Lenovo | Lianhai | Wulh5@lenovo.com |
| Ericsson | Pradeepa Ramachandra | pradeepa.ramachandra@ericsson.com |
| Xiaomi | Yumin Wu | wuyumin@xiaomi.com |
| ZTE | Fei Dong | Dong.fei@zte.com.cn |
| Huawei, HiSilicon | David Lecompte | david.lecompte@huawei.com |
| Vivo | Chenli | Chenli5g@vivo.com |
| Docomo | Masato Taniguchi | masato.taniguchi.mf@nttdocomo.com |
| ASUSTeK | Xinra Kung | Xinra\_Kung@asus.com |
| Nokia, Nokia Shanghai Bell | Tero Henttonen | tero.henttonen@nokia.com |

It is suggested to provide comments before the first recommendated deadline what chairman suggested (Monday May 24 for on-line CB), based on the feedback from companies more time may required to draft LS reply.

# 2 Discussion

During the online session in RAN2#114-e meeting, RAN2 intensively discussed the L1/L2 centric mobility based on the summary of email discussion [1]. Some agreements were made but still there are controversal issues in terms of RAN2 impact on both mTRP-like model and HO-like model.

[R2-2106314](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_114-e%5CDocs%5CR2-2106314.zip) Summary of email discussion [Post113bis-e][061][feMIMO] InterCell mTRP and L1/L2 mobility (Samsung) Samsung report NR\_feMIMO-Core

DISCUSSION

- Mediatek think we need to ask R1 some questions, e.g. which configurations of non-serving cells are needed, and e.g. is RACH needed.

- Xiaomi agres with MTK that multiTRP and mobility scenarios are seemingly similar. If we focus on intra-DU it gets simpler.

- vivo think R1 need to discuss he scope is it one or two models? Think also that R2 need to clarify the common configurations.

- Nokia agrees that we should ask some questions. Think that event triggered measurements from R2 can be reused. Ok with Rapporteur proposal.

- ZTE also think we need to ask questions, e.g. if resources in src cell are released after HO.

- Oppo think we should understand the model and understand what issues we need to resolve. Oppo think we can also consider that there is only one cell. With two cells the workload gets too high.

- Apple also think the two models are similar, but think e.g. mTRP assumes overlap of src and TGT cell. Think that if we limit to intra-DU there are no issues with security.

- Intel think that the current proposal is a good starting point, but we need to clarify things. Think e.g. that it is easier if neighbour cell resource is just an assiting resource.

- Huawei think P1 as described here is one possibility, but R1 has not decided this (yet)

- Samsung think this is for common understanding. Agree with Huawei that some contents in P1 is just one possibility, but can generalize when we draft the LS. Samsung agrees with Intel. Think we need to ask R1 whether switching between TRPs can be done.

- Chair wonder if we have same MAC entity for all TRPs. Intel think yes (for intra-DU).

- LG think singelprotocol stack is applicable to both models. Think the second model is unclear in R1. Think we should avoid speculating too much on mobility model. Oppo agrees.

- Ericsson think we have single protocol stack, and scenario is intra-DU. Think the work can start by looking at the common parts.

- QC think multi-TRP and L1L2 mobility are different, think we need to understand L1L2 mobility. Think we don’t need to discuss the MAC CE details now.

- FW think that the mobility scenario should be worked on and defined in RAN2. Think there is lots of overlap, can start with multi-TRP.

- Chair think that we need to understand what would be the objective of HO

P3-P7

- LG has concerns on multiple C-RNTI. Chair wonder if from R2 perspecitve there is an issue, is this a R1 issue. Xiaomi as well think that multiple CRNTI may cause issues with RACH BFR.

- ZTE think P3 need to be rephrased.

- Oppo think P3-P5 there is just a single cell. Chair think the multi-cell is in the WID.

- Nokia think that if cells is a bad word, then we can use resources

- FW and Huawei are ok with current proposals knowing that the difference between cells may be just the PCI ..

P4

- Chair proposes to not agree. Samsung think R1 asked for this. Intel think we can ask R1 is there is any issue.

P1

- Huawei think we canot agree to P1 as there is too much details.

Chairman:

- It seems that with the intra-DU restriction everyone assumes a single MAC entity / single L2 protocol stack that can use L1 transmission resources of > 1 cell, both for multi-TRP-scenario and mobility-scenario, and that the protocol stack doesn’t need to be relocated.

- Such assumption makes it also quite unclear why a mobility / handover fuction is needed, it is needed in order to reconfigure security? In order to change roles of the cells? Do they have differnet capability? (e.g. in terms of which Phy channels are supported).

- Without clarifying the objective of a mobility function it will not be possible to design one.

* RRC provides the configuration for “the cells for L1/L2 centric mobility”, and L1/L2 signaling can be used/feasible for the dynamic usage/switching of the configured value.
* R2 didn’t see a problem with using different C-RNTIs for different cells. Different C-RNTI seems more natural in a mobility scenario. No conclusion in R2 for mTRP scenario.
* RRC configurations of the cells for L1/L2 centric mobility, including C-RNTI, are configured by RRC.
* RAN2 prefer to restrict the scope of the deployment only for intra-DU case in Rel-17.
* RAN2 assumes to prioritize intra-frequency case in Rel-17, but RAN2 follows the RAN4 decision to support inter-frequency case.
* Use P1 and P2 as baseline for further discussion, aiming to reply to the LS. (P1 seems to be too detailed need generalizing).

In this offline discussion, RAN2 aim to reply to the RAN1 LS [2] questions, and identify questions to ask to RAN1, and iddentify the FFSes (i.e. RAN2 impacts). In addition, elaborate P1 and P2 in R2-2106314 into agreeable R2 assumptions, if possible.

## RAN2 impacts on L1/L2-centric inter-cell mobility

RAN2 considered two main scenarios (i.e. mTRP-like model and HO-like model), and Rapportuer describes the detail procedures for each scenario as below:

* Scenario 1: Inter-cell multi-TRP-like model (i.e. without serving cell change)
1. UE receives from serving cell, configuration of SSBs/CSI-RSs of the cell having TRP with different PCI for beam measurement.
2. UE performs beam measurement for the cell having TRP with different PCI and report it to serving cell.
3. Based on the above reports, TCI state of the cell having TRP with different PCI is activated from the serving cell (by L1/L2 signaling).
4. UE starts receiving/transmitting using UE-dedicated channel on the cell having TRP with different PCI.

FFS whether UE switch to the UE-dedicated channel to non-serving cell or UE use both channels (i.e. serving cell and non-serving cell)

1. L3 mobility (e.g. HO) is not involved by L1/L2 signaling i.e. independent legacy HO procedure is used.
* Scenario 2: Inter-cell HO-like model (i.e. with serving cell change)
1. UE receives from serving cell, configuration of SSBs/CSI-RSs of the cell having TRP with different PCI for beam measurement/ serving cell change.
2. UE performs beam measurement for the cell having TRP with different PCI and report it to serving cell.

FFS additional RRM structure e.g. event-triggered reporting or filtering for ensuring robustness of the L1/L2 mobility.

1. Based on the above reports, TCI state of the cell having TRP with different PCI is activated along with the serving cell change (by L1/L2 signaling).
2. UE changes the serving cell and starts receiving/transmitting using the pre-configured UE-dedicated channel and TCI states.

Rapportuer think it would be beneficial to clealy described both Scenarios

**Q1-1: Do you agree the above scenarios 1? If you think further aspects are reuqired please explaine what you understand for scenario 1.**

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| Company | Yes/No | Comments |
| Samsung | Yes | We think it would be better to share the RAN2 understanding to RAN1.FFS points should be checked by RAN1 |
| Qualcomm | No | Our understanding of Scenario 1 may also not be compatible with RAN1. Since there was no question on this scenario in the LS, it is not clear what benefit it will achieve.  |
| OPPO | No | The procedure is described as such that still two different cells are assumed. But we think it is naturally assumed that there is only one cell considering there is only single user plane protocol stack is assumed during online discussion. Based on single cell assumption there is no mobility issue at all and the connection switch between two TRPs with different PCI become purely physical layer procedure with some assistant operation in L2/L3. Here is updated scenario description:* Scenario 1: multi-TRP-like model
1. UE receives from serving cell, configuration of SSBs/CSI-RSs of the TRP with different PCI for beam measurement.
2. UE performs beam measurement for the TRP with different PCI and report it to serving cell.
3. Based on the above reports, TCI state of theTRP with different PCI is activated from the serving cell (by L1/L2 signaling).
4. UE starts receiving/transmitting using UE-dedicated channel on the TRP with different PCI.
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| Lenovo&MM | See comments | The following questions should be further clarified. * 1st item: RAN1 has not agreed to use CSI-RS for beam measurement purpose yet.
* 2nd item: is L1 beam measurement reported by the UE? In addition, UE needs to continue to perform L3 measurement report.
* 3rd item: one or multiple TCI state of the cell can be activated? It is RAN1 issue.
* 4th item: before transmtting/receiving the data from another cell, whether does UE perform random access for scenario 1? In additon, it is not clear of ‘FFS whether UE switch to the UE-dedicated channel to non-serving cell’? after the non-serving cell is activated, UE switches to the non-serving cell and does not receive/transmit the data from/to the serving cell.
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| Ericsson | No | We propose to not include inter-cell mTRP in this LS reply as the LS sent by RAN1 was clearly about L1/L2 centric inter-cell mobility. Though we support both scenarios, we should not mix them in our LS reply. This is going to cause more confusion. |
| Xiaomi | Yes, but | We think that if we are going to list the RAN2 FFS issues for the better understanding of RAN1, RLM/System information/RACH should be added. |
| ZTE | Yes, but | We are fine with the description in general. In addition, since no serving cell change will be involved, we prefer to revise the descrption as follow: * 2.UE performs beam measurement for the TRP with different PCI and report it to serving cell.
* 3.Based on the above reports, TCI state associated to the TRP with different PCI is activated from the serving cell (by L1/L2 signaling).
* 4.UE starts receiving/transmitting using UE-dedicated channel on the TRP with different PCI.
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| Huawei, HiSilicon | With comments | For scenario 1, since it is mTRP, the FFS is irrelevant, it should be removed. |
| vivo | Yes with comments | We are fine to share some RAN2 understanding/impacts to RAN1 in the reply LS. But it is too early to list all such detailed procedure without extensive discussion, which may not aligned with RAN1 on-going work. E.g. 1. Wheter CSI-RS could be used.
2. Whether/how L3 mobility could be involed.
3. Whether/how to enhance the current beam measurement.
4. Whether/how multiple TCI states could be activated.
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| MediaTek | Yes | The description of Scenario 1 reflects current RAN2 understanding. It’s true that the LS is about L1/L2 inter-cell mobility, but it’s also important for RAN1 and RAN2 to clarify the difference and similarity between the two scenarios.  |
| Docomo | Yes, but | Since the original LS from RAN1 is about mobility, including the descriptions of Scenario 1 as “reply“ would be misleading. Including as an additional consideration may be suitable. We also prefer removing the FFS point. |
| ASUSTeK | No | We agree with Ericsson that scenario 1 is in another agenda item and does not include in L1/L2 mobility. |
| Nokia, Nokia Shanghai Bell | Yes | There are of course a lot of finer details to cover beside these, but this is the basic operation for inter-cell multi-TRP. We would also note that the RAN1 LS was always meant to cover both mTRP and L1 mobility, not just the latter. Since these are all in one WI we should consider them together. |

**Q1-2: Do you agree the above scenarios 2? If you think further aspects are reuqired, please explaine what you understand for scenario 2.**

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| Company | Yes/No | Comments |
| Samsung | Yes | We think it would be better to share the RAN2 understanding to RAN1.FFS points should be checked by RAN1 |
| Qualcomm | Yes |  |
| OPPO | No | For this scenario, inter-cell mobility and intra-cell TRP switch assumption can both work. But we still prefer intra-cell assumption due to the fact that inter-cell mobility assumption will result in complicated control plane procedures which can most likely not be finished in time in Rel17. By assuming intra-cell TRP swtich, the main difference between this scenario and mTRP-Like scenario is that UE has to switch TRP while in mTRP-Like scenario UE may or may not switch TRP. Here is updated scenario description:* Scenario 2: HO-like model
1. UE receives from serving cell, configuration of SSBs/CSI-RSs of the TRP with different PCI for beam measurement.
2. UE performs beam measurement for the TRP with different PCI and report it to serving cell.

. 1. Based on the above reports, TCI state of the TRP with different PCI is activated along with TRP change (by L1/L2 signaling).
2. UE changes the TRP and starts receiving/transmitting using the pre-configured UE-dedicated channel and TCI states.
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| Lenovo&MM | See comments | The following questions should be futher clarified. * 1st item: RAN1 has not agreed to use CSI-RS for beam measurement/serving cell change purpose yet.
* 2nd item: is L1 beam measurement reported by the UE? In addition, UE needs to continue to perform L3 measurement report.
* 3rd item: one or multiple TCI state of the cell can be activated? It is RAN1 issue.
* 4th item: When to release the source serving cell?
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| Ericsson | Yes but | In our understanding, the discussions on robustness impact is premature. When the mobility occurs within the DU (both source cell and the traget cell are in the same DU) then pingpong is not a large overhead in terms of signaling as there is no X2/Xn overhead and this does not increase the probability of mobility failure as the DU is aware of the previous optimal beam directions towards the UE and nothing precludes the DU from using this information. Further, the following is not clear to us. *FFS additional RRM structure e.g. event-triggered reporting or filtering for ensuring robustness of the L1/L2 mobility.* In our understanding event triggered reporting does not improve the robustness. This is mainly for signaling reduction. Regarding the L3 filtered measurements usage for handover decision making by CU-CP; we agree that filtered measurements remove the fast fading impacts and thus more trust worthy but this does not mean that RAN2 has discussed the L1 measuements‘ trustworthiness. Obtaining multiple L1 samples periodically could aid the DU to perform filtering and take the mobility decisions in a robust way. So, we are a bit concerned in the phrasing. We propose the following phrasing.*FFS any need of additional RRM structure for L1/L2 mobility if L1/L2 mobility is deemed not robust.*   |
| Xiaomi | Yes, but | The L3 mobility (i.e. handover) should not be involved by L1/L2 signaling. Othewise it seems there is no benefit to use the L1/L2 signaling for the inter-cell mobility, as the L2 (i.e. RLC/PDCP) reset would anyway introduce interruption like the legacy handover.RLM/RACH/System information should be added as FFS. |
| ZTE | No | It seems to early to have such description from RAN2 perspective. As we mentioned in R2-2105857, we think it is better to clarify the modeling issue first.For example, for the FFS part in scenario 1 “FFS whether UE switch to the UE-dedicated channel to non-serving cell or UE use both channels (i.e. serving cell and non-serving cell)”, if the answer is that UE should switch to the TRP of non-serving cell (not use both channels simultanously), then we don’t see much difference between scenario 1 and scenario 2 since the resource of “source cell” will not be used anyway after the switch.In addition, even in case some kind of serving cell level switch is required, we still have two alternatives:* Carrier aggrgation similar model, in which case the two serving cell will be added to UE simultanously and UE can switch forth and back between the two serving cells dynamically with activation/deactivaiton similar command.
* HO similar model, the resource for source cell will be removed after the switch
 |
| Huawei, HiSilicon | Yes | There is no FFS point to share |
| vivo | Yes with comments | We are fine to share some RAN2 understanding/impacts to RAN1 in the reply LS. But it is too early to list all such detailed procedure without extensive discussion, which may not aligned with RAN1 on-going work. E.g. 1. Wheter CSI-RS could be used.
2. Whether/how L3 mobility could be involed.
3. Whether/how to enhance the current beam measurement.
4. Whether/how multiple TCI states could be activated.
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| MediaTek | Yes, but | The description of Scenario 2 reflects current RAN2 understanding. However, RAN1 need to be aware that Scenario 2 may not work if security concerns are not resolved (e.g. Can UE report un-ciphered measurement results of a neighbor cell? Can cell switching command be L1/L2 signals which are neither ciphered nor integrity-protected?). |
| Docomo | Yes |  |
| ASUSTeK | Yes |  |

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| Nokia, Nokia Shanghai Bell | Mostly Yes | The step 4 depends on the design: It's not clear whether UE always changes the serving cell. This needs to be still discussed in RAN2!We would also note that there is a large commonality with scenario 1. |

As results of the post email discussion [1], RAN2 collected expected RAN2 impacts on both Scenario 1 and 2, these are summarized as P1 and P2 below based on the input from companies.

**Proposal 1: For inter-cell multi-TRP-like model (i.e. without serving cell change), following RAN2 impact can be considered:**

1. **‘serving cell’ definition update, if UE transmit/receive data to/from more than one PCI**
2. **Addition/release/modification of inter-cell multi-TRP: PxxCH configuration with different TCI states linked to a different PCI than serving cell PCI**
3. **Common configuration of the cells for L1/L2 centric mobility e.g. SSB, paging/SI monitoring, RACH, etc.**
4. **L1 measurement/ report procedures to use the inter-cell multi-TRP**
5. **Introducing the new MAC CE/DCI to start/stop receiving (i.e. TCI state switching) data from/to a cell with different PCI**
6. **RRM/RLM measurement on the cells for L1/L2 centric mobility**
7. **Handling of MAC/RLC/PDCP entities at the change of TRP or TCI state e.g. timing management**

**Proposal 2: For inter-cell HO-like model (i.e. with serving cell change), following RAN2 impact can be considered:**

1. **Addition/release/modification of the candidate cell(s) for L1/L2 centric inter-cell mobility: contents of what can and needs to be pre-configured: common configurations (e.g. SSB, SI, paging, RACH, etc) and dedicated configurations (e.g. PxxCH configurations, etc)**
2. **Analysis of security of L1/L2 centric inter-cell mobility to avoid attacks causing unnecessary cell changes**
3. **How to ensure reliability and robust for the L1-triggered serving cell change**
4. **Measurement reporting for L1 measurement, and how do RRM/RLM measurements work with L1 triggered serving cell change (e.g. event-triggered reporting, network implementation, etc.)**
5. **Introducing the new MAC CE/DCI to trigger the serving cell change (with TCI state update) from/to a cell with different PCI**
6. **Handling of MAC/RLC/PDCP entities at the change of TRP or TCI state e.g. timing management**
7. **Interaction with existing features e.g. CA/DC, legacy HO mechanism**

**Q2-1: Do you agree above proposal 1 could be the baseline RAN2 assumption for further work? If not, which part could be updated/removed/added?**

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| Company | Yes/No | Comments |
| Samsung | Yes |  |
| Qualcomm | No | We don’t know what RAN1 inter-cell mTRP design yet. |
| OPPO | No | With single cell model, no impact is expected on user plane protocol stacks. And furthermore UE can run common channel operation in both TRPs by monitoring CSS. Here is udpated RAN2 impact with single cell asummption:**Proposal 1: For multi-TRP-like model, following RAN2 impact can be considered:**1. **‘serving cell’ definition update, if UE transmit/receive data to/from more than one PCI**
2. **Addition/release/modification of multi-TRP: PxxCH configuration with different TCI states linked to a different PCI**
3. **L1 measurement/ report procedures to use the multi-TRP**
4. **Introducing the new MAC CE/DCI to start/stop receiving (i.e. TCI state switching) data from/to a TRP with different PCI**

**It is assumed the timing difference between two TRPs is less than one CP. It is up to network’s implemenation to guarantee how to realize it.** |
| Lenovo&MM | Yes |  |
| Ericsson | No | We propose to discuss inter-cell mTRP separately compared to L1/L2 centric mobility. They are different WI objectives. Otherwise it causes confusion. |
| Xiaomi | No | Bullet P1-4) is not needed, as L1 measurement/report is in the scope of RAN1.For Bullet P1-7), we could add extra clarification that intra-DU is assumed. |
| ZTE | See comments | Before we goto the detail of RAN2 impact, we prefer to clarify the modeling issue with RAN1 first, since different model will lead to different impact on RAN2. As we analysed in R2-2105857, the possible modeling for L1/L2 centric mobility is as below:* Alt1: TCI state of “Non-serving cell” and “serving cell” can be configured in the same BWP. And the TCI state can be refer to a SSB with different PCI other than the PCI of the serving cell.
* Alt2: TCI state of “Non-serving cell” and “serving cell” can be configured in different BWP of the same serving cell. And the TCI state can be refer to a SSB with different PCI other than the PCI of the serving cell.
* Alt3: TCI state of “Non-serving cell” and “serving cell” have to be configured as TCI state of different cell.

And for each modeling , the potential impact for corresponding alternative can be seen as below:* For Alt.1, The L1/L2 centric mobility refer to the TCI state switch within one BWP, which can be transparent to L3. And the only requirement for RAN2 is to support the configuration of TCI state refer to SSB of other cell as part of TCI states of the serving cell.
* For Alt.2, The L1/L2 centric mobility refer to the BWP switch within one serving cell, which can be transparent to L3. And the only requirement for RAN2 is to support the configuration of TCI state refer to SSB of other cell as part of TCI states of the serving cell.
* For Alt.3, since TCI state is associated with different serving cell, the following two procedure can be considered from RAN2 perspective:
	+ Alt 3-1: The L1/L2 centric mobility can be modeling as something similar as conditional handover or serving cell change, which can be triggered by L1/L2 command.
	+ Alt 3-2: The L1/L2 centric mobility can be modeling as serving cell activation/deactivation, in which case both serving cells will be configured to UE, and the two serving cells can be activated/deactivated by L1/L2 centric command. Compared to current CA procedure, the main difference are whether and how to handle the PCell role change, whether the two serving cells can be activated at the same time and whether only the activated serving cell will consume the UE capability.
 |
| Huawei, HiSilicon | No | There are too many items given the time allocation, 1), 3) and 6) are not essential, at least they should be low priority.2): suggest replacing with "RRC signalling for the parameters required by RAN1"7): RLC/PDCP should not be impacted |
| vivo | Yes with comments | For bullet P1-3), we would like to clarify the “common configuration”, is it means the common part of configuration? In our understanding, the common part of the configuration could be different between different cells. While the configuration of target cell is not needed to be informed to UE, as UE could obtain them on source cell, during tx/rx on multiple TRP. In this way, we could elaborate this bullet more.For butllet P1-6), BFD should be added.For bullet P1-7), in PHY layer, sync timing is assumed on multiple TRPs in previous RAN1 meetings.  |

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| MediaTek | Yes, but | The proposals may be revised to reflect the similarity and difference of the scenarios. For example, in Proposal 1, “PxxCH configuration” is mentioned in 2) and “common configurations” is in 3), but in Proposal 2, they are both included in 1). In our understanding, Common issues for both scenarios include:* Addition/release/modification of the additional cell(s): common configurations (e.g. SSB, SI, paging, RACH, etc) and dedicated configurations (e.g. PxxCH configurations, etc)
* Measurement reporting for L1 measurement, and how RRM/RLM measurements work
* New MAC CE/DCI design
* Handling of MAC/RLC/PDCP entities at the change of TRP, cell, or TCI state e.g. timing management

Specific issues for Scenrio 1 (multi-TRP) include:* ‘serving cell’ definition update, if UE transmit/receive data to/from more than one PCI

Specific issues for Scenrio 2 (handover) include:* Analysis of security of L1/L2 centric inter-cell mobility to avoid attacks causing unnecessary cell changes
* How to ensure reliability and robust for the L1-triggered serving cell change
* Interaction with existing features e.g. CA/DC, legacy HO mechanism
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| Docomo | No | Agree with Ericsson comments. The items in Proposal 1 contains both mTRP and mobility aspects, which is already confusing. |
| ASUSTeK | No | Agree with Ericsson. |

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| Nokia, Nokia Shanghai Bell | Yes (with comments)  | Step 1: It's not clear if this needs to be updated: Instead, we might just define an additional "assisting cell (Acell)" configuration and use that as basis for the discussion. In essence, UE is operating in two cells at the same time.We would also note that UE capabilities might be affected by this, as it's not clear if the resources for the Acell would be coming from UE processing otherwise used for Scells.  |

**Q2-2: Do you agree above proposal 2 could be the baseline RAN2 assumption for further work? If not, which part could be updated/removed/added?**

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| Company | Yes/No | Comments |
| Samsung | Yes |  |
| Qualcomm | Partially | We should first focus on the essential components within RAN2 scope. Reliability and robustnes are optimizations and can be open ended. Security is also not within RAN2 domain. So at least #2 and #3 are not needed. |
| OPPO | No | With single cell model, no impact is expected on user plane protocol stacks. And furthermore UE can run common channel operation in both TRPs by monitoring CSS. Here is udpated RAN2 impact with single cell asummption:**Proposal 2: For HO-like model, following RAN2 impact can be considered:**1. **‘serving cell’ definition update, if UE transmit/receive data to/from more than one PCI**
2. **Addition/release/modification of the candidateTRP dedicated configurations (e.g. PxxCH configurations, etc)**
3. **Measurement reporting for L1 measurement**
4. **Introducing the new MAC CE/DCI to trigger theTRP change (with TCI state update) from/to a TRP with different PCI**
5. **It is assumed the timing difference between two TRPs is less than one CP. It is up to network’s implemenation to guarantee how to realize it.**
 |
| Lenovo&MM | Yes  |  |
| Ericsson | Yes but | As we wrote in the comment previously, discussions on robustness is premature at this stage. How the network uses the L1 measurements to trigger mobility is network implementation and already doubting the robustness of such a mobility decision is too early in our opinion.Regarding the MAC/RLC/PDCP handling, it is good if RAN2 can indicate that in the intra-DU mobility scenario, there is no impact on MAC/RLC/PDCP. This is one of the reason for restricting to intra-DU mobility in Rel-17. Therefore, we can either remove this or narrow it down to only address the timing informaiton updation at inter-cell mobility.Regarding the security, in our understanding the model that we are discussing is the one wherein the RRC provides the configurations and they are activated/deactivated via lower layer signaling. |
| Xiaomi | No | For Bullet P2-2, we should mention that SA3 needs to be involved.For Bullet P2-3, L1 relaiblity discussion should be in RAN1. RAN2 can inform RAN1 that the L1 reliabiliy needs to be considered while using the L1 signaling to indicate the cell change.For Bullet P2-4, the first sentence “Measurement reporting for L1 measurement” can be removed, as the L1 measurement and reporting is in the RAN1 scope.For Bullet P2-6, we shoud mention that intra-DU is assumed. |
| ZTE | See above comments  |  |
| Huawei, HiSilicon | No | 1) ok2) disagree: sending fake MAC CEs e.g. with wrong TCI states is already possible and will result in reception failure, there is nothing special here.3) this is unclear. There are two things a) the DL indication, DCI or MAC CE b) the mobility procedure. a) is related to 5), we see no need for a separate bullet. b) shoyuld be a bullet on its own, like "access to the new serving cell"4) should be low priority5) ok but could also be L1 indication6) ok7) unclear, suggest removing |
| v**ivo** | Yes with comments | For Bullet P2-1), “common configuration” should be the “common part of the configurations”.For Bulllet P2-4), BFD should be added. |
| MediaTek | Yes | See Q2-1 |
| Docomo | See comments | 3) this should be discussed in RAN14) "Measurement reporting for L1 measurement“ is a RAN1 issue |
| ASUSTeK | Yes with comments | At least 1) is needed. 5) and 6) are ok. 2) and 3) may be low priority and 4) should be based on RAN1 discussion on L1 reporting design. 7) is unclear |
| Nokia, Nokia Shanghai Bell | Yes (with updates) | Like with mTRP case, the serving cell definition may need some updates if the "Acell" resources used in L1 mobility are added beforehand. So this shuold be added as another discusion point, i.e. the "serving cell definition" may also be needed for this case. |

**Q3: Do you agree RAN2 share the RAN2 impact (e.g. P1 and P2) to RAN1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | No | Those listed RAN2 impact could be used for the baseline for RAN2 further work. |
| Qualcomm | Mostly No | No need to share anything other than requested in the LS at this point. |
| OPPO | Yes | But with udpated content |
| Lenovo&MM | Yes with comments | Only the agreements having RAN1 impact can be shared with RAN1.  |
| Ericsson | No | The listed issues are related to RAN2. |
| Xiaomi | No strong view | No strong view on sharing the RAN2 impacts with RAN1. It seems that RAN2 may not easily agree on all the impacts within the short period. More discussion in the RAN2 is needed. |
| ZTE | Yes | We suggest to provide above mentioned three alternative modeling to RAN1 and ask RAN1 what is the actual modeling for L1/L2 centric mobility from their point of view. |
| Huawei, HiSilicon | No |  |
| vivo | Yes with comments | We are fine to share the about RAN2 impact to RAN1, if we fixed the points raised by companies (or just removed the uncertained part).  |
| MediaTek | Yes | These are “RAN2 impacts” because RAN2 specifications need to be modified accordingly. However, what exactly need to be modified depand largely on RAN1 feedback. For example, it is unclear what configurations need to be changed across cells: maybe only PCI and imlicitly assume that other configurations must be the same, or SSB configurations need to be given?  |
| Docomo | Yes but | If potential RAN1 impact can be agreed |
| ASUSTeK | No | The first priority should be addressing our questions to RAN1 for clarification. |
| Nokia, Nokia Shanghai Bell | Depends | We can (and should) share relevant aspects of RAN2 work, but only if they matter to RAN1. What we can state is that there are several commonalities with the mTRP and L1 mobility approach, and they might potentially be possible to model in a similar way. But doing that is not something RAN2 can do in one meeting, so time is needed and it may not be possible to do both during Rel-17. |

## Required questions to ask to RAN1

According to the contributions from companies [4][5][19], there are some unclear aspects to understand the scenarios and work scopes from RAN2 perspective so it is suggested to ask RAN1 for ambiguous aspects directly.

Rapporteur collected some questions from the contributions [4][5][19] as below:

* + - 1. Whether RAN1 assume both mTRP-like model and HO-like model as WI scope.
			2. For mTRP-like model, whether serving cell TRP is still activated and/or is deactivated when Secondary TRP is activated.
			3. For mTRP-like model, how PUSCH/PUCCH in multi-TRP operation is supported especially with activation of downlink channels.
			4. For HO-like model, how frequently HO is expected between serving cell and secondary TRP cell.
			5. For HO-like model, how downlink measurement and uplink TA are supported for the secondary TRP cell.
			6. which measurement events for the additional cell having different PCI than serving cell are supported for HO-like model?

**Q4: Do you agree to include above RAN2 questions into the reply LS to RAN1? If you have further comments/question to be asked, please provide it in your comments.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | No |  |
| Qualcomm | Mostly no | RAN1 doesn’t know about measurement events in #6. #4 does not impact RAN2 design. As mentioned above, #1, #2, #3 are not relevant until RAN1 completes their work and informs RAN2. Only #5 can give RAN2 some useful information. |
| OPPO | Yes for 1 and no for 2~6 | With the agreed scenario description, RAN2 need to understand whether RAN1 want to proceed with which scenario in Rel17. It would help RAN2 to decide to focus on which scenario. |
| Lenovo&MM | No |  |
| Ericsson | Yes to 5, (May be for 1 as a compromise) | We can include 1) just as an information (if every company wants to include inter-cell mTRP aspects in this reply LS) as this has caused too much confusion in RAN2. In our understanding both these should be considered and they should not be mixed up. The mobility discussion should not involve Scenario-1. We are fine with asking RAN1 about the UL TA assumptions.  |
| Xiaomi | Yes | We think that the uplink TA issue is common for both models.We would also like to understand whether the UE is required to have the simulatneous reception or transmission on some PHY channels (e.g. common search space) of different cells, especially for the mTRP-mode. |
| ZTE | Yes | As we commented before, we prefer to clarify the modeling issue first.For the HO-like model, based on the potential modelings we listed in Q2-1, there could be two different models: * Handover similar model
* CA similar model.

The main difference between the two is whether the resource of “source cell” will be removed or not. Therefore, we want to clarify with RAN1 that:* Whether the resource associated with “source cell” will be released after the L1/L2 centric mobility? Or, some fast deactivation/activation mechanism is expected from RAN1 perspecitve to enable the fast switch (back and forth) between “source cell” and “targt cell”?
 |
| Huawei, HiSilicon | No |  |
| vivo | Yes with comment for 1, and no for others | We think it is better for RAN1 to confirm the scope and how to proceed L1/L2 XCM and MTRP in Rel-17. But the wording could be updated, as it is very clear that both models are in WI scope. What we would like to check with RAN1 is whether both models are necessary in Rel-17 for there work. Maybe we could consider:* + - 1. Whether RAN1 assume both mTRP-like model and HO-like model need be specified in Rel-17.

For other bullets, they are not related to RAN1 strongly, but required for RAN’s further discussion on the procedure. We could discuss firtsly in RAN2, and check with RAN1 after we have better understanding on the full picture for inter-cell mobility.  |
| MediaTek | Yes, but | In addition to the questions listed above, we need to ask RAN1:* In each sceanrio, what common and dedicated configurations are expected to be the same or different across cells?
* In each scenario, is UE expected to perform RACH before switching to another cell?
 |
| Docomo | See comments | 1, 2) No. It is clear from WID that both mTRP and mobility should be considered in feMIMO. We can wait for RAN1 progress for mTRP.3, 4) No strong view5) Yes6) No, this is a RAN2 issue. |
| ASUSTeK | Yes  | Agree with Ericsson. |
| Nokia, Nokia Shanghai Bell | Partly | 1: No: This is more about WI scope so RAN matter, not RAN1.2: Yes: This is a relevant assumption that needs answer and impacts both RAN1 and RAN2.3: Yes: This is something RAN1 works on but RAN2 has to understand how it impacts the operation (e.g. can dual UL be used? Is there a UL TDM pattern? Can both channels be coming from Acell?4: Unclear:This is a relevant question but it's not sure RAN1 knows the answer to this. This will depend heavily on network configuration and deployment scenario. We would also note that we did some simulations on this (see R2-2104988 [4]), and it appears that the L1 mobility increases the ping-pong handovers quite a bit.5: Yes: This impacts RAN2 work quite a lot (e.g. TA question may impact MAC operation)6: Yes: RAN2 should also state here that RAN1 shall not start duplicating RRM functionality in L1: If lower-layer measurement events need to be defined, they shall be configured and defined in RAN2. |

Some companies have concerns on the feMIMO TUs in Rel-17, i.e. RAN2 have not enough TUs to investigate both mTRP-liked modle and HO-like model. Especially, HO-like mode requires further study/check to stable operation in terms of security and robustness of mobility.

**Q5: Do you agree to provide RAN2 concerns on the TU to RAN1? Especially for HO-like mode requires more effort to support.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | No strong view but slightly prefer | It may efficient for RAN1 to consider the work item scope in Rel-17. We think RAN2 TUs are not enough to support both scenario 1 and . |
| Qualcomm | No | TU allocation is not up to RAN1; it should be discussed at RAN. |
| OPPO | Yes | We’d better provide current RAN2 TU plan to RAN1. Our opinion is that current RAN2 TU allocation (0.5/0.5/0.5/0.5/1) may be able to finish both scenaria with single cell assumption. |
| Lenovo&MM | No strong view | If scenarion#1 and scenario#2 can be merged to one procedure as DAPS handover, this question is not needed. |
| Ericsson | No | Same view as QC.  |
| Xiaomi | No | It seems that there are lots of commonalities between the two models. Maybe it is up to RAN1 to decide whether some scenarios can be de-prioritized in Rel-17. |
| ZTE | Yes | In our understanding, we need to notify RAN1 about the RAN2 time budget situation in order to avoid overburdening RAN2. |
| Huawei, HiSilicon | No | In our understanding, scenario 2 is mostly in RAN2 scope. |
| vivo | Yes | We need to inform RAN1 about RAN2 impacts and corresponding work, as well as the trueth about the limited TU. It is up to RAN1 to determine whether/how to proceed both modesls in Rel-17.  |
| MediaTek | Yes |  |
| Docomo | No | Same view as Qualcomm |
| ASUSTeK | No | Agree with Qualcomm. |
| Nokia, Nokia Shanghai Bell | Yes but | RAN2 can indicate the concerns to RAN1, but those concerns must at least go to RAN since TU discussion will take place there. So it's best to just include RAN in "To" and include the TU concerns as action to RAN#92e. |

## Answers on questions from RAN1 in LS [2]

RAN2 made some agreements which will help to make answer on questions from RAN1. Some companies provided the draft LS reply [17][19][20], but it is very difficult to make draft before RAN2 understanding is converged.

So, Rapporteur assume that Q1 and Q2 would be further determined in phase 2 discussion, but the draft response from companies [17][19][20] could be helpful to make answer.

Alt1: R2-2105999 [17]

Alt2: R2-2106315 [19]

Alt3: R2-2106355 [20]

|  |
| --- |
| **Question 1**: In regard of serving cell, 1. Is there a need for a UE to change a serving cell for DL reception from or UL transmission to another (non-serving) cell, at least on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH?
2. If so, how can the addition, release or change of a non-serving cell for DL reception and/or UL transmission be done? For example, would any of such actions require L3 handover and/or selection/activation among pre-configured candidate cells from RAN2 perspective?
3. If so, how can the TCI states associated with the previous serving cell be handled?
4. If so, what is the impact on the system information reception by the UE?
5. If so, what is the impact on the RACH and PUCCH-related procedures and configurations?
6. If not, what is the impact on the applicable use cases? That is, in what scenarios can the UE be configured for DL reception from or UL transmission to another (non-serving) cell, at least on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH, if the serving cell does not change?
 |

|  |
| --- |
| **Question 2**: In regard of RRC configuration, RAN1 is discussing whether to allow a UE to be configured for DL reception from or UL transmission to a non-serving cell on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH. From RAN2 perspective1. Depending on the answer to question 1-1, what would be the impact of allowing the UE to transmit and/or receive on some or all of those channels and which RRC parameter(s) would need to be reconfigured for the UE?
2. Is it feasible to update some of the above RRC parameter(s) via dynamic signaling (e.g. MAC CE and/or DCI, potentially selecting pre-configured values) without any additional RRC reconfiguration signaling?
 |

**Q6: Do you agree the answers for Q1/Q2 will be treated in phase 2 discussion?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | Yes | Results of this offline discussion and the answers from the alternatives could be the baseline. |
| Qualcom | Yes |  |
| OPPO | Comment | Only if RAN2 achieved consensus on the modelling issue first |
| Lenovo&MM | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| ZTE | See comments | We think before discussing the LS reply, we need to clarify which modeling would be used for the L1/L2 centric mobility, or we can answer the question based on the above mentioned Alternatives case by case. |
| Huawei, HiSilicon | ? | Does the question mean: "are you ok not to discuss this now"? Since anyway, no draft answer is proposed in this file, we cannot do anything else. |
| vivo | Yes |  |
| MediaTek | Yes |  |
| Docomo | Yes |  |
| ASUSTeK | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | We should at least try to answer the questions. Even partial answers can help RAN1 to progress. |

**Q7: Which one do you prefer as the baseline draft LS? Please provide the good answer if you have for Q1/Q2.**

|  |  |  |
| --- | --- | --- |
| Company | Alt1/Alt2/Alt3 | Comments |
| Samsung | Alt2 | Anyhow, many changes seem required. |
| Qualcomm | Alt3 | R2-2105355 |
| OPPO |  | Without further discussion and conclusion it is difficult to comment |
| Lenovo&MM | see comments | More discussions are required to decide it. |
| Ericsson | Alt1 | We can as well merge the contents of these draft LS replies as some changes are necessary anyway. |
| Xiaomi | Alt2 |  |
| ZTE |  | See above comments |
| Huawei, HiSilicon | Alt2 | Alt1 includes answers relying on L1 considerations not included in RAN1 LS. For instance, RAN1 did not say that it is necessary to use the SSBs as QCL source, so RAN2 should not assume that.Besides, Alt1 and Alt3 seem to not consider mTRP. |
| vivo | Alt2 | Either one is fine after we made the decision on the above points.  |
| MediaTek | Alt2 | Let’s start from rapporteur’s draft. |
| Docomo | Alt2 |  |
| Nokia, Nokia Shanghai Bell | No strong view | This seems more like a matter of who is the LS contact: We don't have a strong view on that, it's more important to discuss **what** to reply: Phase2 discussion should focus on the content rather than which is the best starting point (as that will be anyway modified quite a bit). |

|  |
| --- |
| **Question 3**: In regard of C-RNTI:1. Is there a need to assign a UE a separate C-RNTI for DL reception from and UL transmission to a non-serving cell, or can the same C-RNTI from the serving cell be reused, at least for transmission and reception on UE-dedicated PDSCH, PDCCH, PUSCH, and PUCCH?
2. In restricting the use of the same C-RNTI for serving and non-serving cells, what would be the impact in applicable use cases and/or required specification support, if any?
3. If separate C-RNTIs are considered necessary in some cases, for serving and non-serving cells, how would this be configured for UE, i.e. is RRC reconfiguration signaling or some other (dynamic) signaling needed for configuring the separate C-RNTI(s)?
 |

Regarding Q3, RAN2 made following agreements during the online session.

* RRC provides the configuration for “the cells for L1/L2 centric mobility”, and L1/L2 signaling can be used/feasible for the dynamic usage/switching of the configured value.
* R2 didn’t see a problem with using different C-RNTIs for different cells. Different C-RNTI seems more natural in a mobility scenario. No conclusion in R2 for mTRP scenario.
* RRC configurations of the cells for L1/L2 centric mobility, including C-RNTI, are configured by RRC.

However, RAN2 did not reached to conclude the restriction on same C-RNTI for mTRP scenario.

**Q8: Do you agree to make answers what RAN2 made as it is? i.e. not include the restriction on same C-RNTI for mTRP scenario. Please provide the comments ff you have good suggestion.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. |
| Qualcomm | Yes |  |
| OPPO | No | After further discussion we can check whether response LS can already cover everything |
| Lenovo&MM | Yes | We can answer the question from RAN1 based on our agreement. |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. |
| Ericsson | Yes  |  |
| Xiaomi | Yes |  |
| ZTE | Yes | We suggest to indicate that all those agreements is from RAN2 perspective which will not bring the any prerequisite rules for RAN1 to design the L1/L2 centric mobility framework. |
| Huawei, HiSilicon | Ok to indicate the above agreements | but not "not include the restriction on same C-RNTI for mTRP scenario " |
| vivo | Yes |  |
| MediaTek | Yes |  |
| Docomo | Yes |  |
| ASUSTeK | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes but | We are fine to discuss these further in Phase 2. But we would note that the PCI assumption for mTRP could be discussed more: Since both the mTRP and L1 mobility use inter-cell resources, C-RNTI should be allowed to be different in both. Otherwise we will end up having different procedures for those, which likely increases the work amount.  |

|  |
| --- |
| **Question 4**: In regard of CU-DU split, from RAN2/3 perspective, is there any difference between supporting intra-DU only and supporting inter- in addition to intra-DU, in terms of the following? 1. The associated RAN2 specification impact,
2. Applicable use cases (e.g. deployment scenarios), and
3. Network inter-operability (e.g. across different gNB vendors)
 |

Regarding Q4, RAN2 made following agreements during the online session.

* RAN2 prefer to restrict the scope of the deployment only for intra-DU case in Rel-17.

**Q9: Do you agree to make answers what RAN2 made as it is?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Lenovo&MM | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |
| MediaTek | Yes |  |
| Docomo | Yes |  |
| ASUSTeK | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | We could also mention that this minimizes the work in RAN2 because it retains the basic signalling structure more easily . However, it remains to be seen if further limitations are needed to make the work feasible in Rel-17. |

|  |
| --- |
| **Question 5**: In regard of CA issues, RAN1 is discussing whether the operation is supported only for intra-band CA scenario (i.e. UE is configured to operate with serving and non-serving cells that belong to the same frequency band) or for both intra-band CA and inter-band CA scenarios. Note that one common TCI state ID associated with a non-serving cell, if supported, may be optionally applied for CCs in a band.1. Are there specific RAN2/4 issues (including higher-layer impact) that need to be considered for deciding between the two alternatives?
 |

|  |
| --- |
| **Question 6**: In regard of inter-frequency issues, from RAN2/4 perspective, what would be the higher-layer and RRM impact assuming inter-frequency scenarios as opposed to intra-frequency scenarios? For intra-frequency scenario, it is assumed that SSBs of non-serving cells have the same center frequency and SCS as the SSBs of the serving cell.* Note: RAN1 has agreed to support intra-frequency scenarios, whereas the support for inter-frequency scenarios is still for further study.
 |

Regarding Q5/Q6, RAN2 made following agreements during the online session.

* RAN2 assumes to prioritize intra-frequency case in Rel-17, but RAN2 follows the RAN4 decision to support inter-frequency case.

**Q10: Do you agree to make answers what RAN2 made as it is?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. RAN2 can provide RAN2 impact on inter-frequency case (e.g. measurement gap). |
| Qualcomm | Yes |  |
| OPPO | Yes |  |
| Lenovo&MM | Yes |  |
| Ericsson | Yes |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |
| MediaTek | Yes |  |
| Docomo | Yes |  |
| ASUSTeK | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | We could mention that inter-frequency case is not the most typical mobility case, so at least for L1 mobility it might be less relevant. If possible it would be good to have a common design for all cases. |

**Q11: Any further comments on drafting LS reply?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Ericsson | Yes | This comment is applicable only if RAN2 decides that the reply LS should include inter-cell mTRP aspects as well.In view of the confusion caused by the LS in RAN2, we could request RAN1 to send separate LSs regarding inter-cell mTRP and inter-cell mobility related questions. If they want to send a single LS, then we could request them to explicitly mention which question refers to inter-cell mTRP, which question refers to inter-cell mobility and which question refers to both.  |
| Nokia, Nokia Shanghai Bell | Yes | The LS should be sent to RAN as well (see Q5) |
|  |  |  |
|  |  |  |
|  |  |  |
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|  |  |  |
|  |  |  |

# 3 Conclusion

To be updated.

# 4 References

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4. R2-2104988 Multi-cell support for multi-TRPand L1 mobility Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_feMIMO-Core
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20. R2-2105355 Responses to RAN1 LS for L1/L2 Mobility Qualcomm Incorporated discussion