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

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| Company | Yes/No | Comments |
| Samsung | No | Those listed RAN2 impact could be used for the baseline for RAN2 further work. |
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## 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.**

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| Company | Yes/No | Comments |
| Samsung | No |  |
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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.**

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| 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 . |
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## 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]

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

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| Company | Yes/No | Comments |
| Samsung | Yes | Results of this offline discussion and the answers from the alternatives could be the baseline. |
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**Q7: Which one do you prefer as the baseline draft LS? Please provide the good answer if you have for Q1/Q2.**

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| Company | Alt1/Alt2/Alt3 | Comments |
| Samsung | Alt2 | Anyhow, many changes seem required. |
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| **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)?
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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.**

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| Company | Yes/No | Comments |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. |
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| **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)
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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?**

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| Company | Yes/No | Comments |
| Samsung | Yes | Further details could be updated during the phase 2 discussion. |
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| **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?
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| **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.
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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?**

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| 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). |
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**Q11: Any further comments on drafting LS reply?**

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# 3 Conclusion

To be updated.

# 4 References

1. R2-2106314 Summary of email discussion [Post113bis-e][061][feMIMO] InterCell mTRP and L1/L2 mobility (Samsung) Samsung report NR\_feMIMO-Core
2. R2-2102627 LS on TCI State Update for L1/L2-Centric Inter-Cell Mobility RAN1
3. R2-2104908 Discussion on L1 L2-Centric Inter-Cell Mobility vivo discussion Rel-17 NR\_feMIMO-Core R2-2102855
4. R2-2104988 Multi-cell support for multi-TRPand L1 mobility Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_feMIMO-Core
5. R2-2105026 Further aspects on L1/L2-Centric Inter-Cell Mobility Intel Corporation discussion Rel-17 NR\_feMIMO
6. R2-2105033 Discussion on L1/2 centric mobility OPPO discussion Rel-17 NR\_feMIMO-Core
7. R2-2105103 L1/L2-centric inter-cell mobility Apple discussion Rel-17 NR\_feMIMO-Core
8. R2-2105294 Procedures of L1L2-Centric Inter-Cell Mobility MediaTek Inc. discussion
9. R2-2105354 L1/L2 Mobility Overview Qualcomm Incorporated discussion
10. R2-2105621 On Scenarios for L1 L2 mobility for FeMIMO CATT discussion Rel-17 NR\_feMIMO-Core
11. R2-2105622 Discussions on L1 L2 mobility for FeMIMO without serving cell change CATT discussion Rel-17 NR\_feMIMO-Core
12. R2-2105826 Discussion on the support of inter-cell multi-TRP operation Lenovo, Motorola Mobility discussion Rel-17
13. R2-2105827 Discussion on the support of L1/L2 centric inter-cell mobility Lenovo, Motorola Mobility discussion Rel-17
14. R2-2105857 Consideration on the L1L2 centric mobility ZTE, Sanechips discussion Rel-17 NR\_feMIMO-Core
15. R2-2105991 L1/L2 centric-mobility: Multi-TRP Huawei, HiSilicon discussion Rel-17 NR\_feMIMO-Core
16. R2-2105992 Handover-like mechanism for L1/L2-centric inter-cell mobility Huawei, HiSilicon discussion Rel-17 NR\_feMIMO-Core
17. R2-2105999 On L1/L2 centric inter-cell mobility Ericsson discussion
18. R2-2106295 Potential RAN2 work for feMIMO LG Electronics discussion Rel-17
19. R2-2106315 DRAFT LS Reply on TCI State Update for L1/L2-Centric Inter-Cell Mobility Samsung LS out NR\_feMIMO-Core To:RAN1 Cc:RAN3, RAN4
20. R2-2105355 Responses to RAN1 LS for L1/L2 Mobility Qualcomm Incorporated discussion