**3GPP TSG RAN Meeting #89-e RP-20xxxx**

**Electronic Meeting, September 14 - 18, 2020**

**Agenda item:** 9.8.1

**Source:** Moderator (Samsung)

**Title:** Moderator’s summary for email discussion [89E][26][R17\_MIMO\_scope]

**Document for:** Discussion and Decision

1. Introduction

Per chairman’s instruction, the goal and pertinent contributions for this email discussion is as follows:

* Goal: Find a way forward on the proposed scope revisions.
* Input contributions covered:  1470, 1839, 1895

Table 1 Summary of the identified input contributions

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| **Tdoc** | **Summary of issue and proposals** |
| RP-201470 | Issue: Telefonica and UIC requested to be added as supporting companies right after the WID was endorsed in RAN#86. The request has not yet fulfilled since the WID has not been revised.  Proposal: Add Telefonica and UIC as supporting companies per their past and not-yet-fulfilled requests |
| RP-201839 | Issue: It is claimed that Rel-16 multi-DCI multi-TRP requirement of receive timing difference within a CP is in general too restrictive and therefore should be relaxed for Rel.17 inter-cell mTRP work (item 2b of the WID).  Proposal:   * “Clarify that a target deployment scenario (both FR1, FR2) for inter-cell operation in Rel-17 should consider non-ideal cell-phase synchronization (timing error) between the two cells.” |
| RP-201895 | Issue: On item 2b of the WID, in RAN1 #102-e, some companies argued that synchronization and timing aspects for inter-cell multi-TRP are out of scope while others think it is a natural part of the practical scenarios.  3 “factors” that require consideration for inter-cell mTRP:   * Propagation delay difference is at least similar to that of Rel-16; in addition, * Synchronization offset between multiple cells; an   + Note that inter-cell synchronization accuracy is up to 3us (TDD only) per RAN4 requirements * Backhaul between the cells can be non-ideal with certain amount of delay   + This requires separate uplink transmissions to multiple TRPs of different cells   Proposal:   * “To proceed Rel-17 inter-cell multi-TRP work, there are 2 alternatives:   + Alt. 1: Only consider factor A, same as in the case of intra-cell     - The applicable scenarios will be very limited: very tightly synchronized cells with very fast backhaul and small cell sizes.   + Alt. 2: Consider all factors A, B, and C     - Applicable to more practical scenarios * RAN Plenary to determine between Alt. 1 and Alt. 2.” |

Evidently, RP-201470 (Samsung, rapporteur) neither requires nor solicits any additional inputs - unless some other companies not listed as supporters would like to add their support as well (which is doable by online or personal emails directly to the rapporteur). Therefore, the proposed amendment on the list of supporting companies is readily accepted and requires no discussion.

Both RP-201839 (Intel) and RP-201895 (Futurewei) attempt to address the same issue raised in RAN1#102-e pertaining to item 2b of the WID.

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| 1. Enhancement on the support for multi-TRP deployment, targeting both FR1 and FR2:    1. ...    2. Identify and specify QCL/TCI-related enhancements to enable inter-cell multi-TRP operations, assuming multi-DCI based multi-PDSCH reception    3. ... |

Intel’s proposal is essentially Alt2 of Futurewei’s proposal. Since some companies voiced their preference on Alt1 in RAN1#102-e, Futurewei’s proposal seems to be a good starting point for discussion. In addition, whether the current WID on item 2b should be refined (and, if needed, how) is to be decided.

1. Summary and moderator proposals

Based on the collected inputs in section 3, the following **observation** can be made:

* Alt1 is supported by 6 companies (Apple, OPPO, Xiaomi, ZTE, Spreadtrum, Mediatek). Alt2 is supported by 4 companies (Huawei, Futurewei, Intel, Nokia)
* The following compromise proposal has been proposed and supported by 4 companies (Futurewei, Intel, Interdigital, Qualcomm):
  + The timing offset between two TRPs at the UE side can be larger than 1 CP for FR2 and is smaller than 1 CP for FR1.

Based on the arguments from all participating companies, the restriction imposed by Rel-16 timing offset restriction (<=1 CP) is less of an issue for FR1 than for FR2. Therefore, the compromise proposal seems reasonable from moderator’s point of view.

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| **Proposed way forward (after the initial round)**: Revise the WID for Rel.17 NR\_FeMIMO as follows:   1. Add 3 additional supporters per their requests in the revised WID (to be endorsed in RAN#89-e): Telefonica, UIC, Spreadtrum 2. For multi-TRP-related work in Rel.17 NR\_FeMIMO WID, clarify that the timing difference/offset between two TRPs at the UE side can be larger than 1 CP for FR2 and is smaller than 1 CP for FR1 |

During the intermediate round (see Table 2), the following **observation** can be made:

* WF proposal 1: Spreadtrum requested to be added in the supporter list just as the two companies indicated in [1]
* WF proposal 2: 4 additional companies expressed the support for the compromise proposal (vivo, LG, Ericsson, Nokia), resulting in a total of 8 supporting companies
  + On the other hand, 7 companies are still opposed to the compromise proposals and maintain their original preferences (Apple, OPPO, Xiaomi, ZTE, Spreadtrum, Mediatek on Alt1; Huawei on Alt2). Therefore, there is no consensus on WF proposal 2 from the moderator
  + Intel noted that the Rel.16 inter-TRP timing difference restriction could imply the need for extra work in RAN4 on a new tighter NW sync requirement for inter-cell multi-TRP. From moderator’s perspective, however, is a WG-level discussion and can be discussed in the next RAN1 meeting

Based on the inputs received during the intermediate round, the proposed way forward is revised as follows:

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| **Proposed way forward (after the intermediate round)**:   1. Revise the WID for Rel.17 NR\_FeMIMO as follows: Add 3 additional supporters per their requests in the revised WID (to be endorsed in RAN#89-e in RP-202024): Telefonica, UIC, Spreadtrum 2. For multi-TRP-related work in Rel.17 NR\_FeMIMO WID, further discuss in RAN1#103-e whether the Rel.16 inter-TRP timing difference restriction could imply the need for extra work in RAN4 on a new tighter NW sync requirement for inter-cell multi-TRP |

During the fine tuning round (see Table 3), the following **observation** can be made:

* WF proposal 1 remains unchanged and is stable
* WF proposal 2: Companies requested to continue discussion on the matter described in this proposal.
  + Among interested companies, there is no objection on requesting some guidance on the issue at hand from RAN4. The difference in opinion seems to be in terms of timing, i.e. after RAN1 normative work on inter-cell mTRP is completed vs. “right away”.
  + From moderator’s perspective, requesting RAN4 for guidance (with an LS from RAN4 to RAN1 as the only outcome) is not expected to consume much time in RAN4.

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| **Proposed way forward (after the fine tuning round)**:   1. {Stable} Revise the WID for Rel.17 NR\_FeMIMO as follows: Add 3 additional supporters per their requests in the revised WID (to be endorsed in RAN#89-e in RP-202024): Telefonica, UIC, Spreadtrum 2. For Rel.17 NR\_FeMIMO WID, RAN4 is requested to provide some guidance to RAN1#104-e on the feasibility of ensuring Rel.16 receive timing difference assumption at the UE (to be less the cyclic prefix duration) for Rel-17 inter-cell multi-TRP operation, taking into account the existing RAN4 requirements for phase synchronization for both FR1 and FR2 |

During the final round (see Table 3), the following **observation** can be made:

* WF proposal 1 remains unchanged and is stable
* WF proposal 2: The request to seek guidance from RAN4 (which will trigger an LS), after some sustained discussion, leads to the following two positions:
  + 6 companies (Apple, Ericsson, Mediatek, Nokia, OPPO, ZTE) are not in favor of triggering an LS from RAN4 and prefer to conclude that there is no consensus on this matter and the WID remains as is.
  + 2 companies (Futurewei, Intel) still see the benefit of seeking the guidance of RAN4 and request to discuss this issue during the last GTW session.

For WF proposal 2, the current situation suggests that there is no consensus on the applicability of Rel.16 receive timing difference assumption at the UE to Rel.17 inter-cell multi-TRP work. If this is indeed the conclusion, the issue remains open (to be addressed in the upcoming RAN1 meeting(s)).

Yet there might be some benefit to have a final check during the last GTW session. But it is the view of the moderator that whether to further discuss this in the last GTW session is at the discretion of the RAN chairman.

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| **Proposed way forward (after the final round)**:   1. {Stable} Revise the WID for Rel.17 NR\_FeMIMO as follows: Add 3 additional supporters per their requests in the revised WID (to be endorsed in RAN#89-e in RP-202024): Telefonica, UIC, Spreadtrum 2. For Rel.17 NR\_FeMIMO WID, it is at the discretion of the RAN chairman whether:    * during the last GTW session, to discuss the possibility of requesting RAN4 to provide some guidance to RAN1#104-e on the feasibility of ensuring Rel.16 receive timing difference assumption at the UE (to be less the cyclic prefix duration) for Rel-17 inter-cell multi-TRP operation, taking into account the existing RAN4 requirements for phase synchronization for both FR1 and FR2; or    * to conclude that there is no consensus on the applicability of Rel.16 receive timing difference assumption at the UE to Rel.17 inter-cell multi-TRP work, i.e. the issue remains open (to be addressed in the upcoming RAN1 meeting(s)) |

1. Compilation of companies’ inputs

During the initial round, interested companies are encouraged to share their view on the following issue brought up by Intel and Futurewei:

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| 3 “factors” that require consideration for inter-cell mTRP:   * Factor A: Propagation delay difference is at least similar to that of Rel-16; in addition, * Factor B: Synchronization offset between multiple cells; an   + Note that inter-cell synchronization accuracy is up to 3us (TDD only) per RAN4 requirement * Factor C: Backhaul between the cells can be non-ideal with certain amount of delay (due to non-ideal cell-phase synchronization)   + This requires separate uplink transmissions to multiple TRPs of different cells   On item 2b of the NR\_FeMIMO WID, consider and choose between the two alternatives:   * Alt. 1: Only consider factor A, same as in the case of intra-cell   + The applicable scenarios will be very limited: very tightly synchronized cells with very fast backhaul and small cell sizes. * Alt. 2: Consider all factors A, B, and C   + Applicable to more practical scenarios |

Table 2 Inputs

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| **Company** | **View** |
| *Initial round* | |
| Apple | We are supportive of “Add two additional supporters per their requests as indicated in RP-201470”  However, we are not supportive of relaxing the inter-cell MTRP timing difference to exceed 1 CP.  In RP-193186, it is explicitly captured that    Relaxing the timing difference to be more than 1 CP will require UE to use two FFT window to process two TRP transmission. Similar discussion has been carried out in V2X as well and prohibited there. We also discussed this with our RAN4 team, similar discussion is also carried out for the DAPS hand over in which there is no UE requirement for multiple FFT window. Even though the MRTD can be up to 6 us for DAPS, it is only the performance lower bound. For NW who cares about the UE performance, NW should strive to reduce the MRTD to be within CP.  Furthermore, as captured in RP-193186, multiple bullets were removed due to the compromise needed for the WID approval and to fulfill the down scoping request from the plenary Chair. Every single bullet has its own justification. If we ever want to discuss to extend the WID scope at this stage, we think it is fairer to reconsider all the past proposals instead of restricting to only a single proposal. |
| Qualcomm | It is a bit unclear why the above items are called ‘Factors’. Factor A, for example, is a particular solution, it is not a factor for consideration. So we might misunderstand some details of what is being proposed.  We acknowledge that limiting the timing differences to very small values limits the applicable scenarios. However, we believe that this was discussed before.  In our view, adding the larger timing offset scenario should only be considered if it doesn’t result in up-scoping of the WID.  From the DL baseband perspective, adding larger timing offsets would not seem a significant up-scoping; however, when FR1 is considered where the TRPs are received with the same antenna/RF, then additional RF aspects, such as AGC setting, etc. would need to be also considered.  Perhaps as a compromise, a limited FR2-only scenario could be further considered, where the signals from the two TRPs are received by the UE with two different antenna panels. We note that in the case of FR2, larger timing offsets are already considered for L1/L2-centric mobility, where the UE is expected to switch between cells with the larger timing offset between them. |
| Nokia | We are supportive of Alt 2 above, i.e. consider all factors A, B, and C listed above and ensure that Rel-17 mTRP is applicable to more practical scenarios. While the discussion document cited by Apple above was the understanding at that point of time, it is also true that overall understanding of the limitations in Rel-16 solution has evolved since then, and hence it is timely to update the WID to clarify that these scenarios are in scope of the Rel-17 WID, thus ensuring that the applicability of Rel-17 mTRP is not restricted by Rel-16 assumptions. Having said that we agree with Qualcomm above that the impact of such clarification should not result in significant up-scoping of the WID. |
| ZTE | We agree that we should avoid up-scoping of the FeMIMO WI at current stage. This is the most critical factor for assessment as we have many other items to be completed.  We have similar understanding that the non-synchronized issue has been discussed during drafting process of the WID. The current WID clearly indicates item 2b should focus on QCL/TCI enhancements based on M-DCI framework, where the existing M-DCI framework in Rel-16 is established assuming timing difference <= 1 CP.  In our view, to include DL aspects of larger timing difference will lead to significant up-scoping. UE needs separate IFFT windows for reception of two PDSCHs. If UE only has single IFFT operation, it is hard to implement such inter-cell MTRP to receive two PDSCHs at a time. How the current M-TRP structure works especially when two PDSCHs overlap in time and frequency domain is not clear.  Regarding QC’s suggestion to focus on FR2 multi-panel UEs, if timing difference issue for such UEs is anyway to be discussed and addressed in item 1 for L1/L2-centric mobility, there is no need to update the current scope of item 2b.  So our suggestion is to keep item 2b as it is now, or to clarify it assumes timing difference <= 1 CP for multiple TRPs. |
| Intel | 1. We agree with Nokia and Qualcomm that the scenarios with larger timing offset should be considered in Rel-17 MIMO WID. As explained in [RP-201839.zip](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_89e/Docs/RP-201839.zip) such scenarios have high practical importance and are already considered in other WIs such as Rel-16 DAPS. It is very hard to image deployment of inter-cell multi-TRP feature allowing only very small timing differences at the UE, resulting into 3x, 6x, 24x tighter requirement for the NW (at SCS 15 kHz, 30 kHz and 120 kHz respectively) than existing TDD synchronization requirement.  2. Though we don’t think the proposed clarification in Alt. 2 is up-scoping of WID, we are OK with Qualcomm proposal to consider the corresponding scenarios for FR2 only with multi-panel UEs, where the synchronization restriction would be more limiting.  3. We also have comment on Factor A in Alt 2. In our understanding there is no justification to inherit Rel-16 restrictions (originating from intra-cell multi-TRP) in Rel-17 work focusing on inter-cell multi-TRP operation. We think some further clarifications on Factor A in Alt. 2 may be needed.  In summary, we are supportive of Alt 2, with some clarifications/modifications to Factor A and possible restrictions of the scenarios to FR2 only. |
| OPPO | We should avoid expanding the current scope of FeMIMO WI since the timeline of R17 has already been expected with a delay of 6 months. Supporting the timing difference more than 1 CP will increase the standardization effort significantly, and expand the scope of WI.   * As many companies said in RAN1 meeting and in this email, this issue was discussed during the preparation of this WID last December. However, it was down-scoped since there are two many tasks in the WID and cannot be studied/specified in timely. We don’t see some solid argument that the situation was changed from last December. Thus, it is not reasonable to add back this task * For the scenarios with timing difference more than 1 CP, there are many solutions for M-TRP transmission. E.g., scheme based on the framework of R16 M-TRP, scheme based on the framework of dual-connectivity with overlapped carriers and so on. Firstly, we need to discuss the simulation assumption for the “loosely-synchronized” network. What are the exact values of timing difference? 2 CPs or 10 CPs or larger timing difference? Secondly, we need solid/throughout simulations/evaluations to down-select the solutions by considering the different values of timing difference. Thus, a huge workload is expected for this new task * As Apple/ZTE explained above, it will impact the UE implementation and a lot of additional work are needed to address the corresponding issues.   In summary, we don’t support expanding the current scope of FeMIMO WI to support timing difference more than 1 CP. |
| InterDigital | In general, we agree with that restricting the timing offset to a small value limits applicable scenario. On the other hand, we prefer not to expand current WID scope considering that its scope is already quite huge for the given timeline.  Therefore, we are ok to consider larger timing offset as long as it requires no (or minimum) standards efforts. For example, allowing larger timing offset than 1 CP in FR2 only as proposed by Qualcomm. |
| FUTUREWEI | We support Alt 2. Our view is that Alt 2 is the correct understanding of the current WID scope for 2b, and should not be viewed as an up-scoping. Timing difference potentially longer than CP is a natural scenario for inter-cell deployment.  As Qualcomm and most companies agreed, limiting the timing differences to very small values limits the applicable scenarios. This is especially true for inter-cell deployment. If the designed feature can only be used in very limited deployment scenarios, this feature will not be useful in practice. We should strive to design usable features.  Regarding Intel’s comment on Factor A, we agree that for R17, the propagation delay difference can be larger than R16. We saw Nokia also has a similar consideration. We are fine to further clarify this.  Note that if the scenario is not clarified, we are not sure how the item 2b can proceed in WG with different understandings from different companies. We should strive to clarify the scenarios here in RAN.  We sympathize the concerns from some companies on the received timing difference exceeding 1 CP. However, simply limiting the time difference to very small value undesirably limits the applicable scenarios. To move forward, along the line of what Qualcomm proposed, here is compromised proposal:   * Consider factors of propagation delay difference, synchronization offset between multiple cells, and non-ideal backhaul between cells; and * Timing difference at the receiver side can be larger than 1 CP for FR2 and is smaller than 1 CP for FR1. |
| *Intermediate round* | |
| Huawei | We prefer Alt 2 above considering it will enable more practical scenarios for Rel-17 mTRP in both FR1 and FR2. Including larger timing difference among two cells for DL transmission may or may not lead to more expensive UE implementation considering the potential trade-off of CA and multi-DCI based MTRP transmission, which was widely discussed during UE cap design.  Moreover, since DAPS can handle up 6us to a certain extent, a certain trade-off with regarding to achievable timing difference for FR1 and FR2 between DAPS and multi-DCI based MTRP transmission can be made and discussed further in RAN1*.*  We don’t support limiting it to FR2 only though, since the scenario is useful and necessary for FR1 also. As commented by Intel, the deployment of inter-cell multi-TRP feature allowing only very small timing differences at the UE at some SCS e.g. 15 kHz, 30 kHz and 120 kHz are very challenging, it is obvious that 15 kHz and 30 kHz is for FR1 thus we don’t think we should limit it to FR2 only. And as commented above UE complexity can be tradeoff among CA and multi-DCI based MTRP even for FR1 also. |
| vivo | Thanks moderator for proposed way forward, we support the proposals |
| LG | We have similar view with Nokia, Futurewei and Intel in that assuming <1 CP will seriously limit the usage of MTRP. We think that Factor A should also be relaxed to support propagation delay difference much larger than that of Rel-16 for URLLC scenarios. It is because even cell/TRP-center UE can have benefit on DL/UL repetition based or SFNed transmission schemes considering potential beam blockage by human body or other materials especially for FR2 deployments. During RAN1#102e, similar discussion on considering large Tx/Rx delay between TRPs were happen in many different items in Rel-17 FeMIMO WI such as Item1, Item2a, Item2b, Item2c. Internal delay between UE panels can also be considered as one additional factor to create some delay. Therefore, it is highly desirable if we can conclude on some common assumption for MTRP scenarios in general, to be applicable to all items in FeMIMO. So, we propose to revise the moderator’s proposal as below (changes in red).  For ~~item 2b of~~ the Rel.17 NR\_FeMIMO WID, clarify that the Tx/Rx timing offset between two TRPs ~~at the UE side~~ can be larger than 1 CP for FR2 and is smaller than 1 CP for FR1 |
| Xiaomi | We agree that we should avoid up-scoping of the FeMIMO WI at current stage. Relaxing the timing difference to be more than 1 CP will require UE to use two FFT window to process two TRP transmission. And it will increase the standardization effort significantly, and expand the scope of WI. So we don’t agree to support timing difference more than 1 CP. |
| Apple | We still have concern on extending the timing offset between TRP to beyond 1 CP for both FR1 and FR2.  The general guideline is not to increase the WID scope which we feel is not the intention of the initial proposal to consider timing difference exceeding 1 CP. If there is no specific design that companies would like to push into the 3GPP, we do not understand why we need to spend time discussing extending the current FeMIMO scope here.  During the UE feature discussion, PDSCH overlapping type is one of the most heated debate and lasted for many meetings until we reach a compromise. We have essentially 3 separate FGs to handle PDSCH overlapping for this purpose. However, looking back, we still feel that the capability design is not complete in terms of at least three areas (1) PRG matching between two TRP (2) VRB to PRB interleaving consistency between two TRP (3) AP-ZP-CSI-RS rate matching handing between two TRPs. All of the these can impact the UE channel estimation and demod design if UE truly wants to optimize its performance. Note, this is when two PDSCH is CP aligned in which case interference handling is per sub-carrier. However, when two PDSCH is not CP aligned, the interference can be much harder to handle and, furthermore, the discussion of the TA and other issues such as power control etc. may not even be avoidable. Having experienced the MTRP UE capability discussion in terms of OOO and overlapping, as well as the per FSPC discussion for MDCI MTRP and FDMSchemeB, we do not want to open up the design for MRTD beyond 1 CP.  Furthermore, we understand the for FR2, due to the large SCS, it is harder to ensure MRTD to be within 1 CP. However, FR2 has more concern on the UE power consumption and thermal dissipation than anything else in the practical deployment. It is much desirable for NW to ensure MTRD to be within 1 CP to truly realize the performance gain that MTRP can provide. We also believe URLLC solution should not solely reply on the UE complexity while NW kept insisting that they cannot achieve good back-haul or good synchronization between two TRPs. An asynchronous MTRP deployment with little or no coordination between TRP clearly performs worse than synchronous MTRP deployment with good coordination between TRP. We are not fine to shift the complexity to the UE for UE to bridge the gap caused by something NW cannot achieve.  In the end, again, we do not agree to extend the current FeMIMO WID to include receiving timing difference > 1CP for neither FR1 nor FR2. |
| OPPO2 | Thanks moderator for the new proposal. We support the 1st bullet, but cannot support the 2nd bullet.  Reply the comment that “supporting timing difference larger than 1 CP will not result in (significant) up-scoping of WID”: In addition to the additional workload we have explained above, we also copy and paste as below some additional issues/topics from RAN1 contributions of some proponents of timing difference larger than 1 CP. Thus, supporting CP larger than 1 CP will enlarge the FeMIMO scope and will lead to a large additional workload  *1. the UE may need to have the capability of supporting multiple tracking loops and FFT windows*  *2. multiple PRACH configurations for multiple TRPs are needed*  *3. multiple TAs have to be maintained by the UE, or Support TRP-specific TA offset value in UL transmission for inter-cell multi-TRP*  *4. When multiple tracking loops and FFT windows are needed on the same carrier on the same OFDM symbol for a UE to receive PDSCH/PDCCH from inter-cell multi-TRPs, whether the standards specify UE assumptions/behaviour under multiple QCL/TCI states should be clarified. For example, the standards may take an explicit approach, that is, the standards specify some UE behaviours such as “the UE applies multiple FFT windows on the same carrier on the same OFDM symbol based on the multiple TCI states for DL receptions”, which may not be preferred. On the other hand, the standards may take a more implicit approach, that is, the standards specify only the minimum UE assumptions such as “the UE assumes multiple QCL assumptions that respectively link to multiple SSBs (directly or indirectly through one or more RS) on the same carrier on the same OFDM symbol based on the multiple TCI states for DL receptions”. This should be discussed in Rel-17.* |
| Spreadtrum | Thanks moderator for your great effort!  For 1st bullet, we support it. If possible, could **Spreadtrum** be added in the supporter list? Thanks!  For 2nd bullet, we don’t support it. As shown by other companies, e.g., OPPO, if we extend the scope, much more specification work should be done. It is not preferred, considering current tight TU arrangement for R17 FeMIMO. We should focus to complete current WID scope. |
| ZTE | We still think the proposed way forward will up-scope the current MIMO WID significantly, thus we don’t think it should be the way to go now. The following is the reasoning.   * It now further expands the scope to all the M-TRP enhancements besides inter-cell M-TRP deployment. * Even for FR2 UEs with multiple panels, the workload is still high. For UL, UE needs separate TA adjustments for different panels. For DL, how the issue can be solved is not clear esp. considering the two PDSCHs can be overlapped in time or frequency.   It would be perfect we can solve the non-sync issue with low spec impact, but it is not the case in our view. So it is better to be solved in a later release when we have sufficient time. |
| Nokia, NSB | The proposed way forward would allow flexibility at least in FR2, where the limitation is naturally stronger due to the shorter CP durations in general. Perhaps we could aim at an intermediate conclusion along the lines of the updated proposal and continue the discussion on FR1 scope, hopefully still this week. Nokia is still supportive of allowing larger timing offsets in FR1 as well, but it seems that requires further discussion. |
| Qualcomm | We can accept the way forward. Handling larger timing offset should be UE optional but this is for later discussion. |
| Ericsson | We are supportive of moderator way forward that allows flexibility in case of FR2. |
| MediaTek | We share the similar views as Apple, OPPO, ZTE, and Spreadtrum. We support Alt 1. In addition, we don’t support Qualcomm’s proposal. We prefer not to extend the current scope. We understand that it is not easy to synchronize two TRPs in FR2. However, it is also true that it is very difficult to handle two timings beyond CP and it leads to much interference between two channels. |

1. Compilation of companies’ inputs: fine tuning round

During the fine tuning round, interested companies are encouraged to share their view on the following issue brought up by Intel:

*For multi-TRP-related work in Rel.17 NR\_FeMIMO WID, further discuss whether the Rel.16 inter-TRP timing difference restriction could imply the need for extra work in RAN4 on a new tighter NW sync requirement for inter-cell multi-TRP*

Table 3 Inputs – fine tuning round

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| **Company** | **View** |
| Futurewei | Alt. 1 in the original proposal, though it may be simple from a UE perspective, is really not feasible as in practical scenarios, especially for FR2. We can understand (though not preferred) that for FR1 with 15 kHz SCS, efforts and some restriction can be made to limit the timing difference at the receiver to be <=1 CP. This is part of the compromised proposal and would like to see if any company is really against this for FR1.  For FR2 with 120 kHz SCS, however, the CP length is just 0.59 us. Consequently, we need at the same time have extremely small cell size and very accurate synchronization between the cells. This basically renders the scenario infeasible and the feature not usable. As it is quite reasonable to assume mTRP capable UE already has multiple receive panels for FR2, the compromise from Qualcomm to allow timing difference > 1 CP for FR2 is a good middle ground for both network and UE vendors. Can companies against such a compromised proposal explain what may be a reasonable alternative for FR2? |
| Nokia | We are OK in principle to ask RAN4 for clarification on the consequences of the assumption of timing difference <=1 CP in FR2, together with the assumption that timing difference >1 CP remains in scope in RAN1 for FR2. Otherwise we are concerned that we would be essentially downscoping the corresponding objective in the WID, which would require a different type of discussion and it is not within the mandate of this email thread. |
| Apple | We are not okay to extend the current WID to include timing difference >1 CP, regardless of whether it is FR1 or FR2.  Regarding the RAN4 requirement, in Rel-16, this is how it was handled. We agreed that timing difference is within CP during the UE feature discussion, and RAN4 also agrees that timing difference is within CP. We still cannot fully understand the rationale behind the argument. TRP is transmission and reception point, which means a cell is nothing but also a TRP. In Rel-16, NW can ensure MRTD < 1 CP for both FR1 and FR2 from two different TRP. But in Rel-17, suddenly, NW cannot support MRTD < 1 CP. We understand, there might be some inter-cell architecture that gives NW hard time to synchronize the two cells, however, UE does not want to handle the shifted complexity so that UE needs to handle two different timing for DL and UL. This simply becomes a deployment that is not mature enough, so, there is no point to discuss this in our view.  Furthermore, as we explained, the outcome of the WID discussion is that many bullets were removed in order to meet the requirement from the plenary chair to reduce the scope by 40%. Among all the bullets being removed, inter-cell MTRP with timing difference more than 1 CP is not the most promising deployment. As we explained before, for FR2, the true issue is how to perform efficient power management and thermal management, instead of solution like async inter-cell MTRP that requires even higher UE complexity. Honestly speaking, even for Rel-16 synchronous MTRP, UE has big concern to support it for FR2 due to the fact that this may require us to turn on two panel simultaneously for reception. Making asynchronous MTRP is a step even further backward for FR2, and makes it even harder for UE to support. Again, we cannot shift the complexity to the UE simply because NW does not want to do something. If neither NW or UE wants to do things, it means the technology is not mature enough, we do not have to discuss it in Rel-17 time frame. If we want to discuss the WID scope change, we need to consider all the previous rejected proposals for a fair treatment. |
| ZTE | Our understanding is in theory RAN4 should discuss and define the applied timing difference restriction based on the solution specified in RAN1, otherwise even Rel-16 M-DCI based M-TRP cannot work in FR2. We are okay to leave this discussion and relevant work to RAN4. The relevant work can be part of the RAN4 Rel-17 FeMIMO WI, after RAN1 completes the normative work. Hence we suggest the following edit.  *For multi-TRP-related work in Rel.17 NR\_FeMIMO WID, further discuss whether the Rel.16 inter-TRP timing difference restriction could imply the need for extra work in RAN4 on a new tighter NW sync requirement for inter-cell multi-TRP. If so, the relevant work is to be done in RAN4 based on the solution specified in RAN1.* |
| FUTUREWEI2 | Based on the discussions so far, we think it is critical to ask RAN4 whether a much tighter synchronization between the cells is feasible for FR1 and FR2 in order to limit the timing difference at the UE within 1 CP before further RAN1 work on this objective. This should be done before instead of after RAN1 work. We should not develop a feature if there is little practical value. |
| OPPO | No need of extra RAN4 work. There is only relative time sync requirement for TDD. However, we don’t preclude the deployment of NR FDD with M-TRP. There are no corresponding RAN4 requirements for NR FDD to deployment Rel-16 M-TRP. It is totally up to NW implementation. Following the similar logic/approach, it is also up to NW implementation to consider the time sync for Rel-17 M-TRP. |
| Qualcomm | It is unfortunate that no agreement can be reached. Even though there are benefits in the WGs evaluating the different options, we would have preferred a clearer Plenary guidance. |
| vivo | Looking at the situation there is no consensus on even considering potential RAN4 work. RAN guidance on one way or other is required. |
| LG | We agree that RAN4’s guidance will be helpful about the feasibility of this tight requirement. On the other hand, RAN4 can give guidance only from gNB-gNB synchronization aspect, and max propagation delay difference from each TRP to UE is up to RAN1 decision to our understanding (i.e. Factor A in the initial discussion). It will be good if RANP can guide RAN1 to analyze propagation delay difference (i.e. Factor A) for URLLC/eMBB use cases and RAN4 to analyze gNB-gNB synchronization (i.e. Factor B/C). |
| Intel | It is unfortunate that some companies are ignoring obvious issue and trying to design feature under assumption that would never be possible to achieve in practical deployments. There is still no clear reply from objecting companies how such tight sync constrain can be fulfilled in practice in FR2?  Given current situation, we prefer clear decision/guidance on this issue from RAN plenary based on proposed compromised WF form Qualcomm.  We have also added some replies for the comments above:  RE to Apple: Similar to all Rel-16 multi TRP, this feature would be optional for implementation in Rel-17. All UE complexity concerns can be resolved as part of UE capability discussion and signaling. This should not be a reason for blocking the scenario from consideration.  RE to OPPO: FR2 bands are TDD, where corresponding requirements are specified in RAN4. Under these requirements, Rx timing difference would be > 1 CP.  RE to ZTE: Since the normative work in RAN4 starts much later, delaying discussion won’t be helpful. We would prefer to have this Rx timing assumption clarified to have clean discussion on this objective in RAN1 WG. |
| Samsung | We sympathize with the concern about the work scope (especially given the current status on “scope tightening” possibly enforced for all the SIs/WIs). We also sympathize with the concern that the Rel.17 inter-cell mTRP is rendered impractical for FR2 (being advertised applicable to FR2 in the heading of item 2 bullet of the WID).  For instance, if the constraint on the inter-TRP timing difference ends up being too restrictive, it is quite obvious that the resulting cell size would be prohibitively small unless some strict timing difference requirement is enforced. Some companies have argued as such in RAN1#102-e, but such observation may not yet be officially affirmed.  Here we agree with companies that see some need for RAN4 guidance on the question posed by the moderator. At least from Samsung perspective, it is understood that such guidance does not imply that additional work in RAN4 is needed for inter-TRP synchronization. It may imply lead to a revised design guideline especially for inter-cell mTRP or, alternatively, a general understanding that Rel.17 inter-cell mTRP may not be applicable/practical to FR2. |
| Huawei | We do not support extra RAN4 work on tighter network synchronization requirements for mTRP in Rel-17.  Given the current discussion status, our view is that no agreement or conclusion can be made during this RAN plenary on this issue. |
| ZTE2 | We share similar view as Huawei. We think it may not be a good idea now to trigger extra RAN4 work now given its workload. If there is something to be done in RAN4, it should be part of the RAN4 normative work for FeMIMO as we said in previous email. Given the fact of no consensus is achieved in this thread, we can live with no agreement or conclusion made in this RAN plenary. |
| Nokia | In our view the question to RAN4 is not only about whether or not there is extra work for them, but the question we need answered is if it is feasible to define tighter NW sync requirements for inter-cell multi-TRP that would make inter-cell mTRP in FR2 viable given the restriction of delay at the receiver being <= 1 CP. If yes, then comes the question on whether this implies (too much) extra work in RAN4 or not.  Even if we manage to get a response within RAN1#103-e, which may be wishful thinking but not impossible, companies writing their contributions to RAN1#103-e need to know what is in scope of the discussion or not. Given that there is no agreement to remove the FR2 inter-cell mTRP from the scope of the WID, the logical consequence is that we must assume delay at the receiver can be > 1 CP in the time being, at least for FR2. After we are able to answer the questions above the topic can be discussed again in RAN Plenary where the potential adjustments to WID scope can be discussed. |
| Intel2 | We should prefer different formulation of the question to RAN4. From our perspective, we should ask RAN4 about feasibility of ensuring Rel-16 receive timing assumption at the UE in the context of Rel-17 inter-cell multi-TRP operation taking into account the existing RAN4 requirement for non-perfect phase synchronization. The proposed modification below.  “For Rel.17 NR\_FeMIMO WID, RAN4 is requested to provide some guidance to RAN1#[xxx] on feasibility of ensuring Rel.16 receive timing difference at the UE (to be less the cyclic prefix duration) for Rel-17 inter-cell multi-TRP operation taking into account the existing RAN4 requirements for phase synchronization for both FR1 and FR2” |
| OPPO2 | We share the same view as Huawei and ZTE. Considering there is no consensus so far, it is nature that no agreement or conclusion is made in this RAN plenary on this issue.  Response to Nokia/Intel’s comment on the feasibility of tight NW sync requirements: Considering the fact that the timing different > 1 CP is removed due to the down-scope of WID, does it mean some companies doubt whether some objective in the current WID is feasible or not? If so, it seems to belong to the “scope tightening” proposed by 3GPP RAN leadership. From our side, we intend to keep the current scope of FeMIMO. Thus, we don’t think it is a good idea to discuss whether some objective of the current WID is feasible or not at current stage. |
| Apple | We do not think the RAN4 LS is needed, definitely not in the form proposed by Intel.  First of all, the whole argument is about the quoted paragraph in Clause 7.4. Note that RAN4 only defines the requirement lower bound, in the sense that RAN4 will never come all the way out to prohibit a better implementation either for the gNB or for the UE. That is why we have the highlighted quoted part. If an infra-vendor decides to have good synchronization between two TRP to ensure good MTRP performance and to work with device company to address our implementation concern, you cannot use this paragraph to prohibit them from doing that. As results, we do not see the point of keeping arguing about 3us.  That is also the reason why we bring up the DAPS, since DAPS is the true agenda where UE may need to perform simultaneously DL (or UL) operation to different cells. There are two things we need to note for DAPS   * DAPS does not even support FR2 to FR2, simply because the complexity and maturity. That is why we explained in the past that FR2 is not the middle ground since FR2 has even higher power/thermal/implementation issue. This is also how it is handled in DAPS * Even for FR1 when the MRTD is assumed to be 6us. There is no expectation that when gNB cannot achieve good synchronization within CP, any performance can be guaranteed. Please see the quoted the part below with the highlight. That is also the proposal from many companies that there is no WID scope change in RAN1. We do not need to do any specific design in RAN1 even if NW cannot handle tight synchronization, the performance just suffers and we can let RAN4 capture is in 38.133 just like DAPS.   Now coming back to the necessity of the RAN4 LS which we fail to see. As we explained, all we need is to hear is the implementation concern from both the infra-vendor and UE vendor   * From infra-vendor side, all we care is whether their product team feels comfortable to ensure MRTD < 1CP for inter-cell MTRP deployment. Whether the feedback is from RAN4 or RAN1 or RAN plenary, we feel it will be a consistent message. So far, we do hear concern from at least from Ericsson and Nokia, which we respect. Again, as I explained, RAN4 only defines the worst performance. So if the decision from the infra-vendor is to achieve the worst performance, then the story is over. We do not need to force infra-vendor to achieve good synchronization neither in RAN plenary, nor in RAN1, nor in RAN4. For the company who deploys NR, they have their choice of the solution. * We also need to hear the feedback from UE vendor whether UE vendor wants to take over the complexity imposed by the fact that infra-vendor does not want to, or technically cannot, ensure good synchronization between two TRP. This is an added complexity beyond Rel-16. We are not discussing about the willingness to agree on some design to be captured in the specification. We are talking about the willingness to deploy this together with infra-vendor in the field in the near future. So far, we hear a lot of concern from multiple companies. We also have strong concern. As I explained, MTRP of FR2 is the biggest concern we have, even for synchronous MTRP. In the end, when people arguing about something to be impractical, a feature is only practical when bot the infra-vendor and device companies want to deploy it. When either party has concern, it is impractical.   I believe the survey is already done. Some Infra-vendors do not want to implement tight synchronization between TRP. Majority of UE vendors do not want to handle the complexity due to loose synchronization. There is a gap, and we need to solve the gap. What we hear in 3GPP is quite different from what we hear from the actual deployment plan. We are still puzzled that for a feature like asynchronous inter-cell MTRP for FR2, why we need to raise this issue to RAN plenary level to resolve it. Does this really have that level of deployment urgency or product concern. Would this actually set up a very bad example for companies escalating issues to plenary level. But, everyone has their freedom of choice.  In the end, we feel the story is very clear. All we want to ensure is that there is no additional RAN1 work on handling the asynchronous inter-cell MTRP, neither in FR1 nor in FR2. But it is our position. We are not ready to agree on the RAN4 LS in this RAN plenary meeting.  **TDD phase accuracy**    **DAPS MRTD** |
| MediaTek | We have the similar views with Apple, OPPO, and ZTE. We believe that keeping current WID doesn’t lead to the extra work in RAN4. We don’t need to send an LS to RAN4. |
| Nokia | Possible way forwards:  **Alt. 1)** Revise the WID to clarify that the timing difference/offset between two TRPs at the UE side can be larger than 1 CP for FR2 and is smaller than 1 CP for FR1  **Alt. 2)** Downscope the WID to remove the objective on “*Identify and specify QCL/TCI-related enhancements to enable inter-cell multi-TRP operations, assuming multi-DCI based multi-PDSCH reception*” for FR2.  **Alt. 3)** No conclusion, in which case the WID remains the same, and timing difference/offset between two TRPs at the UE side remains in scope of RAN1 discussions, for both FR1 and FR2.  While preferring Alt1, leaning toward Alt3 and not agreeing to Alt2 for this meeting. |
| Ericsson | We restate here our response on the reflector for convenience:  We have been discussing the possible way forwards internally from both RAN1 and RAN4 perspectives, extensively. Based on our assessments, we are not supportive of sending an LS to RAN4. From our understanding, while the answer to the LS is clear, it may result in unintended consequences.  We totally agree with Cassio’s assessment for the situation and found ourselves in the same position, showing support to Alt 1 but admitting that we are leaning towards Alt 3, while not agreeing to Alt 2.  Perhaps for this meeting we should settle on Alt 3 and avoid to unnecessarily load to RAN4. |
| OPPO3 | On the scope of inter-cell MTRP, refer to the moderator summary prior to the endorsement of Rel.17 NR\_FeMIMO WID: RP-193186 (RAN#86)   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 1. Discussion summary   At least the following companies have expressed their views on the above down scoping proposal:   |  |  | | --- | --- | | **Proposal to remove objective** | **Companies’ view: supporting removal** | | 1 b i (STXMP) | Apple, Huawei, OPPO, vivo | | 1 c (UE-initiated) | CATT, Ericsson | | 3d (SRS for hi-res precoding) | Ericsson, LGE | | 4 (UL) | Ericsson, LGE, OPPO (4a) | | 5c (hi-speed CSI) | CATT, Ericsson, Huawei, Intel, LGE, Qualcomm, Samsung, ZTE |   In addition:   * There is a comment not to remove 1 b i from LGE. The proposal was not agreed. * There were also proposals to expand/relax the scope for some of the above items but **were not accepted**. For example:   + 2b: remove restriction on only QCL/TCI enhancement (Intel)   + **2b: add support for transmission when inter-cell delay is > 1 CP (Intel)**   + 2c: add TD-OCC (ZTE, Intel, Huawei) and increased number of sequences (Huawei)   + 5b: allow more general CSI enhancement (AT&T)   + 2e: Study on interference alignment (vivo) | |

# References

1. RP-201470 Revised WID: Further enhancements on MIMO for NR Samsung
2. RP-201839 MIMO multi-TRP timing constraints for inter-cell operation Intel Corporation
3. RP-201895 Clarification of synchronization aspect for inter-cell multi-TRP in Rel-17 FeMIMO WI Futurewei