**3GPP TSG-RAN WG4 Meeting #104-e R4-22XXXXX**

**Electronic Meeting, Aug. 15 – 26, 2022**

**Agenda item:** 13.4

**Source:** Moderator (Apple)

**Title:** Email discussion summary for [104-e][240] LS\_reply

**Document for:** Information

# Introduction

This email thread treats the following topics:

1. Time difference for MIMO with two TAs (R1-2205593)
2. Feature Group 6-1a (R2-2204009, RP-221870)
3. UL Segmented Transmission for UL synchronization for IoT NTN (R1-2205642)

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# Topic #1: Time differente for MIMO with two TAs (R1-2205593)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2211906**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211906.zip) | Reply LS on maximum uplink timing difference for multi-DCI multi-TRP with two TAs | Apple | **Proposal 1: check with RAN1 to see if RAN4 can still assume MRTD from multiple TRP is within a CP in R18.****Observation 1: MTTD is different for different scenarios. RAN4 needs to know which scenarios to be supported when calculating MTTD.****Proposal 2: check with RAN1 on the following supported scenarios*** **Both FR1 and FR2**
* **Both sync and async**
* **Only intra-frequency**
* **Maximum distance between two TRPs: 9km in FR1 and 1.5km in FR2.**

 Proposal 3: on scenarios mentioned in proposal 2, MTTD is as following:

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| **Frequency range** | **Deployment** | **MTTD** |
| FR1  | Sync  | 34.6us  |
| Async  | Half slot |
| FR2 | sync  | 8.5us  |

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| [**R4-2211979**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211979.zip) | On Maximum uplink timing difference for multi-DCI multi-TRP with two TAs | Xiaomi | **Observation 1: The two TA of corresponding two UL transmission are both for one cell.****Observation 2: The maximum distance of the two TRPs can be within one cell or for different cells.****Observation 3: Both FR1 and FR2 need to be considered.****Observation 4: Current RAN4 RRM spec has only defined MTTD requirement for inter-band NR CA, NR-DC, EN-DC, NE-DC and intra-band EN-DC cases.****Proposal 1: For intra-cell m-TRP case, the maximum uplink transmission timing difference refer to the Rel-18 RAN4 intra-band non-collocated WID defined MTTD requirement.****Proposal 2: For inter-cell m-TRP case, the current inter-band CA MTTD requirement can be reused.** |
| [**R4-2212115**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212115.zip) | On Multiple TA for multi-TRP MRTD MTTD limits | InterDigital Communications | ***Observation 1:*** *For NR-DC synchronous case or NR inter-band CA within FR2 the maximum receive time difference defined in 38.133 specification is 8us.****Observation 2:*** *The baseband and time processing may impose limits of the Maximum Receive Time Difference and Maximum Transmit Time Difference for the multi-TRP scenario with 2 TAs scenario.****Proposal 1:*** *For m-TRP with two TAs Maximum Transmit Time Difference limits adopt NR inter-band CA cases as baseline.****Proposal 2:*** *Adopt for intra-cell m-TRP scenario with two**TAs the MTTD within FR1 as 34.6us and within FR2-1 as 8.5us.****Proposal 3:*** *The LS reply mention that for intra-cell m-TRP scenario with two**TAs RAN4 agreed that the MTTD within FR1 is 34.6us and within FR2-1 is 8.5us like the current NR inter-band UL CA timing requirements.****Proposal 4:*** *Adopt for intra-cell m-TRP scenario with two**TAs the MRTD within FR1 as 33us and within FR2-1 as 8us and covey this information to RAN1 in the LS reply.* |
| [**R4-2212326**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212326.zip) | Reply LS to RAN1 on mTRP mDCI mTAG TA difference | Qualcomm Incorporated | **Observation 1: The inter-band CA MTTD is an upper-bound for TA difference in the multi-DCI multi-TRP case.**In TDD bands, there is no meaningful front-end protection for the receiver. Here, for the TDM case, there is the potential for overlapping Tx symbols when there is a TCI-state switch. In our view, some clarification of prioritization or similar treatment in RAN1 would be useful.Finally, there is the potential of UL and DL symbol overlap, but this is an old problem and is assumed to have been addressed with the proper choice of ‘F’ symbols in the ‘S’ slot.**Observation 2: For the TDM multi-DCI UL case, there is potential for overlap between UL symbols across TAGs when there is a TCI-state switch.**These conclusions are FR-agnostic and apply to any TDD band. **Proposal: (reply LS draft in the annex.)** |
| [**R4-2212468**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212468.zip) | Discussion on maximum uplink timing difference for Multi-DCI Multi-TRP with two TAs and Reply LS | Samsung | ***Observation 1:* In RAN4, all the existing MRTD requirements (for NR-CA, EN-DC, NR-DC) have been agreed to apply for the case with multi-TRPs in Rel-16.** ***Observation 2:* In RAN4, there is no final decision explicitly to define MRTD requirement from two TRPs, but there is one clarification in TS 38.133:** **The requirements defined in clause [7.6] are also applicable when UE is configured to receive multiple PDSCH transmission occasions from one or more QCL sources on any one of the aggregated NR carriers.*****Observation 3:* In RAN1, for both intra and inter-cell, multi-TRP operations were limited to within a CP reception in Rel-17, but has not yet concluded that whether the downlink signals arrive within a CP or not in Rel-18**For RAN4’s reply to RAN1 LS (R1-2205593), the following proposals are provided: ***Proposal 1:* RAN4 provide the following reply to Q1 raised in RAN1 LS:*** **RAN4 see the existing MTTD requirement for inter-band sync NR-DC, i.e., 34.6us for all cells in MCG and SCG in FR1, and 8.5us for all cells in MCG and SCG in FR2-1, can be used as a starting point for RAN1, assumed as the maximum uplink timing difference between the two TAs for multi-DCI multi-TRP operation.**
* **Specifically, the maximum uplink timing difference between two TAs for multi-DCI multi-TRP operation discussed in RAN4 is the relative transmission timing difference between slot timing boundaries of the TX signals with TA1 and TA2.**
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| [**R4-2212527**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212527.zip) | Discussion on LS on maximum uplink timing difference for Multi-DCI Multi-TRP with two TAs | MediaTek Inc. | **Observation 1: Whether to use multiple panels or single panel for UL transmission is up to UE implementation.****Observation 2: For two UL signals transmitted from one panel at a time, the power jump problem may lead to the phase of the signal is not contiguous and network may not receive the signals successfully.****Proposal 1: For single UE panel, the timing difference between two UL signals transmission at a time should be smaller than one CP.****Proposal 2: For multiple UE panels, the timing difference may be larger than one CP, e.g. MTTD for CA case.** |
| [**R4-2212672**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212672.zip) | Discussion and draft reply LS on maximum uplink timing difference for multi-DCI multi-TRP with two TAs | vivo | **Observation 1 Based on RAN1 agreements, the 2 TA enhancements can be applicable to 3 types of scenarios:*** **FR1 UE**
* **FR2 UE, probably with the simultaneous different QCL-D Rx capability, but is only able to Tx from one panel.**
* **FR2 UE that is capable of Tx from 2 different panels.**

**Observation 2 For simultaneous Rx with different panels, the RTD assumption is being discussed in R18 multi-Rx chain WI.****Observation 3 MTTD requirements in TS 38.133 define the maximum Tx timing difference between different carriers in CA/DC scenario that UE is required to assumed, and it is up to RAN 1 to define the Tx timing difference between different TRPs within the single carrier.****Proposal RAN4 to provide RAN1 with the following feedback for the LS*** **For FR1 UE, or for FR2 UE which is only able to Tx from one panel at a time, the maximum Tx timing difference between different carriers in CA/DC scenario that UE is required to assumed, is specified in clause 7.5.4 of TS 38.133, and it is up to RAN 1 to define the Tx timing difference within the single carrier.**
* **For FR2 UE that is capable of simultaneous Tx from 2 different panels, RAN4 postpone the discussion until the RTD assumption is concluded in R18 multi-Rx chain WI.**
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| [**R4-2212917**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212917.zip) | Discussion on maximum uplink timing difference for multi-DCI multi-TRP with two TAs | Nokia, Nokia Shanghai Bell | 1. RAN1 has agreed to support two TA enhancement for both intra-cell and inter-cell multi-DCI multi-TRP non-collocated scenarios in FR1 and FR2 in Rel-18.

The current MTTD requirements defined in RAN4 are applicable to inter-band carrier aggregation and dual connectivity scenarios, in which it is considered that the UE has separate RX chains. There are currently no MRTD/ MTTD study or requirements specified for MIMO transmissions and non-collocated TRP scenariosIt is not clear from the WI what is the assumption on the UE receiver chain: single or multiple time tracking and control chains for UE RX and TX respectively RAN1 is still discussing UE behaviours of multi-DCI multi-TRP operation with two TA commands1. RAN4 to discuss the UE Tx/Rx architecture and time tracking and control assumptions for the definition of MTTD requirements. UE behaviors should be further clarified regarding
* UE reference timing tracking behaviors in DL on two TRPs
* UE TX timing determination in UL based on two TA commends

The MTTD depends on the TAE at the gNB, the propagation delay difference between both TRPs, and TA step size and adjustment accuracy. 1. RAN4 to discuss the tolerable MTTD for the non-collocated scenarios. The baseline for the discussion can be the values considered in the inter-band CA case.
* If reusing the requirements of the inter-band CA, a UE should be able to track DL timings separately for two non-collocated TRP and also maintain two TX timing based on two TA commands for two non-collocated TRP respectively.
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| R4-2213304 | Reply LS on maximum uplink timing difference for Multi-DCI Multi-TRP with two TAs | ZTE Corporation | Withdrawn？ |
| [**R4-2213496**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213496.zip) | Reply LS on maximum uplink timing difference for multi-DCI multi-TRP with two TAs | Huawei, HiSilicon | **Observation 1: The maximum uplink transmit timing difference between multi-TRPs relies on the maximum downlink receive timing difference between multi-TRPs.****Observation 2: In both R16 and R17, RAN4 agreed that the receive timing difference between different TRPs is assumed to be within a CP length.****Proposal 1: In R18, the maximum uplink transmit timing difference between multiple TRPs can be assumed as a CP length.** |
| [**R4-2213887**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213887.zip) | Reply LS on maximum uplink timing difference for Multi-DCI Multi-TRP with two TAs | ZTE Corporation | **Proposal: The maximum uplink timing difference can be assumed as:*** **For FR1, not larger than CP+1.6µs**
* **For FR2, not larger than CP+0.5µs**
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| [**R4-2213960**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213960.zip) | Discussion on MTTD for multi-DCI multi-TRP with two TAs | Ericsson | **Proposal 1: RAN4 to reuse MRTD and MTTD values of inter-band CA scenario for multi-DCI and multi-TA feature of Rel-18 MIMO.****Proposal 2: RAN4 to send a soft response (i.e., not indicating exact values) regarding the design constraints that effect MRTD and MTTD computation.** |
| [**R4-2213961**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213961.zip) | LS on maximum uplink timing difference for Multi-DCI Multi-TRP with two TAs | Ericsson | Draft LS reply.  |
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## Open issues summary

In Rel-18 discussions on MIMO Evolution for Downlink and Uplink, RAN1 has agreed to support multi-DCI multi-TRP operation with two TAs. With regards to the maximum uplink timing difference between the two TAs for multi-DCI multi-TRP operation, RAN1 made the following conclusion in RAN1#109-e:

**Conclusion: For multi-DCI multi-TRP operation with two TAs, the decision on the maximum uplink timing difference is left up to RAN4.**

* **send an LS to RAN4 asking them the maximum uplink timing difference RAN1 can assume between the two TAs for multi-DCI multi-TRP operation.**

RAN1 would kindly like to ask RAN4 to provide feedback on what maximum uplink timing difference that RAN1 can assume between the two TAs for multi-DCI multi-TRP operation.

### Sub-topic 1-1: Align views on whether MRTD/MTTD requirements in 38.133 cover intra-cell case.

* Proposals
	+ Option 1: No. The current MRTD/MTTD requirements in RAN4 defines the limitation on time difference only for inter-cell case. E.g. the concerning signals are from different CCs.
	+ Option 2: Yes. The current MRTD/MTTD requirement in RAN4 cover both intra-cell case and inter cell case.
	+ Option 3: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 1-2: MTTD for multiple TRPs for intra-cell case

* Proposals
	+ Option 1: the maximum uplink transmit timing difference between multiple TRPs can be assumed within a CP length (single FFT)
	+ Option 2: the maximum transmit timing difference depends on UE capability on number of panels
		- For single UE panel, the MTTD between UL signals should be within CP.
		- For multiple UE panels, the MTTD between UL signals may be larger than CP, e.g. MTTD for CA case.
	+ Option 3: the maximum uplink transmission timing difference refer to the Rel-18 RAN4 intra-band non-collocated WID defined MTTD requirement.
	+ Option 4: RAN4 to reuse MRTD and MTTD values of inter-band CA scenario for multi-DCI and multi-TA feature of Rel-18 MIMO.
	+ Option 5: The maximum uplink timing difference can be assumed as:
		- For FR1, not larger than CP+1.6µs
		- For FR2, not larger than CP+0.5µs
	+ Option 6: other, please specify
* Recommended WF
	+ TBA

### Sub-topic 1-3: MTTD for multiple TRPs for inter-cell case

* Proposals
	+ Option 1: the maximum uplink transmit timing difference between multiple TRPs can be assumed within a CP length (single FFT)
	+ Option 2: the maximum transmit timing difference depends on UE capability on the number of panels
		- For single UE panel, the MTTD between UL signals should be within CP.
		- For multiple UE panels, the MTTD between UL signals may be larger than CP, e.g. MTTD for CA case.
	+ Option 3: the current inter-band CA MTTD requirement can be reused.
	+ Option 4: RAN4 to reuse MRTD and MTTD values of inter-band CA scenario for multi-DCI and multi-TA feature of Rel-18 MIMO.
	+ Option 5: The maximum uplink timing difference can be assumed as:
		- For FR1, not larger than CP+1.6µs
		- For FR2, not larger than CP+0.5µs
	+ Option 6: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 1-4: LS reply to RAN1

* Proposals
	+ Option 1: Reply RAN4’s recommendation based on the conclusion for Sub-topic 1-1/2/3.
	+ Option 2: RAN4 to send a soft response (i.e., not indicating exact values) regarding the design constraints that effect MRTD and MTTD computation.
	+ Option 3: reply to RAN1 that the existing MTTD requirement for inter-band sync NR-DC, i.e., 34.6us for all cells in MCG and SCG in FR1, and 8.5us for all cells in MCG and SCG in FR2-1, can be used as a starting point for RAN1, assumed as the maximum uplink timing difference between the two TAs for multi-DCI multi-TRP
	+ Option 4: clarify the intended scenarios with RAN1 at first.
	+ Option 5: other, please specify.
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| ZTE | **For sub-topic 1-1:**For MTTD, the current requirements only focus on inter-cell case, including intra/inter-band EN-DC, intra/inter-band CA, inter-band NE-DC and inter-band NR-DC. For MRTD, an clarification was captured in 133, i.e. The requirements defined in clause [7.6] are also applicable when UE is configured to receive multiple PDSCH transmission occasions from one or more QCL sources on any one of the aggregated NR carriers. But not any MRTD requirement under intra-cell case was provided in 133.So we prefer Option 1.**For sub-topic 1-2:**We are fine with Option 3 and Option 5.For Option 5, since MTTD is mainly defined by MRTD and UE transmission timing error. Regarding to MRTD between mTRP, in R17 FeMIMO topic, RAN4 has identified that the Timing offset between serving cell and the cell with different PCI are within CP.Regarding to the UE transmission timing error, for intra-cell mTRP, the distance of two TRP is the inter-cell distance. Since not any requirements identified for intra-band CA case, so we can only reference to inter-band CA case. By comparing the MTTD and MRTD in inter-band CA case, it can be shown that the difference between MTTD and MRTD is 1.6µs for FR1, and 0.5µs for FR2. So we estimate the MTTD between mTRP as CP+1.6µs for FR1 and CP+0.5µs for FR2. **For sub-topic 1-3:**We are fine with Option 4 and Option 5.For Option 5, since MTTD is mainly defined by MRTD and UE transmission timing error. Regarding to MRTD between mTRP, in R17 FeMIMO topic, RAN4 has identified that the Timing offset between serving cell and the cell with different PCI are within CP.Regarding to the UE transmission timing error, for inter-cell mTRP, which is non-colocated, similar as inter-band CA case. So by comparing the MTTD and MRTD in inter-band CA case, it can be shown that the difference between MTTD and MRTD is 1.6µs for FR1, and 0.5µs for FR2. So we estimate the MTTD between mTRP as CP+1.6µs for FR1 and CP+0.5µs for FR2. **For sub-topic 1-4:**We are fine with Option 2 and Option 3. |
| IDC | **For sub-topic 1.1:**We believe that Option 2 is feasible as Rel-18 is focusing on multi-panel UE. Also, we see benefits and synergies on keeping the deployment size (in terms of propagation time) same as inter-band CA case for MRTD, MTTD respectively.**For sub-topic 1-2:**We are fine with Option 4. But we are fine with Option 2 is the number of the UE panels must be mentioned. But we believe that Rel-18 is about multi-panel UE. For option 2, obviously we think of inter-band CA MRTD, MTTD requirements.**For sub-topic 1-3:**Option 3 (for multi-panel UE obviously).**For sub-topic 1-4:**Option 3. We believe it is feasible. But if the group decides to send a softer message it would be Ok as well (option 2) indicating what kind of design constrains are on the horizon. |
| Apple | **Sub-topic 1-1: Align views on whether MRTD/MTTD requirements in 38.133 cover intra-cell case.**Observation in option 1 aligns with current MRTD/MTTD requirements design.**Sub-topic 1-2: MTTD for multiple TRPs for intra-cell case**MTTD and MRTD are symmetric to some extent. RAN1 had assumption in R16 and R17 that MRTD is within CP. It is unclear whether we can still hold this assumption in R18 discussion. If so, we support option 1 and 5. Note that existing MRTD and MTTD assume 9km (FR1) and 1.5km (FR2) distance between the two Nodes, which we believe is larger than typical intra-cell deployment. Another point we would like to highlight is that the WID is not limited to multiple panels capable UE according to our understanding.**Sub-topic 1-3: MTTD for multiple TRPs for inter-cell case**Similar with intra-cell case, it is better to check the assumption of MRTD first.**Sub-topic 1-4: LS reply to RAN1**We support option 4, which is necessary to discuss MRTD/MTTD.  |
| vivo | **Sub-topic 1-1**The MRTD/MTTD should cover both the intra-cell case and inter-cell case. However, a tighter TAE requirement for gNB between multi-TRP is normally assumed, for the case when M-TRP transmission is performed. Such tighter TAE is also applicable to both intra-cell case and inter-cell case. Therefore, we would like to support option 3:The current MRTD/MTTD requirement in RAN4 cover both intra-cell case and inter-cell case, if ‘intra-cell’ here means transmission/reception from serving cell(s) in multiple carriers, and ‘inter-cell’ means reception/transmission to any cell that are not serving cell.For M-TRP scenario, a tighter TAE requirement, e.g. <CP, for gNB between multi-TRP is normally assumed, for both UL and DL.**Sub-topic 1-2**We would like to support option 6• For FR1 UE, or for FR2 UE which is only able to Tx from one panel at a time, the maximum Tx timing difference between different carriers in CA/DC scenario that UE is required to assumed, is specified in clause 7.5.4 of TS 38.133, and it is up to RAN 1 to define the Tx timing difference within the single carrier.• For FR2 UE that is capable of simultaneous Tx from 2 different panels, RAN4 postpone the discussion until the RTD assumption is concluded in R18 multi-Rx chain WI.**Sub-topic 1-3**Same as intra-cell case, i.e. sub-topic 1-2. Actually we do not see any difference between intra-cell and inter-cell for this issue.**Sub-topic 1-4**Same as sub-topic 1-2. |
| Ericsson | Sub-topic 1-1: Align views on whether MRTD/MTTD requirements in 38.133 cover intra-cell case.* + We think Option 3. In RAN4, we defined MRTD requirement for CA or DC case and not for MIMO. So far in RAN4, we assumed that for MIMO case RTD is with in CP.

Sub-topic 1-2: MTTD for multiple TRPs for intra-cell case* + We defined MRTD requirement for CA or DC case and not for MIMO. So far in RAN4, we assumed that for MIMO case RTD is with in CP. MTTD = MRTD + UL margins.
	+ First, we need to agree on the deployment scenario. That means the maximum distance or separation between TRPs should be agreed. Next thing is UE architecture like single FFT or multiple FFT can be supported needs to be agreed.
	+ Assuming multiple FFT, scenario can be treated as non-collocated .

Sub-topic 1-3: MTTD for multiple TRPs for inter-cell case* + We defined MRTD requirement for CA or DC case and not for MIMO. So far in RAN4, we assumed that for MIMO case RTD is with in CP. MTTD = MRTD + UL margins.
	+ First, we need to agree on the deployment scenario. That means the maximum distance or separation between TRPs should be agreed. Next thing is UE architecture like single FFT or multiple FFT can be supported needs to be agreed.
	+ Assuming multiple FFT, scenario can be treated as non-collocated .

Sub-topic 1-4: LS reply to RAN1 * We support Option 2, that is RAN4 to send a soft response (i.e., not indicating exact values) regarding the design constraints that effect MRTD and MTTD computation. Once we had conclusion in RAN4 after further study, we could send a detailed LS.
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### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | Company A |
| Company B |
|  |
|  | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: Feature Group 6-1a (R2-2204009, RP-221870)

## Companies’ contributions summary

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| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2211905**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211905.zip) | On BWP operation without bandwidth restriction | Apple |  **Observation 1: it is RAN4 common understanding that it is not a valid scenario to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.****Observation 2: there is extra power consumption for type 1 UE.****Observation 3: discussion on scheduling restriction for UE performing BM/RLM/BFD on RS outside active BWP is needed if RAN4 is to support type 1 implementation.****Observation 4: extra power consumption for type 2 UE is limited compared to type 1 UE.****Observation 5: discussion on interruption and scheduling restriction for UE performing BM/RLM/BFD on RS outside active BWP is needed if RAN4 is to support type 2 implementation.****Observation 6: type 3 may benefit system throughput, depending on progress of other ongoing R18 work items.****Observation 7: further study is necessary on interruption and scheduling restriction for UE performing BM/RLM/BFD on RS outside active BWP is needed if RAN4 is to support type 3 implementation.****Observation 8: it is more challenging to support RS outside UE CBW than RS outside active BWP but within CBW.****Observation 9: current 3GPP design can already support BM/RLM/BFD on the BWP which does not contain initial SSB, i.e. via CSI-RS based BM/RLM/BFD. CSI-RS based RLM is even a mandatory feature since R15.****Observation 10: using NCD-SSB can also allow BM/RLM/BFD on the BWP which does not contain initial SSB. However, RAN4 standardization work is still needed since existing NCD-SSB related RAN4 requirements only apply to RedCap UE. Besides, it comes at the price of network signaling overhead compared to existing CSI-RS based approach.****Proposal 1: RAN4 shall not further discuss BWP operation without bandwidth restriction issue in R17.****Proposal 2: if necessary, study feasibility of supporting BM/RLM/BFD outside active BWP and NCD-SSB based BM/RLM/BFD in R18 RRM enhancement scope.** |
| [**R4-2212140**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212140.zip) | BWP operation without bandwidth restriction | Qualcomm Incorporated | **Observation 1: Current RAN4 requirements are artificially limited to the case when RLM-RS is transmitted within the active BWP, however, this is not related to implementation feasibility.****Observation 2: It is feasible for the UE to process both the signals within the active BWP and the configured reference signals outside the BWP if the UE supports a channel BW that spans both.****Observation 3: From a UE operation and requirements point of view, configuring the bandwidth to receive both the active BWP and the reference signals is same as receiving all signals within the active BWP.****Observation 4: If a scenario in which the UE would process concurrently signals within the active BWP and reference signals outside the active BWP were to be introduced, clarifications and applicability changes to the RAN4 specifications would be required.**Hence, it can be concluded that **from a UE implementation point of view, it is feasible for the UE to perform BM/RLM/BFD when the active BWP does not contain the reference signals used for RLM/BFD (e.g. SSB). The UE operation is the same as when these signals are withing the active BWP.**  |
| [**R4-2212144**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212144.zip) | Views on BWP without Restriction and NCD-SSB | Intel Corporation | **Observation 1**: All of the potential methods for monitoring separate initial BWP from active BWP due to RSs configured outside the active BWP result in increased power consumption and/or hardware complexity for the UE.**Observation 2:** The existing RAN4 specification does not currently require UEs to monitor RSs outside the active DL BWP, so there would be a specification impact to adding such a capability.**Observation 3**: The best solution is to pursue the NCD-SSB approach that has been discussed in RAN2 and RAN Plenary. Utilizing an NCD-SSB as the RS would allow an SSB RS to be tracked within the active BWP. This would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD.**Proposal:** For Q2 in the LS, we should not pursue defining RS outside the active BWP but instead respond noting the value of developing the NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD |
| [**R4-2212285**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212285.zip) | Reply LS On BWP operation without bandwidth restriction | CMCC | **Proposal 1: Configuring a DL BWP which does not contain SSB associated to the initial DL BWP, while not configuring CSI-RS for BM/RLM/BFD is not a valid scenario.****Proposal 2: Perform BM/RLM/BFD based on CSI-RS are mandatory features, and should be the baseline assumption for supporting *bwp-WithoutRestriction*.****Proposal 3: Feature Group 6-1a “*bwp-WithoutRestriction*” with mandatory supporting FG 1-7 and /or 2-31, and the corresponding requirements can already be supported from Rel-15.** |
| [**R4-2212548**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212548.zip) | Reply LS on BWP operation without bandwidth restriction | OPPO | **Proposal 1: From a RAN4 specification point of view, the scenario in which UE does not perform BM/RLM/BFD is not valid.****Proposal 2: UE should be allowed to perform BM/RLM/BFD when the active BWP does not contain SSB, which is up to UE implementation** **at least in Rel-15/16/17.**  |
| [**R4-2212868**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212868.zip) | Discussion on LS on BWP operation without bandwidth restriction | Nokia, Nokia Shanghai Bell | **Reply to Q1:** Conditionally yes. But the UE would need to have access to the SSB e.g., intra-frequency gaps would be allocated if such are required by the UE.**Reply to Q2:** The UE should always be allocated intra-frequency measurement gaps to enable the UE to perform intra-frequency measurement including serving cell measurements if such are required by the UE. A UE which does not need intra-frequency measurement gaps for performing SSB measurements outside the active BWP can perform such measurements without gaps. Based on such measurement, the UE would be able to perform SSB based RLM/BFD.One question to further discuss in RAN4 is whether e.g., SSB based measurement performed outside the active BWP as described above can be considered can be used for RLM/BFD measurements? |
| [**R4-2213052**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213052.zip) | On BWP operation without bandwidth restriction | vivo | ***Proposal 1: For UE supporting bwp-WithoutRestriction, it is feasible for the UE to perform L1 measurements, including RLM/BFD/CBD/L1-RSRP measurements, when reference signals which should be SSB in the context of RAN2 LS are outside the active BWP, provided the UE is working in a larger channel bandwidth that includes bandwidth of both active BWP and SSB.******Proposal 2: Expected changes to RRM requirements for UE supporting bwp-WithoutRestriction could be as follows.**** ***The UE is required to perform L1 measurements (RLM/BFD/CBD/L1-RSRP/downlink timing tracking) when reference signals (SSB) are not contained with active BWP.***
* ***Measurement restriction requirements for L1 measurements with reference signals (SSB) within active BWP are also applicable to when reference signals (SSB) are not contained with active BWP.***
* ***Scheduling restriction requirements for L1 measurements with reference signals (SSB) within active BWP are also applicable to when reference signals (SSB) are not contained with active BWP.***
* ***No interruptions are allowed for UE to perform layer measurements when reference signals (SSB) are not contained with active BWP.***

***Proposal 3: For UE supporting bwp-WithoutRestriction, it may be feasible, at least for some of the cases, for the UE to perform L1 measurements, including RLM/BFD/CBD/L1-RSRP measurements, when reference signals which should be SSB in the context of RAN2 LS are outside the active BWP, provided measurement gaps are configured for the UE to perform L1 measurements.******Proposal 4: Further study is needed in RAN4 on measurement gaps based L1 measurements.******Proposal 5: For UE supporting bwp-WithoutRestriction, it is feasible for the UE to perform L1 measurements, including RLM/BFD/CBD/L1-RSRP measurements, when reference signals which should be SSB in the context of RAN2 LS are outside the active BWP, provided UE additionally indicates no-gap via NeedForGapsIntraFreq.******Proposal 5a: A measurement gap for L1 measurement should be configured, provided UE additionally indicates gap via NeedForGapsIntraFreq.******Proposal 6: For UE supporting bwp-WithoutRestriction, it is feasible for the UE to perform L1 measurements, including RLM/BFD/CBD/L1-RSRP measurements, when reference signals which should be SSB in the context of RAN2 LS are outside the active BWP, provided UE additionally indicates nogap-noncsg via intraFreq-needForNCSG.******Proposal 6a: A measurement gap for L1 measurement would be configured, provided UE additionally indicates gap via intraFreq-needForNCSG.******Proposal 6b: A NCSG gap for L1 measurement would be configured, provided UE additionally indicates gap via intraFreq-needForNCSG.******Proposal 7: For UE supporting bwp-WithoutRestriction, it is not considered that L1 measurements on reference signals (SSB) outside the active BWP are conducted by RF retuning.*** |
| [**R4-2213401**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213401.zip) | Discussion of BWP operation without bandwidth restriction | Ericsson | Proposal 1 For a UE which supports ‘*bwp-WithoutRestriction*’, it is feasible to perform BM/RLM/BFD on RSs that are not contained within the active BWP based on following:* + - UE’s capability to operate using larger BW,
		- Whether UE is equipped with a separate RF chain

**Proposal 2 RAN4 to further discuss the no interruption conditions for UE supporting *bwp-WithoutRestriction*.** |
| [**R4-2213561**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213561.zip) | Discussion on requirements for bwp-WithoutRestriction | Huawei, HiSilicon | **Proposal 1: RAN4 to define requirements for L1 measurement on SSB outside BWP for FG 6-1a.****Proposal 2: RF re-tuning before and after the measurement should be allowed for UE to perform L1 measurement on SSB outside BWP.****Proposal 3: L1 measurement on SSB outside BWP are performed with shared MG or NCSG for L3 measurement.** **Proposal 4: RAN4 to consider the following updates to the L1 measurement requirements*** **MGRP/VIRP are accounted in the measurement interval**
* **When L1 measurement is performed with MG, CSSF is applied**

**Proposal 5: Requirements for FG 6-1a are defined in Rel-18.** |
| R4-2213591 | Discussion of RRM aspects on BWP without bandwidth restriction | ZTE Corporation | Withdrawn? |
| [**R4-2213650**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213650.zip) | BWP operation without BW restrictions for Non-RedCap Ues | MediaTek inc. | **Proposal 1: RAN4 discussion, analysis, solution, and LS response shall focus solely on non-RedCap UEs where RedCap UEs discussion is out of scope.****Observation 1: RAN4 requirements for BM/RLM/BFD based CSI-RS in FR1 can be directly applied for BWP without SSB.****Observation 2: RAN4 requirements for BM/RLM/BFD based CSI-RS in FR1 can not be directly applied for BWP without SSB because it is dependent on SSB signals to acquire QCL information.****Proposal 2: RAN4 shall not rely on CSI-RS for BM/RLM/BFD in FR2 for the BWP operation without SSB.****Observation 3: One possible UE implementation to perform BM/RLM/BFD outside the active BWP is using large RF and baseband bandwidth to cover both the active BWP and the SSB outside that BWP.****Observation 4: Using large BW to perform BM/RLM/BFD outside the active BWP comes at the cost of high-power consumption (i.e., reduced UE power efficiency).****Observation 5: With a small gap, UE can perform RF/BB reconfiguration and achieve most UE power saving to measure SSBs outside its active BWP.****Proposal 3: For non-RedCap UEs, introduce a new optional Rel-18 UE capability for SSB-based RLM/BFD/CBD/BM using SSBs outside active BWP with a small gap.****Observation 6: When UE is configured with narrow BWP for power saving on PCell/PSCell, its traffic load is very likely to be low and its SCells, if any, are likely to be deactivated or dormant.****Proposal 4: The support for SSB-based L1 measurements using SSBs outside active BWP is applicable to PCell/PSCell only.****Observation 7: Specification of R16 NeedForGap is incomplete and remaining work is to be discussed in Rel-18 RAN4 WI.****Observation 8: Coupling Rel-16 NeedforGap with L1 measurement for BWP without restriction requires long and controversial discussion in RAN4.****Observation 9: Specification changes are minimized, and controversial discussions can be avoided, if we leverage R17 NCSG to support L1 measurement for BWP without restriction.****Proposal 5: For non-RedCap UEs, RAN4 shall introduce a new optional Rel-18 UE capability to indicate the support for SSB-based RLM/BFD/BM on SpCell (i.e. PCell or PSCell) using SSBs outside active BWP with a small gap.****Proposal 6: Reuse the UE capability reporting framework from Rel-17 NCSG for the new capability of SSB-based RLM/BFD/BM using SSBs outside active BWP.** |
| [**R4-2213778**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213778.zip) | Discussion of RRM aspects on BWP without bandwidth restriction | ZTE Corporation | **Observation 1: Not any impact on RRM measurement for the UE capable of bwp-WithoutRestriction.** **Observation 2: The impact from the perspective of RAN4 is: for a UE capable of *bwp-WithoutRestriction*, the UE can only perform RLM based on CSI-RS in the BWP without SSB.****Observation 3: The impact from the perspective of RAN4 is: for a UE capable of bwp-WithoutRestriction, the UE can only perform BFD based on periodic CSI-RS in the BWP without SSB.****Observation 4: The impact from the perspective of RAN4 is: for a UE capable of bwp-WithoutRestriction, the UE can only perform L1 measurement based on CSI-RS resource configured within the active BWP without SSB.** |

## Open issues summary

In RAN2 LS R2-2204009, the following Questions were raised to RAN4

**Question 1:**

Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.

**Question 2:**

If the answer to question 1 is that this is not valid, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.

In RP-221870,

To task the relevant Working Groups (RAN 1, 2, 4) to make progress on their discussions related to the RAN 2 LS in R2-2204009, aim to ensure that Feature Group 6-1a “*bwp-WithoutRestriction*” works in an early implementable form in R18, or, possibly R17, and report progress to RAN #97.

### Sub-topic 2-1: Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.

* Proposals
	+ Option 1: No. From RAN4 specification point of view, it is not a valid scenario.
	+ Option 2: Yes.
	+ Option 3: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 2-2: if the answer to Sub-topic 2-2 is ”no”, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.

* Proposals
	+ Option 1: Perform BM/RLM/BFD based on CSI-RS are mandatory features, and should be the baseline assumption for supporting *bwp-WithoutRestriction*.
	+ Option 2: UE should be allowed to perform BM/RLM/BFD when the active BWP does not contain SSB, which is up to UE implementation at least in Rel-15/16/17.
	+ Option 3: It is feasible to perform BM/RLM/BFD on RSs that are not contained within the active BWP based on following:
		- UE’s capability to operate using larger BW,
		- Whether UE is equipped with a separate RF chain
	+ Option 4: To support the concerning scenario, existing RAN4 requirements need to be updated by taking into the following potential aspects.
		- FFS on RF re-tuning before and after the measurement should be allowed for UE to perform L1 measurement on SSB outside BWP.
		- FFS on L1 measurement on SSB outside BWP are performed with shared MG or NCSG for L3 measurement.
		- FFS on Intra-frequency GAP and CSSF for L1 measurement
		- RAN4 shall not rely on CSI-RS for BM/RLM/BFD in FR2 for the BWP operation without SSB.
	+ Option 5: developing the NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD
	+ Option 6: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 2-3: in which release and how to introduce enhanced RRM requirements to support Feature Group 6-1a “*bwp-WithoutRestriction*”?

* Proposals
	+ Option 1: Continue discussion in Rel-17 under TEI17
	+ Option 2: In Rel-18 under the umbrella WI “ Rel-18 RRM enhancement”
		- The support of Feature Group 6-1a “*bwp-WithoutRestriction*” in Rel-17 is left to implementation.
	+ Option 3: Feature Group 6-1a “*bwp-WithoutRestriction*” with mandatory supporting FG 1-7 and /or 2-31, and the corresponding requirements can already be supported from Rel-15.
	+ Option 4: other, please specify.
* Recommended WF
	+ TBA

### Sub-topic 2-4: scope of the RAN4 discussion

* Proposals
	+ Option 1: non-RedCap UEs where RedCap UEs is out of scope.
	+ Option 2: other, please specify.
* Recommended WF
	+ TBA

### Sub-topic 2-5: LS reply to RAN2 (CC RAN)

* Proposals
	+ Option 1: discuss LS reply in 2nd round based on the conclusion for Sub-topic 2-1/2/3/4.
	+ Option 2: other, please specify
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | **For sub-topic 2-2:**From the legacy specification, UE can only perform RLM/BFD based on the SSB within the active BWP. But from the UE implementation, we do not believe UE can not perform RLM/BFD based on the SSB out of the active BWP, since in fact which depend on the UE RF and baseband bandwidth. As long as UE RF and baseband bandwidth is wide enough to cover both active BWP and the SSB used for RLM/BFD, UE can perform RLM/BFD based on such SSB even they are outside of active BWP. Which is similar as RRM measurement. So we prefer Option 3 and possible Option 4. For the last bullet in Option 4, it is too artificial, we believe whether UE need to rely on CSI-RS based BM/RLM/BFD, which is somehow UE capability related. **For sub-topic 2-5:**Prefer Option 1. |
| vivo | Sub-topic 2-1: Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.Option 1. RLM/BM/BFD is essential functionality to guarantee that good radio link quality is maintained and it is known between UE and NW. Sub-topic 2-2: if the answer to Sub-topic 2-2 is ”no”, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.As provided in our paper R4-2213052, there are three alternatives that UE can be used to perform BM/RLM/BFD when the active BWP does not contain SSB.* Alt 1. UE works in a larger bandwidth than active BWP so that SSB can be included in the UE working channel bandwidth, which could be either the configured UE carrier channel bandwidth or a larger channel bandwidth that includes bandwidth of both active BWP and SSB.
* Alt 2. UE is provided measurement gaps, including NCSG gap pattern, to perform BM/RLM/BFD when the active BWP does not contain SSB.
* Alt 3. UE uses redundant RF chain to perform BM/RLM/BFD when the active BWP does not contain SSB.

Alt 1 has minimum spec changes, which would mainly be applicability of requirements.Alt 2 needs further study and evaluation. Big impacts to spec, including requirements and signaling, are expected.Alt 3 needs to specify measurement requirements in RAN4 and new signalling may be needed.If the feature is supported from Rel-17, then Alt 1 would be the only feasible solution considering minimum spec changes which could be done in R17 maintenance/TEI.If the feature is to be supported from Rel-18, then all the three alternatives can be considered.Option 1 is not about what is asked in RAN2 LS, in our understanding.Option 5 is interesting approach. However, it may not be used to make FG 6-1a workable, which is under the assumption that there is no SSB in the active BWP. Sub-topic 2-3: in which release and how to introduce enhanced RRM requirements to support Feature Group 6-1a “bwp-WithoutRestriction”?Option 1. At least for Alt 1, the work can be done in Rel-17.Sub-topic 2-4: scope of the RAN4 discussionOption 1 is fine in general. However, for RedCap UE, there is an issue related to this, which was triggered by RAN1 LS two meetings ago, being discussed in RedCap WI. In this email thread, it is focused on normal UE.Sub-topic 2-5: LS reply to RAN2 (CC RAN)We should try to figures out technical solutions for BWP without restriction firstly.  |
| Apple | **Sub-topic 2-1: Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.**Option 1. RAN4 discussed this in RAN4#103e and we believe it is common understanding that existing RAN4 requirements cannot cover this scenario.**Sub-topic 2-2: if the answer to Sub-topic 2-2 is ”no”, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.**Support option 1. Using CSI-RS for BM/RLM/BFD has already been supported since R15. RAN4 already has a full set of requirements. For other options, RAN4 needs to discuss all the possible implementations and introduce corresponding requirements which is time consuming. Considering core part design for R17 has completed, RAN4 can discuss these options as enhancement in R18.**Sub-topic 2-3: in which release and how to introduce enhanced RRM requirements to support Feature Group 6-1a “*bwp-WithoutRestriction*”?**We support option 3, which is more like an observation. We are open for further discussion for other possible solutions in R18 considering the timeframe.**Sub-topic 2-4: scope of the RAN4 discussion**Support option 1. RAN2 clearly stated in their LS that “**NOTE:** This LS is for pre-Release-17 behaviour, and RedCap is out of the scope.”**Sub-topic 2-5: LS reply to RAN2 (CC RAN)**Option 1 is fine. |
| OPPO | **Sub-topic 2-1: Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.**Option 1. It is common understanding that existing RAN4 requirements cannot cover this scenario.**Sub-topic 2-2: if the answer to Sub-topic 2-2 is ”no”, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.**Support option 2. It seems hard for RAN4 to conclude corresponding requirements in R17 due to diverse solutions and limited time. We prefer RAN4 to discuss these options as enhancement in R18, and leave it to UE implementation in R15/16/17. Besides, Option 1 could be correct understanding that target RS can be SSB or CSI-RS within active BWP. **Sub-topic 2-3: in which release and how to introduce enhanced RRM requirements to support Feature Group 6-1a “*bwp-WithoutRestriction*”?**If RAN4 decide to fix this issue, we are ok to start from either R17 or R18. If it cannot concluded in TEI17, we think R18 eFeRRM could be a good place to continue the discussion. **Sub-topic 2-4: scope of the RAN4 discussion**Support option 1.**Sub-topic 2-5: LS reply to RAN2 (CC RAN)**Option 1 is fine. |
| Qualcomm | **Sub-topic 2-1:** Option 1, this is not a valid scenario. In our understanding this answer in the LS was not controversial in previous meeting and the reply to Q1 discussed in the previous RAN4 meeting can be used.**Sub-topic 2-2:** These opitons are not exclusive. Option 1 is feasibl in principle, however, there are no interoperability testing opportunities for CSI-RS based RLM, hence, this option is not valid from a deployment point of view.UEs can perform BM/RLM/BFD on RSs that are not contained within the active BWP as shown in our paper. Some small changes to the current specifications would be needed. It is also feasible to introduce gaps or NCSG/interruptions for such a scenario, however, this will have bigger system and spec impact and should be taken as lower priority. We support Option 3. Option 4 can be complimentary to Option 3, a separate feature can be defined for such a scenario. The baseline should be that no measurement gaps or interruptions are needed. There will be a slight increase in UE power consumption, however, this will be compensated by the increase in throughput. **Sub-topic 2-3:** In our understanding this is a plenary discussion, not a RAN4 discussion. From a RAN4 point of view, requirements can be added to Rel-17.Among all the options, we would pick Option 4 and continue this discussion in RAN plenary considering the input from other WGs**Sub-topic 2-4:** In our understanding this discussion is about non-RedCap UEs, however, it should be easy to extend to RedCap UEs also.**Sub-topic 2-5:** Option 1. RAN4 should focus on the feasibility discussions. |
| MediaTek | **Sub-topic 2-1: Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.**We support Option 1, for the same reasons mentioned by Apple and OPPO.**Sub-topic 2-2: if the answer to Sub-topic 2-2 is ”no”, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.**While for BM/RLM/BFD based CSI-RS in FR2 the existing requirements in RAN4 is dependent on the existing of SSB in the active BWP to provide the QCL information. This can be observed from the CSI-RS FR2 requirements where beam sweeping scaling factor (N) is equal to 1, which is not the case for the BM/RLM/BFD based SSB requirements where N = 8. Nevertheless, this issue can be handled by setting the CSI-RS repetition on. Therefore, for CSI-RS based solution, we agree with Apple that the requirements are completed, however, there should be a condition in FR2, where the repetition is set on. We support option 1 with additional study on the condition for FR2 so the option can be written as:* Option 1a: Perform BM/RLM/BFD based on CSI-RS are mandatory features, and should be the baseline assumption for supporting *bwp-WithoutRestriction*.
	+ For FR2: the CSI-RS repetition is on (FFS).

Besides, for the SSB-based solutions when SSB is outside the active BWP, RAN4 should further study these solutions taking into consideration that interruption is needed for RF re-tune operation. We also want to highlight that introducing new mechanism is time consuming and given that Rel-17 core part is closed, hence, new requirements should be defined in Rel-18. **Sub-topic 2-3: in which release and how to introduce enhanced RRM requirements to support Feature Group 6-1a “*bwp-WithoutRestriction*”?**We support Option 3 if it is specifically written for CSI-RS based solution as:* Option 3: Feature Group 6-1a “*bwp-WithoutRestriction*” with mandatory supporting FG 1-7 and /or 2-31 and/or FG-24, and the corresponding requirements can already be supported from Rel-15.
	+ For FR2: the CSI-RS repetition is on (FFS).

**Sub-topic 2-4: scope of the RAN4 discussion**We support Option 1.**Sub-topic 2-5: LS reply to RAN2 (CC RAN)**Fine with Option 1. |
| CMCC | Sub-topic 2-1: Option 1. And this is also not a valid scenario from real deployment since network can simply configure CSI-RS for UE within the active BWP, so lack of necessary reference signal in the active BWP is not a valid scenario.Sub-topic 2-2: We support option 1. The problem of option 3 is that not all UEs implement in such way, so network still need to configure CSI-RS if there is no SSB within active BWP. Also, we don’t think UE capability is needed for UE using larger BW. Network cannot do anything with such capability. Sub-topic 2-3: This issue depends on the outcome of previous ones. In our view, no requirements are needed (option 3).Sub-topic 2-4: Option1 |
| Ericsson | **Sub-topic 2-1:**At last meeting it was agreed that the RAN4 BM/RLM/BFD requirements are defined for the case when the target RS to perform the BM/RLM/BFD is contained within the UE active BWP, see the agreement below [R4-2211219]:***“Agreement****:** *RAN4 is to inform RAN2 that RAN4 requirements are defined only for the case when the target RS (SSB or CSI-RS) to perform BM/RLM/BFD is contained within the UE active BWP”*

This agreement corresponds to option 1 and we don’t think any further discussions is needed. **Sub-topic 2-2:**The options depend on which release the listed solutions apply. For example, we believe option 3 is already possible based on existing specification and UE capability. However, solutions listed under option 4 and 5 require new RRM work and specification of new requirements which would be possible from new releases (e.g. Rel-18) only. Hence, we would like the issue to be clarified whether applies to existing releases/specifications or new releases (Rel-18). Assuming the former case, we support option 3. Assuming the latter case, solutions listed under option 4 and 5 can be discussed. **Sub-topic 2-3:**It depends on the type of solutions agreed or assumed. For example, as we have commented above, some of the listed solutions (e.g. UE’s capability to operate using larger BW, Whether UE is equipped with a separate RF chain) can be used already in existing releases/specifications. However, if new solutions such as those listed under option 4 and 5 in sub-topic 2-2 are considered then it is better to introduce associated requirements from Rel-18 as this would require some more work in RAN4 which cannot be done TEI. **Sub-topic 2-4:**There is following note in the original LS from RAN2 [R2-2204009]:***“NOTE:*** *This LS is for pre-Release-17 behaviour, and RedCap is out of the scope.”*Thus we support option 1. **Sub-topic 2-5:**Option 1 is fine.  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | Company A |
| Company B |
|  |
|  | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: UL Segmented Transmission for UL synchronization for IoT NTN (R1-2205642)

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** |  | **Company** | **Proposals / Observations** |
| [**R4-2212909**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212909.zip) | Discussion on UL synchronization for IoT NTN | Nokia, Nokia Shanghai Bell | 1. RAN4 to prioritize the definition of requirements for UE transmit timing, UE timer accuracy and timing advance for eMTC/NB-IoT devices, considering the impact of UL segmented transmission for UL synchronization.
2. The TN eMTC / NB-IoT UL timing requirements do not allow the timing adjustment during a UL repetition period.
3. RAN4 to define requirements considering timing adjustment during a UL repetition period.
4. RAN4 to define the UE transmit reference point as:$\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{s}$ .
5. RAN4 to discuss the impact of initial transmission timing error on segment duration and decoding performance.
 |
| [**R4-2213572**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213572.zip) | Views on RAN4 action on UL Segmented Transmission for UL synchronization for IoT NTN | Sony | **Observation 1: for eMTC PUCCH/PUSCH with frequency hopping enabled, the UE can adjust the uplink transmit timing and transmit frequency when hopping to a new narrowband if the frequency hopping interval is less than or equal to the configured transmission segment duration, which may also need RAN4 to clarify the corresponding UE behavior in 36.113.** **Proposal 1: RAN4 shall clarify the IoT NTN behavior in TS 36.133 for Rel-17 to allow UEs to adjust TA during the ongoing repetition.** **Proposal 2: RAN4 shall specify the IoT NTN behavior in TS 36.133 to ensure the UE keeps a constant TA value within each segment** **Proposal 3: RAN4 shall further study if there is any specification impact when UE performs frequency hopping for IoT NTN.**  |
|  |  |  |  |

## Open issues summary

An LS from RAN1 is sent to RAN4 with the aspects of UL segmented transmission and leaves it up to RAN4 to specify it for UL synchronization for IoT NTN:

* *UE applies segmented UL transmission according to duration configuration by the network*
* *Different values (e.g., TA) for pre-compensation may be used per segment, where UE pre-compensation per segment of NPUSCH for NB-IoT and PUSCH/PUCCH for eMTC is applied from one segment to the next segment*

*RAN1 respectfully requests RAN4 to prioritize the UL Segmented Transmission for UL synchronization for IoT NTN work by considering the above.*

The following Sub-topics will focus the discussion on time adjustment during a UL repetition period, UE transmit reference point and the impact of initial transmission timing error.

### Sub-topic 3-1: timing adjustment during a UL repetition period.

* Proposals
	+ Option 1: following proposal 1&2
		- Proposal 1: RAN4 shall clarify the IoT NTN behaviour in TS 36.133 for Rel-17 to allow UEs to adjust TA during the ongoing repetition.
		- Proposal 2: RAN4 shall specify the IoT NTN behaviour in TS 36.133 to ensure the UE keeps a constant TA value within each segment
	+ Option 3: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 3-2: UE transmit reference point

* Proposals
	+ Option 1: the UE transmit reference point is defined as $\left(N\_{TA}+N\_{TA,offset}+N\_{TA,adj}^{common}+N\_{TA,adj}^{UE}\right)T\_{s}$
	+ Option 3: Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 3-3: further study on UE transmission timing error

* Proposals
	+ Proposal 1: investigate the following cases A-C for UE transmit error impact
1. Case A: The UE attempts to adjust the initial transmission timing error to be as close to 0 s as possible. The network-controlled segment duration may be defined such that the transmission timing at the end of the segment is causing an error of Te (due to the timing advance change).
2. Case B: The UE attempts to adjust the initial transmission timing error to be -0.5\*Te. Using the same segment duration as in case A, this means the UE stops the transmission when the timing advance change causes an error of 0.5\*Te.
3. Case C: The UE attempts to adjust the initial transmission timing error to be -Te. Assuming the network-controlled segment duration is configured similarly to case A, i.e. to stop when the transmission timing error is Te, the network-controlled segment duration can be twice as long as in cases A and B.



* + Proposal 2: RAN4 shall further study if there is any specification impact when UE performs frequency hopping for IoT NTN
	+ Other, please specify
* Recommended WF
	+ TBA

### Sub-topic 3-4: whether LS reply is needed in this meeting?

* Proposals
	+ Option 1: Yes. Simple reply saying that “RAN4 has noted the issue raised by RAN1 and will prioritize UL Segmented Transmission for UL synchronization for IoT NTN”. And RAN4 will inform RAN1 once consensus is reached.
	+ Option 2: No. Reply the LS after RAN4 has conclusion in future meetings.
	+ Option 3: Other, please specify
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | Sub-topic 3-1: We support Proposal 1 and disagree Proposal 2. On Proposal 2, what RAN4 should do is to specify requirements based on RAN1 agreement as in RAN1 LS to RAN4 (attached R1-2205642).  **Agreement in 8.14 for IoT NTN**UE pre-compensation per segment of NPUSCH for NB-IoT and PUSCH/PUCCH for eMTC is applied from one segment to the next segment by using one or more of the following methods if supported by UE implementation       1. UE may drop / Insert samples / Puncture OFDM symbols         2. UE may blank subframes / slots where UE skip a slot or a subframeThe total transmission time is not changedUE autonomously Drop / insert samples / Puncture OFDM symbols or Blank subframes / slots where UE drops a subframe / slotRAN1 did not make any agreement to preclude UE pre-compensating the TA during the segment. If UE does the UE pre-compensation, there should be no issue as long as the RAN4 timing requirements (e.g. Te\_NTN) are met. There is no need to forbid UE to apply UE pre-compensation during the segment and somehow test for this. Sub-topic 3-2: Is the intention of Option 1 to clarify the UL transmission reference timing for IoT NTN? Option 1 is the same as the current spec for NR NTN and seems fine. The complete statement, as in 7.1C.1 is attached below for reference:*The uplink frame transmission takes place (NTA + NTA-offset + NTA,common + NTA,UE-specific)×Tc before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell.*  Sub-topic 3-3: comment on Proposal 1 is provided. Note that the Te\_NTN is the limit of UL transmit error, while UE may not know exactly it's UL transmit error. If UE doesn't do any pre-compensation, in Case A, for example, although UE attempts to adjust the initial transmission timing error to be as close to 0 s as possible, the actual UE UL transmit error can be +/- Te\_NTN at the begin of the segement. And at the end of the segments, the UE UL transmit error becomes +/- Te\_NTN **+ D** (timing drift\*seg duration), and thus the error will exceed Te\_NTN at the end of the segment.Similar to the Case B/C, the error will exceed Te\_NTN either at the begin or at the end. If UE does pre-compensation during the segment duration, then there is no need to differentiate Case A/B/C, as long as UE can meet the specified Te\_NTN requirements.  Sub-topic 3-4: Prefer to Option 2 unless RAN4 can reach consensus in this meeting. On Option 1, simply reply provides less information and it will still need another LS in the future to inform RAN1 the RAN4's conclusion.  |
| Ericsson | **Sub-topic 3-1: timing adjustment during a UL repetition period.**We support option 2 which is in line with current LTE eMTC/NB-IoT timing requirements as quoted below, [section 7.20 in TS 36.133]:*“When a repetition period is configured on the uplink for which R>1, the UE shall not adjust the uplink transmission timing autonomously during an ongoing repetition period other than at initial transmission as defined above.”*eMTC/NB-IoT UEs can be configured with large number of repetitions and the impact of adjusting the timing on reception window during an uplink repetition period was discussed and led to the above agreement. Since this issue being discussed for the first time in RAN4 in the NTN context, we are fine to continue the discussions and allow more time to study for the next meeting.**Sub-topic 3-2: UE transmit reference point**The reference time from NTN timing requirements is reused for IoT NTN.**Sub-topic 3-3: further study on UE transmission timing error** We support proposal 2. Since this issue is brought up for the first, more discussions and analysis is needed to identify potential impact. **Sub-topic 3-4: whether LS reply is needed in this meeting?** This LS (R1-2205642) is only for information and does not require any response. Whether RAN4 still needs to send reply LS depends on outcome of the discussion of the abovementioned issues which need more time.  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)