**3GPP TSG-RAN WG4 Meeting # 112 R4-2411815**

**Maastricht, Netherlands, 19th ‒ 23rd August, 2024**

**Agenda item:** 8.18.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [112][220] NR\_MIMO\_Ph5

**Document for:** Information

# Introduction

This topic summary covers the contributions submitted under the following AI for RRM of Rel-19 NR MIMO Phase 5:

* 8.18 NR MIMO Phase 5
* 8.18.3 RRM core requirements

This is the first RAN4 meeting to start the discussion on this work item.

# Topic #1: RRM work plan

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2412134 | Samsung | Proposal: It is proposed for RAN4 to approve the RAN4 MIMO work plan in Table 2. |

## Open issues summary

### Sub-topic

**Issue 1-1: RAN4 RRM work plan**

* Proposals
	+ Option 1: RRM part in R4-2412134 for work plan.
* Recommended WF
	+ Discuss the RRM part of RAN4 work plan based on R4-2412134 and approve the work plan.

# Topic #2: RRM core requiements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411392 | Apple | **Observation 1: UE initiated/event-triggered beam reporting has impact to RRM core requirements.****Observation 2: No impact to RRM core requirements with CSI enhancements for up to 128 CSI-RS ports.****Observation 3: The delay, frequency and phase offset range and resolution are small to define any accuracy requirements.****Observation 4: No impact to RRM core requirement impact with CJT calibration reporting enhancement.****Observation 5: RAN4 to discuss introducing mapping tables for the delay, frequency, phase offsets in performance part.****Observation 6: No impact to RRM core requirement impact with 3TX codebook enhancement.****Observation 7: RAN4 is introducing a path loss offset to support UL on TRP transmission.****Observation 8: The pathloss offset can be activated by MAC-CE similar to pathloss RS** **Observation 9: Pathloss offset update requirement would be similar to pathloss switching requirements introduced in eMIMO****Observation 10: It is under discussion if 2TA is supported for asymmetric DL sTRP/ UL mTRP.****Observation 11: There could be RRM impact with support of 2TA for asymmetric DL sTRP/ UL mTRP.****Proposal 1: Further discuss RRM requirements for UE initiated beam management****Proposal 2: RAN4 to discuss RRM requirements for Asymmetric DL sTRP/UL mTRP with 2TA based on progress in RAN1** |
| R4-2411629 | Xiaomi | **Proposal 1: UE-initiated/event-driven beam management will have impact on RAN4 RRM requirement.****Proposal 2: CSI codebook design will not have impact on RAN4 RRM.****Proposal 3: UE reporting enhancement for CJT deployments will not have impact on RAN4 RRM.****Proposal 4: Non-coherent UL codebook to facilitate 3-antenna-port codebook-based transmissions will not have impact on RAN4 RRM.****Observation 1: For the asymmetric DL sTRP/UL mTRP deployment scenario, reuse the rel-17 unified TCI/ICBM and rel-18 unified TCI framework,****Observation 2: For the asymmetric DL sTRP/UL mTRP deployment scenario, PL-RS and source RS in UL TCI state may not be the same or QCL-typeD.****Observation 3: Legacy UL TCI state activation requirement is define based on DL-RS. While for UL-only TRP, there is no DL-RS. It’s FFS how to consider SRS as reference signal when defining UL TCI state activation requirement. It’s FFS whether DL-RS from anchor DL RS can be used to define UL TCI state activation requirement.****Observation 4: RAN1 is currently exploring the feasibility of extending single TA to two TAs to enable this functionality.****Proposal 5: Asymmetric DL sTRP/UL mTRP will have impact on RAN4 RRM.** |
| R4-2411784 | Qualcomm Technologies Ireland | **Observation 1: 128 CSI-RS ports and non-coherent uplink codebook for three antenna ports does not have RRM impact.****UE-initiated/Event-driven Beam Management****Proposal 1: No new accuracy requirements for existing L1 measurements are required.****Proposal 2: RAN4 should study how the reporting delay for UE-initiated/event-driven beam management can be defined. The definition of L3 measurement reporting delay could serve as a starting point.****Observation 2: One possibility to define the L1 reporting delay could be the time between the triggering event and the transmission of the 1st PUCCH. However, this does not allow to distinguish between the reporting modes Mode A and Mode B that have been defined in RAN1 so far.** **Proposal 3: RAN4 should investigate whether it is needed to define additional delay requirements between the individual steps of Mode A and Mode B beam report.****Proposal 4: RAN4 should investigate whether any new required TCI state switch delays need to be defined or existing requirements are sufficient.****Reporting Enhancement for CJT Deployments****Observation 3: Reporting enhancements for CJT deployments impact performance requirements but not the RRM core requirements.****Observation 4: Performance impact by reporting enhancements for CJT deployments can be appropriately covered by defining accuracy requirements. Defining PDSCH throughput requirements for CJT reporting enhancements is beyond the scope of 3GPP.** **Proposal 5: Specification impact of reporting enhancement for CJT deployments should be covered in TS 38.133 under RRM performance and not in 38.101-4 under demodulation performance.** **Proposal 6: The work on defining requirements for reporting enhancements for CJT deployments under non-ideal synchronization and backhaul should start in RAN4 #115 in May ’25.****Enhancement for Asymmetric DL sTRP/UL mTRP Deployments****Observation 6: It is not expected that the pathloss reference signal switch delay is impacted by the new deployment.****Observation 7: The pathloss offset towards the UL-TRP may change together with the UL TCI but may also be changed independently. This may imply that new requirements should be defined how quickly the UE is able to transmit an uplink signal applying the new path loss offset.****Proposal 7: RAN4 should study whether the uplink TCI state switch delay is impacted if the target TCI is associated with a pathloss offset.****Proposal 8: RAN4 should study whether new requirements should be defined if the pathloss offset changes independently from the uplink TCI.**  |
| R4-2411972 | CMCC | **Proposal 1: for UE-initiated/event-driven beam management, one RRM impact is to define L1 measurement reporting requirements for event triggered reporting.****Proposal 2: for SSB bsed UE-initiated/event-driven beam reporting, one of the reporting requirements to be specified is that the reported L1 measurement contained in event triggered measurement reports shall meet the accuracy requirements, and it is proposed to discuss whether Rel-18 LTM measurement accuracy can be reused.****Proposal 3: for SSB bsed UE-initiated/event-driven beam reporting, it is proposed to define measurement reporting delay requirements. And it is proposed to discuss whether measurement period defind in Rel-18 LTM can be reused (in detail, it is proposed to discuss whether the measurement reporting delay can be defined as TL1-RSRP\_Measurement\_Period or TL1-RSRP\_Measurement\_Perioa + TSSB\_time\_index for SSB based measurement, which are specified for L1-RSRP measurement for Rel-18 LTM .****Proposal 4: since RAN1 agreed to support periodic CSI-RS based L1-RSRP measurement for UE-initiated/event-driven beam reporting, it is proposed to define CSI-RS based L1-RSRP measurement requirements for intra-freqeucny and inter-freqeuncy case.****Proposal 5: for CSI support for up to 128 CSI-RS ports on FR1, no RRM impact are identified.****Proposal 6: for CJT calibration reporting, it is proposed to define accuacy requirements and report mapping for delay offset reporting, frequency offset reporting and phase offset reporting.****Proposal 7: For the support for 3-antenna-port codebook-based transmissions, FFS on RRM impact. It is proposed to discuss whether existing interruption requirements at SRS antenna port switching can be reused.****Proposal 8: for enhancements for asymmetric DL sTRP/UL mTRP scenarios, whether there is RRM impact can be further discussed.** |
| R4-2412110 | Samsung | **Proposal 1: RAN4 should specify RRM requirements for UE-initiated/event-driven beam management.****Proposal 2: RAN4 can start the discussion based on Event-2 for UE-initiated beam management. For other trigger events, need further RAN1 progress.** **Observation 1: For Event-2, it can be observed that current beam should be measured and new beam(s) should be measured. L1-RSRP is used as quality for comparison.** **Observation 2: For the scenario, the target is FR2 for sTRP with intra- and inter-cell beam management.** **Observation 3: The measurement quantity on SSB for intra-cell and inter-cell. and CSI-RS.** **Proposal 3: For the measurement RS:*** + - **Current beam, both SSB or CSI-RS can be configured. Derived from QCL RS by indicated TCI state. The details are still FFS.**
		- **New beams, the explicit configuration is supported, need further RAN1 progress.**

**Observation 4: However, in Rel-18 MIMO, only SSB based L1-RSRP is supported for inter-cell. There is no CSI-RS based L1-RSRP is supported.****Proposal 4: RAN4 can start the discussion based on SSB firstly. Send LS to ask RAN1 confirmation for CSI-RS based measurement for inter-cell if necessary.****Observation 5: For the beam reporting, the beam report can include the report for current beam or not depends on the configuration by RRC. The beam report should comprise N beams for new beams: N includes at least one new beam which satisfies the event-2 trigger condition.** **Proposal 5: RAN4 can discuss UE-initiated/event-driven beam management requirements for above contents, use L1-RSRP as baseline, more RAN1 progress is needed.****Proposal 6: No impact to RRM requirements for objective#2: CSI support for up to 128 CSI-RS ports.****Proposal 7: For objective#3, CJT calibration reporting of delay offset/frequency offset/phase offset, no RRM core requirements.** **Proposal 8: If 3t6r is supported in NR\_ENDC\_RF\_Ph4, it is supposed no additional enhancement for MIMO 3-antenna-port codebook-based transmissions, reuse the same requirement in 3t6r SRS antenna switching as the assumption if no further difference is observed.****Observation 6: RAN1 introduced the associate a UL TCI state with a PL offset.****Observation 7: RAN1 intended to extend two TA in single-DCI multi-TRP. The discussion is postponed until RAN#105. RAN4 define timing requirements for two TA in multi-DCI multi-TRP in Rel-18.** **Proposal 9: If the extension to single-DCI multi-TRP in Rel-19, RAN4 should update the timing requirements to single-DCI multi-TRP. Wait further RAN/RAN1 conclusion.****Observation 8: For FR2, joint TCI state cannot be supported in asymmetric DL sTRP/UL mTRP scenario. DL-RS as source RS cannot be used. The UL states can only be associated to SRS in FR2.** **Observation 9: For UL TCI states switching delay if the UL TCI state is associated to SRS, no RAN4 requirement.** **Proposal 10: In asymmetric DL sTRP/UL mTRP scenario:*** + - * **For FR1, FFS on UL TCI state switching delay requirement for unified TCI states.**
			* **For FR2, no RRM impacts on UL TCI state switching delay requirement for unified TCI states. Do not define such requirements if the UL TCI state is associated to SRS.**

**Proposal 11: RAN4 should wait further RAN1 progress to discuss whether other new RRM requirements are needed or not.****Proposal 12: In summary, the potential RRM impact is as below:**

|  |  |  |
| --- | --- | --- |
| Topic | Description | RRM impact |
| UE-initiated/event-driven beam management | UE-initiated/event-driven beam management | YES |
| CSI enhancement | Type-I codebook refinement supporting up to a total of 128 CSI-RS ports | NO |
| Type-II codebook refinement supporting up to a total of 128 CSI-RS ports | NO |
| CRI-based CSI refinement for up to 128 CSI-RS ports | NO |
| Aperiodic standalone CJT calibration reporting | NO RRM core |
| 3TX | 3-antenna-port codebook-based UL transmission | NO, if no further special difference is identified |
| Asymmetric DL sTRP/UL mTRP | PL-offsetFFS on two TA in s-DCI | [YES] |

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| R4-2412204 | Huawei, HiSilicon | **Observation 1: Following Event-2 is agreement in RAN1 so far with at least L1-RSRP as the quality metrics.*** **Event-2: quality of at least one new beam, such as L1-RSRP, becomes a threshold value better than the current beam**

**Observation 2: For the current beam and new beam determination, at least followings are agreed in RAN1 so far:*** **Current beam: Implicitly derived from a QCL RS of indicated TCI state (QCL RS or SSB QCL-ed with QCL RS)**
* **New beam: Explicitly configured**

**Observation 3: At least SSB-based L1-RSRP for intra-cell and inter-cell and periodic CSI-RS for beam management are supported.****Observation 4: For Event-2, following two triggering determinations are supported:*** **Once the L1-RSRP of the new beam becomes a threshold value better than the current beam, UE initiated beam report occurs**
* **If within a time window (which is configurable), the number of Event-2 instance(s) for at least one same new beam is greater than or equal to a configurable number M, UE initiated beam report occurs.**

**Proposal 1: RAN4 to define RRM requirements for Objective#1 (UE-initiated/event-driven beam reporting).****Proposal 2: RAN4 start with Event-2:*** **L1-RSRP as the quality metrics**
* **SSB and periodic CSI-RS as RS for beam management**
* **Following two triggering determinations**
	+ **Once the L1-RSRP of the new beam becomes a threshold value better than the current beam, UE initiated beam report occurs**
	+ **If within a time window (which is configurable), the number of Event-2 instance(s) for at least one same new beam is greater than or equal to a configurable number M, UE initiated beam report occurs.**

**Note: Can be updated based on further RAN1 progress.****Proposal 3: No RRM impacts for Objective#2.****Proposal 4: RAN4 to discuss whether to define core requirements for CJT calibration reporting for delay offset/frequency offset/phase offset.****Proposal 5: No RRM impacts for Objective#4.****Proposal 6: No RRM impacts for Objective#5.** |
| R4-2412494 | Nokia | **Observation 1: For UEIBM, L1 measurements are considered for triggering events and reports.****Proposal 1: RAN4 to reuse legacy measurement requirements for measurement reports triggered by UEIBM.****Observation 2: With UEIBM, once an event has been triggered, the UE first sends an UL indication in the first PUCCH channel.****Observation 3: Event triggered measurement reporting delay defined in 9.2.4 of TS 38.133 are not directly applicable to UEIBM.****Proposal 2: RAN4 to define new measurement reporting delay requirements for UEIBM. The details of the reporting delay depend on further RAN1 agreements.****Observation 4: The RS(s) for current beam and new beams that the UE is supposed to monitor are configured by the network.****Observation 5: As part of the UEIBM report, the UE may be allowed/configured to report also beams that do not satisfy the conditions to trigger the event.****Proposal 3: RAN4 to discuss the impact of UEIBM on known/unknown conditions for TCI states depending on RAN1 reporting design.****Observation 6: The asymmetric DL sTRP / UL mTRP scenario is a sDCI mTRP scenario.****Observation 7: Inter-TRP distance is strongly limited without two TA operation in asymmetric DL sTRP / UL mTRP scenario.****Observation 8: Maximum inter-TRP distance in worst-case scenarios using single TA operation in asymmetric DL sTRP / UL mTRP scenario is less than 8.5 m in FR2.****Proposal 4: RAN4 to not progress on FR2 asymmetric DL sTRP / UL mTRP until there is decision on two TAs enhancements for sDCI by RAN plenary.****Proposal 5: RAN4 to discuss TCI switching requirements for asymmetric DL sTRP / UL mTRP.** |
| R4-2412523 | vivo | **Proposal 1 Specify RRM requirements for event-triggered L1 beam reporting for the serving cell and the cell with different PCI at least for FR2.****Proposal 2 RAN4 specifies RRM requirements at least for Mode-A event-triggered L1 reporting.** **Proposal 3 To determine how to count latency for the uncertainty in acquiring UL resource for event-triggered L1 reporting, RAN4 waits further conclusion from RAN1 on whether the first PUCCH is SR or not.****Proposal 4 For event-triggered L1 reporting, RRM requirements are specified at least for the following RS types:*** **SSB of serving cell or cell with different PCI.**
* **CSI-RS with repetition on.**

**Proposal 5 RAN4 specify RRM requirements for event-triggered L1 reporting without time-window-based filtering or other filtering configured.****Proposal 6 RAN4 further discuss whether this is an error case where RRM requirements would be not applicable:*** **A UE reports for N times that a target TCI state is worse than a current TCI, (e.g. meeting the event-leaving condition), but gNB still sends TCI state switching command indicating UE to switch to such target TCI. FFS value of N.**
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| R4-2413017 | Ericsson | **Proposal 1: RAN4 to specify the requirements for SSB based event triggered L1-RSRP reporting and periodic CSI-RS based event triggered L1-RSRP reporting.****Proposal 2: RAN4 to define the event evaluation time (i.e., the minimum time required to complete the event evaluation and be ready to send on first UL channel from the measurement occasion).****Proposal 3: RAN4 to define the requirements for the Frequency offset (FO), Delay offset (DO), Joint delay offset and frequency offset (DO-FO), DL/UL phase offset (PO) reporting.****Proposal 4: RAN4 to define the measurement delay or measurement behaviour for the aperiodic standalone CJT reporting** **Proposal 5: RAN4 to agree that delay offset is measured on the first detected path in time of the periodic TRS resource set of reference TRP and other TRP.****Proposal 6: RAN4 to agree that frequency offset is measured on the first detected path in time of the periodic TRS resource set of reference TRP and other TRP.****Proposal 7: RAN4 should investigate the allocation of total budget onto separate error terms, including UE Resolution, for frequency offset reporting, to fit the required resolution to a total budget approach.****Proposal 8: The required UE Resolution for frequency offset reporting, from a RAN4 point of view, has to be feed back to RAN1.****Proposal 9: RAN4 should investigate the allocation of total budget onto separate error terms, including UE Resolution, for DL/UL phase offset report, to fit the required resolution to a total budget approach.****Proposal 10: The required UE Resolution for DL/UL phase offset report, from a RAN4 point of view, has to be feed back to RAN1.****Proposal 11: RAN4 to study PL estimation requirements from PL-RS and pathloss offset.****Proposal 12: MAC CE based pathloss offset update requirement delay is equal to MAC CE processing time.** |
| R4-2413080 | ZTE Corporation, Sanechips | **Observation 1: RAN1 has decided the general procedure of UE-initiated beam management. During the whole procedure, RAN4 could focus on the measurement and detection requirements.****Observation 2: RAN1 agreed to perform the L1-RSRP measurement based on intra-cell SSB, inter-cell SSB and periodic CSI-RS for BM. Whether to extend the candidate RS to TRS, RAN1 is still in discussion.****Observation 3: The framework of report contains N+1 beams, in which 1 means the current beam, and N means multiple new beams, i.e. the potential target beams. The exact candidates of the current beam and new beam are still in RAN1 discussion.****Observation 4: A new type of trigger event based on L1-RSRP measurement is identified by RAN1, such trigger event introduce a timer and counter.****Proposal 1: To reduce the latency and overhead of intra-cell and inter-cell BM, both enhanced Tx beam tracking and Rx beam refinement can be considered.****Proposal 2: The assumption of N = 8 fine beam sweeping can be enhanced to realize more efficient BM. For example the combination of coarse Rx beam and fine Rx beam would facilitate faster Tx and Rx beam refinement.****Proposal 3: To support inter-cell BM, for the issues regardless of NW driven or UE-initiated, it is better to leverage the R17 ICBM conclusions/requirements as much as possible.****Observation 5: In the legacy NW driven BM, the NW can predict when the UE would report and in fact multiple reporting would not lead to beam switching especially under periodic reporting configuration. While for UE-initiated BM, NW is unaware of whether and when the UE would report. Such UE-initiated reported target beam is largely probably lead to beam switching.****Proposal 4: Whether need to tight the accuracy requirement on top of legacy L1-RSRP accuracy or design new requirement, which should be discussed in RAN4.****Observation 6: In R18 MIMO, sDCI based and mDCI based mTRP scenario have been supported. Especially for mDCI, two TA based UL transmission is introduced for the capable UE. While two TA based UL transmission is not supported for sDCI due to a lack of time and scope management.****Observation 7: One important difference between R18 MIMO and R19 MIMO lies on the number of CORESET Pool. Since only the macro node send DL transmission, so it is nature that only one CORESET Pool exists.****Proposal 5: It should be clarified only sDCI case allowed in R19 asymmetric mTRP scenario.****Proposal 6: Even two TA mechanism in R18 MIMO is only applicable to m-DCI case, while the R19 MIMO focus on s-DCI case, from the perspective of scenario, R18 MIMO and R19 MIMO both target at the non-co-located UL mTRP case, so it is nature to reuse the R18 two TA mechanism to address the timing issue.****Observation 8: Two points distinguish R19 from R18: 1) Removing the association between TAG and CORESETPooIndex since only one CORESETpool in s-DCI case allowed in R19; 2) Utilizing a single DL timing (from the macro to UE) for both TAs, instead of using two DL reference signals as in the Rel-18 mDCI two-TA solution****Observation 9: Based on the single DL timing, UE has to send SRS or PRACH signals to micro to let NW determine the TA for micro link.****Proposal 7: Regarding how to identify the common DL timing for macro link and micro link, leverage the DL timing derivation identified in R18 MIMO, i.e. the single DL timing is determined as the reception of the first detected path (in time) of the corresponding downlink frame of the reference signal associated with UL/joint TCI state of macro link.****Proposal 8: Reuse the unified TCI state framework defined in R18 MIMO sDCI case as much as possible, just add the adaptation update to facilitate the multiple UL transmission.** |
| R4-2413328 | MediaTek inc. | **Proposal 1: RAN4 to discuss the RRM impact for UE-initiated/event-driven beam management at least for L1-RSRP measurement requirement and applicability.****Proposal 2: No RRM impact for CSI support for up to 128 CSI-RS ports.****Proposal 3: RAN4 to discuss whether there’re RRM impact for the Rel-19 aperiodic CJT calibration reporting.****- Delay requirement****- RRM accuracy requirement****Proposal 4: No RRM impact for 3TX CB-based Uplink (3-antenna-port codebook-based transmissions) since there's no enhancement for 3-port SRS antenna switching in Rel-19.****Proposal 5: No RRM impact at least for unified TCI state switching since RAN1 agreed to reuse Rel-17/Rel-18 unified TCI framework on the enhancement of asymmetric DL sTRP/UL mTRP deployment scenarios.** |

## Open issues summary

### Sub-topic 2-1: Enhancement for UE-initiated/event-driven beam management

**Issue 2-1-1: Whether RRM impacts exist by enhancement for UE-initiated/event-driven beam management in general?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, Qualcomm, CMCC, Samsung, Huawei, Nokia, vivo, Ericsson, ZTE, MediaTek)
		- Yes
* Recommended WF
	+ RRM impacts exist by enhancement for UE-initiated/event-driven beam management. RAN4 to discuss how to specify the new sets of RRM requirements for SSB/periodic CSI-RS based event triggered L1-RSRP reporting.

**Issue 2-1-2: Scope of the scenario of event-triggered L1 beam reporting**

* Proposals
	+ Proposal 1: (Samsung, vivo)
		- Intra-cell and inter-cell for FR2.
* Recommended WF
	+ It is aligned with the definition in WID. Discuss by using this scenario in general. If specific requirements cannot be applicable, discuss it case by case.

**Issue 2-1-3: Whether/how to define new delay requirements such as measurement reporting delay/measurement period?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, Qualcomm, CMCC, Samsung, Nokia, vivo, Ericsson)
		- Yes
	+ Proposal 1a: (Xiaomi)
		- Measurement period will be the same for both event-triggered reporting and other reporting type.
	+ Proposal 1b: (Qualcomm)
		- RAN4 should study how the reporting delay for UE-initiated/event-driven beam management can be defined. The definition of L3 measurement reporting delay could serve as a starting point
		- FFS on whether to define additional delay requirements between the steps of Mode A and Mode B beam report.
	+ Proposal 1c: (CMCC)
		- RAN4 to discuss whether the measurement period defined in Rel-18 LTM can be reused.
	+ Proposal 1d: (Samsung)
		- RAN4 can discuss UE-initiated/event-driven beam management requirements for above contents, use L1-RSRP as baseline, more RAN1 progress is needed
	+ Proposal 1e: (Nokia)
		- Event triggered measurement reporting delay defined in 9.2.4 of TS 38.133 are not directly applicable to UEIBM.
		- RAN4 to define new measurement reporting delay requirements for UEIBM. The details of the reporting delay depend on further RAN1 agreements.
	+ Proposal 1f: (vivo)
		- RAN4 specifies RRM requirements at least for Mode-A event-triggered L1 reporting.
		- To determine how to count latency for the uncertainty in acquiring UL resource for event-triggered L1 reporting, RAN4 waits further conclusions from RAN1 on whether the first PUCCH is SR or not.
	+ Proposal 1g: (Ericsson)
		- RAN4 to discuss the event evaluation time (i.e., the minimum time required to complete the event evaluation and be ready to send on first UL channel from the measurement occasion)
		- RAN4 may not need to specify requirements for Transmission on first UL channel, obtain resource for second UL channel and transmit on second UL channel.
* Recommended WF
	+ RAN4 to discuss whether/how to define the requirements of
		- Event triggered measurement reporting delay
		- Whether to support both mode A and mode B
		- Whether to differentiate mode A and mode B
		- Etc

**Issue 2-1-4: How to measurement RS during the measurement?**

* Proposals
	+ Proposal 1: (Samsung, vivo)
		- Current beam, both SSB or CSI-RS can be configured. Derived from QCL RS by indicated TCI state. The details are still FFS.
		- New beams, the explicit configuration is supported, need further RAN1 progress.
* Recommended WF
	+ Cannot further discuss without RAN1 conclusion. But RAN4 can discussion with Issue 2-1-5 to discuss how to specify RAN4 requirements

**Issue 2-1-5: measurement metrics for beam report?**

* Proposals
	+ Proposal 1: (Qualcomm, Samsung, Huawei, Nokia)
		- Based on L1-RSRP
	+ Proposal 1a: (Samsung)
		- beam report can include the report for current beam or not depends on the configuration by RRC. The beam report should comprise N beams for new beams: N includes at least one new beam which satisfies the event-2 trigger condition.
	+ Proposal 2: (Nokia)
		- DL RS resource indicator, in the form for instance of CRI or SSBRI, other than L1-RSRP
* Recommended WF
	+ TBA

**Issue 2-1-6: L1-RSRP for CSI-RS measurement?**

* Proposals
	+ Proposal 1: (CMCC, Huawei, vivo, Ericsson, ZTE)
		- Define CSI-RS based L1-RSRP measurement requirements for intra-frequency and inter-frequency case. CSI-RS is periodic CSI-RS.
	+ Proposal 2: (Samsung)
		- Start the discussion based on SSB firstly.
		- Send LS to ask RAN1 confirmation for CSI-RS based measurement for inter-cell if necessary
	+ Proposal 3: (ZTE)
		- FFS on TRS
* Recommended WF
	+ To confirm with companies for Proposal 1.

**Issue 2-1-7: Whether to specify new unified TCI state switching delay?**

* Proposals
	+ Proposal 1: (Qualcomm)
		- FFS on whether to define new TCI state switching delay or existing requirements are sufficient
* Recommended WF
	+ TBA

**Issue 2-1-8: Whether to filter L1-RSRP?**

* Proposals
	+ Proposal 1: (vivo)
		- RAN4 specify RRM requirements for event-triggered L1 reporting without time-window-based filtering or other filtering configured.
* Recommended WF
	+ TBA

**Issue 2-1-9: Impact of beam on known/unknown conditions for TCI states?**

* Proposals
	+ Proposal 1: (Nokia)
		- FFS. Depends on RAN1 further progress.
	+ Proposal 2: (vivo)
		- RAN4 further discuss whether this is an error case where RRM requirements would be not applicable:
		- A UE reports for N times that a target TCI state is worse than a current TCI, (e.g. meeting the event-leaving condition), but gNB still sends TCI state switching command indicating UE to switch to such target TCI. FFS value of N.
* Recommended WF
	+ TBA

**Issue 2-1-10: Whether to enhance beam sweeping in event triggered L1 beam reporting?**

* Proposals
	+ Proposal 1: (ZTE)
		- The assumption of N = 8 fine beam sweeping can be enhanced to realize more efficient BM. For example the combination of coarse Rx beam and fine Rx beam would facilitate faster Tx and Rx beam refinement.
* Recommended WF
	+ TBA

**Issue 2-1-11: Whether to define new accuracy requirements by Enhancement for UE-initiated/event-driven beam management?**

* Proposals
	+ Proposal 1: (Qualcomm, Nokia)
		- No new accuracy requirements for existing L1 measurements are required.
	+ Proposal 2: (CMCC, ZTE)
		- FFS
	+ Proposal 2a: (CMCC)
		- For SSB based UE-initiated/event-driven beam reporting, RAN4 to discuss whether Rel-18 LTM measurement accuracy can be reused.
	+ Proposal 2b: (ZTE)
		- Whether need to tight the accuracy requirement on top of legacy L1-RSRP accuracy or design new requirement, which should be discussed in RAN4.
* Recommended WF
	+ TBA

### Sub-topic 2-2: CSI enhancement to support up to 128 ports

**Issue 2-2-1: Whether RRM impacts exist by CSI enhancement to support up to 128 ports?**

* Proposals
	+ Proposal 1: No (Apple, Xiaomi, Qualcomm, CMCC, Samsung, Huawei, Ericsson, MediaTek)
* Recommended WF
	+ No RRM impact by CSI enhancement to support up to 128 ports

### Sub-topic 2-3: UE reporting enhancement for CJT calibration

**Issue 2-3-1: Whether RRM core requirements impacts exist by UE reporting enhancement for CJT calibration?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, Qualcomm, CMCC, Samsung)
		- No
	+ Proposal 2: (Huawei, MediaTek)
		- RAN4 to discuss whether to define core requirements for CJT calibration reporting for delay offset/frequency offset/phase offset.
		- FFS on delay requirements
	+ Proposal 3: (Ericsson)
		- Yes
		- RAN4 to define the measurement delay or measurement behaviour for the aperiodic standalone CJT reporting
* Recommended WF
	+ TBA

**Issue 2-3-2: Whether RRM performance requirements impacts exist by UE reporting enhancement for CJT calibration?**

* Proposals
	+ Proposal 1: (Apple)
		- No accuracy requirements. Potential mapping tables are needed if any.
	+ Proposal 2: (Xiaomi)
		- No RRM impacts
	+ Proposal 3: (Qualcomm)
		- Define accuracy requirements
	+ Proposal 4: (CMCC)
		- Define accuracy requirements and report mappings
	+ Proposal 5: (Ericsson)
		- For frequency offset/phase offset report, RAN4 should investigate including UE resolution from RAN4 point of view, send feed back to RAN1.
	+ Proposal 6: (MediaTek)
		- FFS. RAN4 to discuss whether there’re RRM impact for the Rel-19 aperiodic CJT calibration reporting
* Recommended WF
	+ TBA

### Sub-topic 2-4: 3TX support

**Issue 2-4: RRM core impacts by introducing 3TX support?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, Qualcomm, Samsung, Huawei, Ericsson, MediaTek)
		- No
	+ Proposal 1a: (Samsung)
		- If 3t6r is supported in NR\_ENDC\_RF\_Ph4, it is supposed no additional enhancement for MIMO 3-antenna-port codebook-based transmissions, reuse the same requirement in 3t6r SRS antenna switching as the assumption if no further difference is observed
	+ Proposal 2: FFS (CMCC)
		- FFS on whether existing interruption requirements at SRS antenna port switching can be reused
* Recommended WF
	+ Discuss whether Proposal 1 can be agreed.

### Sub-topic 2-5: Enhancement for asymmetric DL sTRP/UL mTRP scenarios

**Issue 2-5-1: Whether RRM impacts exist by Enhancement for asymmetric DL sTRP/UL mTRP scenarios in general?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, CMCC, Samsung, Ericsson)
		- FFS
	+ Proposal 2: (Huawei, MediaTek)
		- No
	+ Proposal 2a: (MediaTek)
		- No RRM impact at least for unified TCI state switching since RAN1 agreed to reuse Rel-17/Rel-18 unified TCI framework on the enhancement of asymmetric DL sTRP/UL mTRP deployment scenarios.
* Recommended WF
	+ TBA

**Issue 2-5-2: Clarification for the scenario of asymmetric DL sTRP/UL mTRP:**

* Proposals
	+ Proposal 1: (ZTE)
		- sDCI only
* Recommended WF
	+ Confirm with companies with Proposal 1

**Issue 2-5-3: Whether RRM impacts exist by 2TA enhancement?**

* Proposals
	+ Proposal 1: (Apple, Xiaomi, Samsung, Nokia)
		- FFS. Need RAN1 conclusion.
		- If the extension of 2TA to s-DCI m-TRP in Rel-19. RAN4 to discuss whether/how to update timing requirements.
	+ Proposal 1b: (Nokia)
		- RAN4 to not progress on FR2 asymmetric DL sTRP / UL mTRP until there is decision on two TAs enhancements for sDCI by RAN plenary.
	+ Proposal 2: (ZTE)
		- Even two TA mechanism in R18 MIMO is only applicable to m-DCI case, while the R19 MIMO focus on s-DCI case, from the perspective of scenario, R18 MIMO and R19 MIMO both target at the non-co-located UL mTRP case, so it is nature to reuse the R18 two TA mechanism to address the timing issue.
		- Regarding how to identify the common DL timing for macro link and micro link, leverage the DL timing derivation identified in R18 MIMO, i.e. the single DL timing is determined as the reception of the first detected path (in time) of the corresponding downlink frame of the reference signal associated with UL/joint TCI state of macro link.
* Recommended WF
	+ According to RAN conclusion, it is hard to have further RAN4 conclusion. However, companies can discuss based on further progress.

**Issue 2-5-4: RRM core impacts of Active uplink TCI state switching delay for unified TCI?**

* Proposals
	+ Proposal 1: (Xiaomi)
		- FFS on how to consider SRS as reference signal for UL TCI state switching delay requirements
		- FFS on whether DL-RS from anchor DL RS can be used to define UL TCI state activation requirements
	+ Proposal 2: (Qualcomm)
		- FFS whether the uplink TCI state switch delay is impacted if the target TCI is associated with a pathloss offset
	+ Proposal 3: (Samsung)
		- For FR1, FFS on UL TCI state switching delay requirement for unified TCI states.
		- For FR2, no RRM impacts on UL TCI state switching delay requirement for unified TCI states. Do not define such requirements if the UL TCI state is associated to SRS.
	+ Proposal 4: (Nokia)
		- RAN4 to discuss TCI switching requirements for asymmetric DL sTRP / UL mTRP.
	+ Proposal 6: (ZTE)
		- Reuse the unified TCI state framework defined in R18 MIMO sDCI case as much as possible, just add the adaptation update to facilitate the multiple UL transmission.
* Recommended WF
	+ TBA
	+ RAN4 can start the discussion from high level

**Issue 2-5-5: Whether to define RRM core requirements of pathloss offset update?**

* Proposals
	+ Proposal 1: (Qualcomm, Samsung)
		- FFS. Need RAN1 further progress.
	+ Proposal 2: (Ericsson)
		- MAC CE based pathloss offset update requirement delay is equal to MAC CE processing time.
	+ Proposal 3: (Apple)
		- Pathloss offset update requirement would be similar to pathloss switching requirements introduced in eMIMO
* Recommended WF

[Moderator’s comment]: In latest RAN1 agreement:

|  |
| --- |
| AgreementFor the association between PL offset and joint/UL TCI state, support the following* Alt1b: One PL offset value is configured in a joint or UL TCI state by RRC, where different PL offset values can be configured to different joint or UL TCI states. A MAC CE can update the PL offset value(s) for joint or UL TCI state(s).
 |

RAN 4 can start whether the new requirements are needed or not from high level.

Recommended online discussion

Issue 2-3-1

Issue 2-4

Issue 2-5-1

Depends on the conclusion above if any, achieve the “? = Y/N/FFS” from high level of each objective based on the below table:

|  |  |  |
| --- | --- | --- |
| Topic | Description | RRM impact |
| UE-initiated/event-driven beam management | UE-initiated/event-driven beam management | ? |
| CSI enhancement | Type-I codebook refinement supporting up to a total of 128 CSI-RS ports | ? |
| Type-II codebook refinement supporting up to a total of 128 CSI-RS ports | ? |
| CRI-based CSI refinement for up to 128 CSI-RS ports | ? |
| Aperiodic standalone CJT calibration reporting | ? |
| 3TX | 3-antenna-port codebook-based UL transmission | ? |
| Asymmetric DL sTRP/UL mTRP | PL-offsetFFS on two TA in s-DCI | ? |

Issue 2-1-3

Issue 2-1-6

Issue 2-1-5

Issue 2-5-2

Issue 2-5-5

Issue 2-5-4