3GPP TSG-RAN WG2 Meeting #116 Electronic [R2-210xxxx](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-210xxxx.zip)

Elbonia, 01 – 12 November 2021

**Agenda item: 8.17.2**

**Source: Nokia (Rapporteur), Ericsson, vivo**

**Title: Summary of [AT116-e][015][feMIMO] Progressing FeMIMO (Nokia [lead], Ericsson, vivo)**

**WID/SID: NR\_FeMIMO-Core - Release 17**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion:

* [AT116-e][015][feMIMO] (Nokia [lead], Ericsson, vivo)

Scope: On RAN1 LSes R2-2111214, R2-2111246, R2-2109326 and their General and high level consequences. Review impacts to RRC (top down) and R2 work, e.g. general observations, structure, common impacts and impact specific to mTRP and MCBF - Find Easy/Potential Agreements, identify points for online discussion, can also identify and capture open issues, and whether LS out is needed. (Comment: please focus on points that need to be discussed/decided to pave the way for more detailed later discussions).

Intended outcome: Report

Deadline: For online W1 Thursday

The LSs in the discussion are shown below:

LS in

[R2-2109326](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2109326.zip) LS on Rel-17 inter-cell multi TRP (R1-2108633; contact: vivo) RAN1 LS in Rel-17 NR\_feMIMO-Core To:RAN2

[R2-2111214](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2111214.zip) LS Reply on inter-cell beam management and multi-TRP in Rel-17 (R1-2110631; contact: Nokia) RAN1 LS in Rel-17 NR\_feMIMO-Core To:RAN2 Cc:RAN4

[R2-2111246](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_116-e\Docs\R2-2111246.zip) LS on Re-17 LTE and NR higher-layers parameter list (R1-2110575; contact: Ericsson) RAN1 LS in Rel-17 NR\_feMIMO, NR\_ext\_to\_71GHz, NR\_IIOT\_URLLC\_enh, NR\_NTN\_solutions, NR\_pos\_enh, NR\_redcap, NR\_UE\_pow\_sav\_enh, NR\_cov\_enh, NR\_IAB\_enh, NR\_SL\_enh, NR\_MBS, NR\_DSS, LTE\_NR\_DC\_enh2, LTE\_NBIOT\_eMTC\_NTN, NB\_IOTenh4\_LTE\_eMTC6, LTE\_terr\_bcast\_bands\_part1 To:RAN2, RAN3 Cc:RAN4

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The contributions on this discussion from AI 8.17.2 are shown below (with proposal copied after each document).

RAN2 impacts of inter-cell beam mgmt

[R2-2109573](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2109573.zip) Discussion on inter-cell beam management OPPO discussion Rel-17 NR\_feMIMO-Core

*Observation 1: Serving TRP and TRP with different PCI belong to same cell*

*Observation 2: Serving TRP and TRP with different PCI don’t belong to different BWP*

*Proposal 1: TRP with another PCI is modelled as beam resource of the same serving cell*

*Proposal 2: A new structure of SSB for both serving TRP and at least one TRP with different PCI should be introduced*

*Proposal 3: This new reference signal is to replace “SSB index” in legacy signalling including beam measurement/reporting, unified TCI state and pathloss reference signal etc.*

*Proposal 4: Agree SSB definition of serving TRP and TRP with different PCI in table 2*

*Proposal 5: Agree the definition of SSB resource set for serving TRP and TRP with different PCI in table 3*

*Proposal 6: Agree definition of unified TCI state in table 4*

*Proposal 7: Proposal 2~6 are applicable for both inter-cell beam management and inter-cell mTRP*

*Proposal 8: CORESET pool ID is not needed for inter-cell beam management.*

[R2-2109641](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2109641.zip) Inter-cell BM and inter-cell mTRP Intel Corporation discussion Rel-17 NR\_feMIMO-Core

*Proposal 1: RAN2 discuss whether the following points comparing inter-cell BM and inter-cell mTRP are correct and can consider as a starting point for further discussion.*

*- A common BFR procedure for inter-cell BM and inter-cell mTRP should be supported.*

*- RRC signaling structure for TCI configuration may be different for inter-cell BM and inter-cell mTRP.*

*o For inter-cell BM, RAN2 should discuss how to define RRC signaling structure for unified TCI framework (linking both DL and UL TCI for joint TCI, or independent DL/UL TCI for separate TCI).*

*o For inter-cell mTRP, RAN2 should discuss what modification/additions to the existing TCI state configuration are needed to support inter-cell mTRP (e.g. adding PCI to TCI state information).*

*- MAC procedure for TCI update may be different for inter-cell BM and inter-cell mTRP.*

*o For inter-cell BM, RAN2 should discuss how to support the unified TCI framework and TRP/TCI state switching.*

*o For inter-cell mTRP, there seems no need to change in the current TCI activation procedure.*

*- It is not necessary to introduce an independent configuration for physical channels associated to TRP with different PCI.*

*- To support joint TCI and separate TCI, DL and UL should be indicated only by TCI and not a cell (or TRP with different PCI) because DL and UL can be decoupled for inter-cell BM. In case of inter-cell mTRP, “PCI” is not visible to MAC as different TRP is distinguished only by TCI.*

*- “different PCI” doesn’t affect MAC functionality because 1) it is managed by TCI state and BFD-RS set and 2) MAC functions (TA, PC, PHR, HARQ) is still single function for multiple TRPs in inter-cell BM and inter-cell mTRP.*

[R2-2109745](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2109745.zip) Discussion on inter-cell BM and RRC structure for inter-cell BM and mTRP vivo discussion Rel-17 NR\_feMIMO-Core

*Proposal 1: RAN2 to discuss how to define the association between non-serving cell configuration with TCI state, e.g. explicitly or implicitly.*

*Proposal 2: Define the association between measurement configuration of TRPs with different PCIs and report/resource configuration.*

*Proposal 3: Reuse the unified TCI switching signaling for inter-cell beam management, i.e. no need to introduce any new L1/L2 signaling.*

*Proposal 4: During transmission/reception on the other TRP with different PCI, UE should keep the RRC connection from serving cell, i.e., RRC procedure will continue on serving cell, e.g., RLM/BFD, SI reception, etc.*

*Proposal 5: During transmission/reception on the other TRP with different PCI, network could reconfigure/(de)activate the configurations of TRP(s) with different PCI(s) for inter-cell beam management.*

*Proposal 6: During transmission/reception on other TRP with different PCI, UE could perform legacy mobility procedure with the change of serving cell, e.g., legacy normal handover, or any enhanced procedure.*

*Proposal 7: The RRC model for inter-cell beam management and mTRP could be (merge of option 1, 3, 4 in RAN2#115e):*

*• PCI of Acell is included in the new IE (e.g. ACellConfig) for “non-serving” cell, which is located at [FFS] the same level of cell/or under BWP.*

*• An index of Acell with corresponding configurations is introduced to associate with TCI state.*

[R2-2109793](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2109793.zip) Inter-cell beam management in RAN2 Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_feMIMO-Core

*Observation 1: ICBM without multi-TRP requires TCI state switch to change PDSCH reception, while multi-TRP ICBM supports PDSCH reception from both TRPs using the Rel-16 CORESET-pool indexes.*

*Observation 2: ICBM can be seen as an extension to TCI state switching and UEs will only support at most two PCIs for the active TCI states.*

*Observation 3: No RAN2 specification changes seem required to MAC for RACH, PHR, HARQ due to ICBM.*

*Observation 4: UE serving and neighbour cell (L3) RRM measurements are not impacted by the ICBM operation.*

*Observation 5: UE configured with ICBM and using TCI state corresponding to ACell TRP will still have to monitor serving cell for system information reception.*

*Observation 6: UE continues doing RLM based on serving cell even when ACell is used for UL or DL.*

*Observation 7: For any BWP-related parameter, current RAN4 requirements in TS38.133 indicate that UE is allowed to have ~16ms UP interruption.*

*Proposal 1: The cell additionally configured for UE in multi-cell multi-TRP is called "Assisting Cell (ACell)". The corresponding serving cell that uses ACell is called "Main Cell (MCell)". When UE is configured with ACell, it is configured with "inter-cell beam management (ICBM)".*

*Proposal 2: Introduce the (inter-cell) PCI for ICBM outside the TCI state configuration.*

*Proposal 3: Model ICBM by introducing a new "TCI state type" (and other necessary parameters) in the TCI-State IE.*

*Proposal 4: Introduce a TDM pattern that enables network to restrict UE SI monitoring occasions when UE is using the ACell TRP.*

*Proposal 5: RAN2 to allow RLM to follow UL TCI state.*

*Proposal 6: Network can configure UE to report L1 measurements via RRC in the L3 measurement report, including PCI that the UE is currently using.*

*Proposal 7: The change of configured TCI state parameters for ICBM that are not activated shall not cause UP interruption in Rel-17.*

*Proposal 8: ICBM configuration is not optimized for SUL and no SUL-specific optimizations to make it work better shall be done in Rel-17.*

*Proposal 9: Do not preclude and do not optimize how ICBM works with other features at this point. Discuss feature interaction once the UE capabilities are discussed at the end of Rel-17.*

[R2-2110131](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110131.zip) Discussion on inter-cell beam management Spreadtrum Communications discussion Rel-17

*Observation 1：The main difference between the operation of “inter-cell beam management” and “inter-cell multi-TRP” is related to simultaneous Rx/Tx.*

*Proposal 1: It is suggested to consider separate RRC modeling for the operation of “inter-cell beam management” and “inter-cell multi-TRP”.*

*Proposal 2: It is proposed to use the option of beam resource to model RRC.*

*Proposal 3: It is suggested to preconfigure the relevant system information associated to the non-serving cell.*

[R2-2110167](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110167.zip) Inter-cell Beam Management and mTRP Qualcomm Incorporated discussion

*Proposal 1: RAN2 should consider inter-cell BM and inter-cell mTRP as different features and classify agreements explicitly for either or for both.*

*Proposal 2: RAN2 design on MAC CE for unified TCI applies to only inter-cell BM.*

*Proposal 3: RAN2 should confirm that TRP specific BFR is also applicable to inter-cell BM.*

*Proposal 4: Based on RAN1 input, RAN2 should assume that both the serving cell and the TRP with different PCI will share a common PxCH configuration for both inter-cell BM and mTRP.*

*Proposal 5: Based on RAN1 input, RAN2 should assume that a single HARQ entity is used for the serving cell and the associated TRP with different PCI and HARQ re-transmissions across the TRPs are supported.*

*Observation 1: Sharing a single HARQ entity between two separate cells will require signification changes to MAC specification.*

*Proposal 6: As a baseline, TRP with different PCI is modeled as part of the associated serving cell.*

*Observation 2: The maximum number of RRC configured TRPs with different PCIs only impacts the stage-3 details of configuration since there is at most one active TRP with different PCI.*

*Proposal 7: RAN2 should assume that any legacy serving cell (SpCell or SCell) can have an associated TRP with different PCI.*

[R2-2110333](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2110333.zip) Discussion on support of inter-cell multi-TRP operation Lenovo, Motorola Mobility discussion Rel-17

*Proposal 1: SSB index from a non-serving cell is configured in QCL-info, and the corresponding information for the SSB is configured by SSB-InfoNcell-r17 and SSB-Configuration-r17 provided in Table 2.*

*Proposal 2: In inter-cell multi-TRP operation, the CORESETPoolIndex with value 0 is associated with the serving cell, while CORESETPoolIndex with value 1 is associated with the non-serving cell.*

[R2-2110341](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110341.zip) On Rel-17 FeMIMO Ericsson discussion NR\_feMIMO-Core

*Observation 1 Based on Rel-16 mTRP enhancements, a UE is able to perform simultaneous reception from two TRPs transmitting SSBs associated to the serving cell PCI.*

*Observation 2 The changes to the WID points at extending the Rel-16 mTRP concepts with enhancing L1-measurement reports of an SSB belonging to a different PCI than the serving cell PCI and TCI state configuration with QCL possibility to a SSB belonging to a different PCI than the serving cell PCI.*

*Observation 3 Large number of RAN1 parameters in R1-2110635 contain notes like “it can be discussed in RAN2” or “detailed design up to RAN2”*

*Observation 4 Unlike in previous releases, in this release the RAN2 work on the objective “Specify higher layer support of enhancements listed above, at least including [RAN2]” involves more RAN2 decision making for the parameters than in earlier releases.*

*Observation 5 As DLonly and ULOnly TCI states are supported in Rel-17 framework the use of the ID space need to be considered to be able to configure enough TCI states for UL and DL*

*Observation 6 A MAC CE very similar to the Rel-16 “Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE” is used to operate the Rel-17 TCI state.*

*Proposal 1 RRM measurements of the serving cell or the non-serving cell is not impacted in Rel-17.*

*Proposal 2 RAN2 to adopt separate DL and UL TCI state configurations and enable joint with either of these. Details FFS.*

*Proposal 3 RAN2 to hope RAN1 gives more details on what all different variations are planned to be supported*

*Proposal 4 RAN2 to adopt the above way of configuring the additional PCI information while details are FFS*

*Proposal 5 Enable search space linking by including same linkage ID(e.g. searchSpaceLinkingId) in each of two SS sets to be linked.FFS details*

*Proposal 6 Define New IE for PUCCH power control for mTRP*

*Proposal 7 Define New list “sri-PUSCH-MappingToAddModList2” for PUSCH power control for mTRP*

*Proposal 8 Wait for further RAN1 input for power control design for BM*

[R2-2110435](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2110435.zip) Considerations on Inter-cell Beam Management CATT discussion Rel-17 NR\_feMIMO-Core

*Proposal 1: RAN2 to discuss the following two issues:*

*Issues 1: whether beam failure recovery on TRP with different PCI is allowed*

*Issues 2: whether BFR on current serving cell TRP is allowed when the UE detects the beam failure on TRP with different PCI*

*Proposal 2: RAN2 to discuss whether the candidate target TRP can be re-configured, and what conditions to reconfigure it.*

[R2-2110436](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110436.zip) Discussion on RRC Modeling of Inter-cell Beam Management CATT discussion Rel-17 NR\_feMIMO-Core

*Proposal 1: RAN2 to agree that the modeling of inter-cell beam management and inter-cell mTRP are discussed separately.*

*Proposal 2: The option 3, i.e., beam resource level modeling, can be taken as baseline for the RRC modeling of inter-cell beam management.*

[R2-2110534](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110534.zip) Considerations on Inter-Cell Beam Management CMCC discussion Rel-17 NR\_feMIMO-Core

*Observation1: It seems that the TCI framework is some kind of beam indication mechanism, and potential RAN2 impacts may include the corresponding RRC configurations for inter-cell beam management and mTRP are different, and could not be reused between them.*

*Observation2: Different UE capabilities may be involved since the simultaneous Rx in DL is not supported for inter-cell BM but supported for inter-cell mTRP, although simultaneous Tx in UL is not supported for both. Also, network side configuration and scheduling will also be different.*

*Observation 3: It seems that almost no MAC changes to support inter-cell beam management. But some changes are needed for inter-cell mTRP.*

*Observation 4: The HARQ operation is the same for inter-cell BM and mTRP since one single HARQ entity is assumed.*

*Observation 5: Inter-cell beam management uses the R17 unified TCI framework, inter-cell mTRP uses the legacy Rel-15/Rel-16 TCI framework. RRC parameters for configuring each of these frameworks are different. RAN1 just started the discussion and no conclusion can be achieved now.*

*Proposal 1: RAN2 starts the work from inter-cell BM, and whether to reuse for mTRP objective could be based studied later.*

*Proposal 2: RAN2 starts the work on RRC modelling for inter-cell BM after RAN1 achieve some progress on RRC parameter discussion.*

*Proposal 3: RAN2 studies the inter-cell BM with no impacts to L3 handover.*

[R2-2110622](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110622.zip) Further Consideration on the inter-cell beam management ZTE Corporation,Sanechips discussion Rel-17 NR\_feMIMO-Core

*Observation 1: According to the Reply LS from RAN1, the framework between inter-cell beam management and inter-cell mTRP is not the same, the inter-cell beam management use the R17 unified TCI framework while the inter-cell mTRP reuse the legacy R15/R16 TCI framework. In addition, inter-cell mTRP is mostly like an enhancement of mPDCCH mTRP in R16 while the DL for UE dedicated channel with inter-cell beam management is only associated with a TRP from either serving cell or non-serving cell at one time.*

*Proposal 1: From RAN2 point of view, RRC models of inter-cell beam management is like beam resource (e.g TCI states, QCL info) which can be configured in PDSCH-Config for each BWP/CC or a reference BWP/CC.*

[R2-2110876](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110876.zip) Inter-cell beam management and inter-cell mTRP Huawei, HiSilicon discussion NR\_feMIMO-Core Revised

[R2-2111205](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2111205.zip) Inter-cell beam management and inter-cell mTRP Huawei, HiSilicon discussion NR\_feMIMO-Core [R2-2110876](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2110876.zip)

*Proposal 1: RAN2 assumes that, for CSI measurements with inter-cell BM and inter-cell mTRP:*

*- each serving cell configuration (e.g. in ServingCellConfig or ServingCellConfigCommon) should be extended to include a list of SSB resources associated with PCI(s) different from that of the serving cell*

*- the CSI-SSB-ResourceSet IE should be extended to include the ID of one element of this list.*

*Proposal 2: In Rel-17 inter-cell BM, for PDCCH/PDSCH reception and PUCCH/PUSCH transmission, a new MAC CE for activating/indicating joint TCI state(s) or separate DL/UL TCI state(s) is needed.*

*Proposal 3: RAN2 assumes that, for inter-cell mTRP:*

*- each serving cell configuration should be extended to include a list of additional PCIs*

*- the TCI-State IE should be extended to include an index into this list.*

*More RAN1 inputs are needed for Rel-17 inter-cell mTRP, at least including:*

*a) the maximum number of TCI states that can be configured per UE and/or per serving cell*

*b) the maximum number of additional PCIs that can be configured per UE and/or per serving cell.*

*Proposal 4: In Rel-17 inter-cell BM, we can model TRPs associated with different PCIs as different beam resources (i.e. Rel-17 TCI states) of the same BWP of the same serving cell.*

[R2-2110976](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110976.zip) Support of Inter-cell Beam Management and Multi-TRP MediaTek Inc. discussion

*Observation 1: A single cell may consist of multiple TRPs, and legacy beam management procedure allows UE to switch between beams from different TRPs.*

*Observation 2: The key enhancement brought by Rel-16 multi-TRP is overlapped transmission by two TRPs, which means UE is indicated to use two TCI states for multi-PDSCH reception.*

*Observation 3: Inter-cell BM procedure allows the UE to be a “guest” in a TRP with different PCI, using the SSBs in that cell only for QCL purposes.*

*Observation 4: When extending Rel-15/16 TCI framework to support inter-cell multi-TRP scenario in Rel-17, we need a way to prevent UEs using Rel-15/16 TCI framework from operating inter-cell BM.*

*Proposal 1: The Rel-15/16 (legacy) and Rel-17 unified TCI frameworks are not configured together in a UE. RAN2 can further study how to tell UE which framework to use.*

*Proposal 2: Inter-cell TCI states are configured as beam resources in the serving cell configurations.*

*Proposal 3: TCI states from serving cell and TRP with different PCI can be contained in the same list in PDSCH-Config.*

*Proposal 4: If UE is configured to use Rel-15/16 TCI framework, TCI states from TRP with different PCI can be configured only in CORESETs with CORESETPoolIndex=1.*

*Proposal 5: The “TCI States Activation/Deactivation for UE-specific PDSCH” MAC CE can be used for both inter-cell BM and inter-cell multi-TRP operations.*

*• For inter-cell multi-TRP, TCI states from TRP with different PCI can only be activated for CORESET Pool #1.*

*• For inter-cell BM, CORESET Pool ID field is always ‘0’, or ignored by UE.*

*Proposal 6: If UE is configured to use Rel-15/16 TCI framework, TCI states from TRP with different PCI can only be indicated for PDCCH monitoring in a CORESET in Pool#1.*

[R2-2111141](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2111141.zip) Inter-cell mTRP and inter-cell BM LG Electronics discussion Rel-17

*Proposal 1: RAN2 does not strive for building a common framework in signaling design, i.e., a separate framework is a baseline for inter-cell BM and inter-cell mTRP.*

*Proposal 2: To adopt option3, i.e., non-serving cell TRP is modelled as beam resources of a serving cell.*

*Proposal 3: For inter-cell BM and inter-cell mTRP, RRC supports that only one PHY configuration for each of PHY channel is configured for each BWP.*

*Proposal 4: For inter-cell BM and inter-cell mTRP, RRC supports that one or more non-serving cell TRPs can be configured by RRC.*

*Proposal 5: For inter-cell BM and inter-cell mTRP, RRC supports that only one additional non-serving cell TRP (the one with different PCI from the serving cell) can be associated with active TCI state(s) per CC.*

*Proposal 6: The maximum number of additional RRC-configured non-serving cell TRP per CC for inter-cell BM/mTRP is introduced as a UE capability. Details of the UE capabilities are discussed based on future RAN1 input, e.g., supported values and whether it is per CC/band per BC, or whether there is per-UE capability constraint).*

*Proposal 7: RAN2 discuss if RA on non-serving cell TRP should be supported or prevented.*

*Proposal 8: No enhancement to existing RRM is pursued.*

*Proposal 9: No enhancement to existing RLM is pursued.*

*Proposal 10: RAN2 to confirm that UE is receiving system information from serving cell TRP.*

*Proposal 11: RAN2 to confirm that UE is required to monitor short messages from serving cell TRP.*

*Proposal 13: No enhancements to support TA management in a non-serving cell TRP is introduced.*

*Proposal 14: To introduce signaling support for unified TCI framework based on further RAN1 input (no immediate action in RAN2)*

*Proposal 15: To introduce signaling support for necessary enhancements of L1 measurement and reporting based on further RAN1 input (no immediate action in RAN2).*

*Proposal 16: No enhancement to PHR is needed.*

[R2-2109746](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2109746.zip) Discussion on inter-cell MTRP operation vivo discussion Rel-17 NR\_feMIMO-Core

*Proposal 1: Introduce a new IE (e.g. NonServingCellConfig) to include all non-serving cell information, at least including: SSB time domain position, SSB transmission periodicity, SSB transmission power of non-serving cell. Others could wait for RAN1.*

*Proposal 2: PCI of non-serving cell is included in the new IE (e.g. NonServingCellConfig) for non-serving cell.*

*Proposal 3: An index of non-serving cell with corresponding configurations is introduced to associate with TCI state.*

[R2-2110621](C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110621.zip) Further Consideration on the beam managment for intra-cell mTRP ZTE Corporation,Sanechips discussion Rel-17 NR\_feMIMO-Core

*Proposal 1:Whether the beam management for mTRP can be applied to inter-cell mTRP case is up to RAN1.*

*Proposal 2: For one serving cell configured with mTRP, if BFI\_COUNTERs for both TRPs are no less than the value of beamFailureInstanceMaxCounter , the Cell level BFR is triggered for SCell or the RACH based BFR is triggered for SpCell.*

*Proposal 3: A new cell level BFR MAC CE shall be used for providing the beam information for both failed TRPs when the cell level BFR is triggered on one SCell.*

*Proposal 4: The new cell level BFR MAC CE shall also be used for UE to provide the beam information to NW when the TRP level BFR is triggered on one SCell.*

*Proposal 5: The BFR MAC CE for RACH based BFR on SpCell is postponed until RAN 1 have concluded all scenarios for triggering RACH based BFR.*

[R2-2110200](file:///C:\\Users\\terhentt\\Documents\\Tdocs\\RAN2\\RAN2_116-e\\R2-2110200.zip) Discussion on RLM for inter-cell Multi-TRP KDDI Corporation discussion

*Proposal 1: RAN2 agree to discuss RLM mechanism for Inter-cell TRP, combined RLM or separate RLM*

*Proposal2:RAN2 agree to discuss Random Access problem detection for Inter-cell TRP, combined detection or separate detection.*

[R2-2110678](file:///C:\Users\terhentt\Documents\Tdocs\RAN2\RAN2_116-e\R2-2110678.zip) Serving cell measurement for mTRP Xiaomi Communications discussion Rel-17 NR\_feMIMO-Core

*Observation 1: According to the current servingCellMO configuration, the UE obtains the measurement results of multiple PCI(s) (including multiple serving cell PCIs), when multiple PCIs are associated to the same serving cell.*

*Observation 2: In the measurement event configuration, the UE needs to know which measurement result of the serving cell PCI is used for the measurement event evaluation, when multiple PCIs are associated to the same serving cell.*

*Observation 3: In the measurement report, the UE needs to know which measurement result of the serving cell PCI is reported, when multiple PCIs are associated to the same serving cell.*

*Proposal 1: When multiple PCIs are associated to the same serving cell, the gNB indicates which PCI is used for the measurement event evaluation.*

*Proposal 2: When multiple PCIs are associated to the same serving cell, all available measurement results of multiple PCIs are included in the serving cell measurement report.*

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
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# 3 Questions

The rapporteur proposes to use the following terminology in this discussion

* TRP1: Serving cell TRP
* TRP2: (Active) TRP with different PCI

The moderators proposes to divide the questions to the following categories: Stage-2 impacts (overall points that impact many of Stage-3 details), RRC impacts (mainly on configuration and procedural aspects), and MAC impacts (MAC specification affecting aspects)

Stage-2 aspects

* **Terminology:** In 38.300, TRP is defined as transmit/Receive Point and the TRP operation is shortly described under 6.12. In Rel-17, “intercell” mTRP operation is specified which means the other TRP will be associated with PCI different from original serving cell TRP but the TRPs share same HARQ entity and (most of) physical layer parameters.From RAN2 perspective, we need to consider if the PCI aspect results in a need to be able to refer one of these TRPs such that it is known whether the TRP is associated to serving cell PCI or to the additional PCI, with possible examples could be ”main-TRP” and ”additional-TRP” or "Main cell" and "additional cell" [R2-2109793]. Is there a need to have a specific terminology for the different TRPs? If yes, what would be the preferred terminology?
* **SI/Short message reception:** According to RAN1, UE always receives SI from TRP1. When UE is using DL with TRP2, does SI/Short Message reception impact TRP2 reception?
* **RLM:** How to handle radio link monitoring with TRP1 and TRP2 - does UE always use TRP1, including doing RRC re-establishment towards TRP1 when the link fails?
* **ICBM vs. multi-TRP**: According to the RAN1 LS, there are commonalities between the ICBM and multi-TRP operation, but there are also some differences (e.g. DL reception and use of unified TCI states). Can there be inter-cell procedures that are common between ICBM and multi-TRP? E.g. do we have common or separate RRC modelling, common or separate PxxCH configuration, common or separate RLM/BFR procedures, etc?

RRC aspects

* **RRM:** According to RAN1, there is no impact to the actual RRM measurements. Are there any RAN2-specific aspects (not impacting RAN1) that would need to be considered for RRM?
* **Unified TCI:** The unified TCI state only applies for ICBM without multi-TRP (as per RAN1 decision). As this is new configuration, RRC impacts will be necessary. RAN1 has agreed that the following reference signals may be used as source RS:
  + DL TCI state: SSB, CSI-RS
  + UL TCI state: SSB, CSI-RS, SRS

For DL TCI state, these are the same as for Rel-16 DL TCI state, but UL TCI state has not been allowed before. At least two options for the TCI state structure have been proposed in [R2-2110341], which differ in how they handle the TCI state IDs: Option 1 shares the ID space for both UL and DL, Option2 has separate ID space for UL and DL. More details can be found in [R2-2110341], but to summarise those options:

**Option 1:** Use common ID for all TCI states, i.e. DL-only, UL-Only and joint use the same ID space.

**Option 2:** Use separate IDs for joint, UL and DL TCI states (with some possibly combined)

It's assumed that the unified TCI state can reuse the existing TCI-State IE (with extensions), but RAN2 needs to decide on the best way to configure the unified TCI state: Will there be separate IDs for joint TCIs, UL TCIs and DL TCIs, or are the IDs part of a common ID space?

* **PCI and SSB configuration:** UE may need to receive SSB from TRP1 and TRP2, and both may have different PCIs. How do we configure the beams with the PCI/SSB information:
  + For the TRP with different TRP, where is the added SSB/PCI located - should it be e.g. within *ServingCellConfig* or within dedicated BWP configuration?
  + Can the existing IEs or fields be reused for the PCI/SSB configuration?
  + How is TRP2 configuration associated with TCI state(s)?
* **TRP-specific configuration:** As per RAN1 LS, additional PHY configuration for TRP2 is **not** needed and TRP2 will use TRP1 configuration. However, it seems the latest RAN1 parameter excel also indicated some TRP-specific parameters, and the TCI states will be per TRP. How should the TRP-specific parameters be configured (e.g. initial addition, modification, release), and are there any ambiguities in the L1 parameters that would need to be clarified from RAN1?

MAC aspects

The moderators would like to point out there are two separate offline discussions led by Samsung:

[AT116-e][016][feMIMO] MAC CE impacts (Samsung)

* Mostly mTRP related MAC CEs with last question about BM related MAC CEs

[AT116-e][017][feMIMO] BFD BFR and Initial Running CRs (Samsung)

* Not started (as of November 2nd, 2021)

The moderator assumes the need for new MAC CEs due to the unified TCI framework will be discussed under (one of) these discussions, so MAC aspects will be omitted in this discussion.

# 4 Discussion

## 4.1 Stage-2 aspects

This section considers Stage-2 aspects that can help the RAN2 discussion to progress.

**Question 1**: Companies are requested to indicate their views to the Stage-2 aspects, i.e.:

* **Terminology:** In 38.300, TRP is defined as transmit/Receive Point and the TRP operation is shortly described under 6.12. In Rel-17, “intercell” mTRP operation is specified which means the other TRP will be associated with PCI different from original serving cell TRP but the TRPs share same HARQ entity and (most of) physical layer parameters.From RAN2 perspective, we need to consider if the PCI aspect results in a need to be able to refer one of these TRPs such that it is known whether the TRP is associated to serving cell PCI or to the additional PCI, with possible examples could be ”main-TRP” and ”additional-TRP” or "Main cell" and "additional cell" [R2-2109793]. Is there a need to have a specific terminology for the different TRPs? If yes, what would be the preferred terminology?
* **SI/Short message reception:** According to RAN1, UE always receives SI from TRP1. When UE is using DL with TRP2, does SI/Short Message reception impact TRP2 reception?
* **RLM:** How to handle radio link monitoring with TRP1 and TRP2 - does UE always use TRP1, including doing RRC re-establishment towards TRP1 when the link fails?
* **ICBM vs. multi-TRP**: According to the RAN1 LS, there are commonalities between the ICBM and multi-TRP operation, but there are also some differences (e.g. DL reception and use of unified TCI states). Can there be inter-cell procedures that are common between ICBM and multi-TRP? E.g. do we have common or separate RRC modelling, common or separate PxxCH configuration, common or separate RLM/BFR procedures, etc?

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| Answers to Question 1A: Is there a need to have a specific terminology for the different TRPs? If yes, what would be the preferred terminology? what could be used? | | |
| Company | Yes/No | Terminology |
| Ericsson | maybe | At least in stage-2 one could have explanation added to 6.12 about “intercell” TRP/BM and at least explain how each TRP related to a given PCI. Then, if one needs explicit names that can be further discussed. However, calling these cells does not seem appropriate due to shared HARQ entity. |
| Nokia, Nokia Shanghai Bell | Yes | We think agreeing to terminology will help us in the long run. The exact term is not so important, as long as it's concise.  We would be fine with "main TRP" and "additional TRP", but the acronyms would be "mTRP" (which is ambiguous) and "aTRP" which is fine. Hence, perhaps "primary TRP (pTRP)" and "secondary TRP (sTRP)" could be good alternatives and these would also conform to the PCell/SCell terminology we already use. |
| MediaTek | Yes | A specific terminology would be helpful, we may use “primary TRP (pTRP)” and “secondary TRP (sTRP)” or “assisting TRP (aTRP)”. |
| Intel | Maybe | Until now, we have not found the need to introduce a specific terminology for the different TRPs because TCI state is the one representing actual operation. Nevertheless, it might be convenient for discussion and for stage-2 purpose. In this case, additional-TRP/assisted-TRP seems preferred than additional cell because it wouldn’t be treated as an independent cell. |
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| Answers to Question 1B: According to RAN1, UE always receives SI/short message from TRP1. When UE is using DL with TRP2, does SI/Short message reception impact TRP2 reception? | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | No | To be confirmed with RAN1 if needed |
| Nokia, Nokia Shanghai Bell | Yes | RAN1 LS [R2-2111214](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116-e/Docs/R2-2111214.zip) indicated this:  *Answer 2.b: The system information for inter-cell beam management can be only received from the serving cell TRP.*  *With respect to the paging/short messages for inter-cell beam management, RAN1 is currently discussing this issue.*  This means that regardless of which TRP UE is using for DL, UE always receives SI from TRP1. Since UE is not required to support TRP1 and TRP2 reception simultaneously, if UE is using TRP2, then all occasions where UE could receive SI (from TRP1) may create interruption in TRP2 reception. To make it easier to avoid this in TRP2 scheduling, using TDM pattern (signalled by serving cell) for UE SI reception to better control the TRP2 scheduling occasions. |
| MediaTek | Yes | When UE is using TRP2, SI reception from TRP1 causes interruption. However, we are not sure if a TDM pattern is needed: This may be resolved by proper scheduling, i.e., UE is indicated to a beam from TRP1 when it should receive SI? |
| Intel | No | If it is not feasible to receive SI from TRP1 while the UE is switched to TRP2, the possible way is to rely on dedicated signaling. |
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| Answers to Question 1C: How to handle radio link monitoring with TRP1 and TRP2 - does UE always use TRP1, including doing RRC re-establishment towards TRP1 when the link fails? | | |
| Company | RLM is only for TRP1? | Technical Arguments |
| Ericsson | yes | To avoid RAN2 work and technically argumented that if UE is assumed to hear TRP1 all the time, RLM can as well be assumed there. RLM and RRM decision goes hand in hand in our view. |
| Nokia, Nokia Shanghai Bell | No - active TRP(s) | RLM is used to detect both UL and DL problems. For DL, the RLM should follow the active DL TRP, and for UL, the active UL TRP. Hence, this requires separate RLM parameters for each TRP, which are then used by the UE when the TRP is active (i.e. there is at least one activated TCI states for the TRP). This may necessitate UE to do RLM for both TRPs.  We would note that if RLM is only for TRP1, then TRP1 DL failure could cause RLF even when UE is fully using TRP2. That doesn't seem the intent of the ICBM, as it can allow to extend the UE service area (similar to mTRP). |
| MediaTek | Yes | In inter-cell BM, UE is like a “guest” in TRP2. UE just uses SSB from TRP2 as QCL source when TRP2 signal is stronger, but UE is assumed to be in the coverage of TRP1. If TRP2 fails, UE simply doesn’t use it. If TRP1 fails, it is true that TRP2 is good, but we think that in this case RLF should still be declared so that UE can change its serving cell, or UE should perform handover before TRP1 RLF. |
| Intel | Yes | In Rel-17 inter-cell BM, we assume that the UE is still in coverage of TRP1. There is no need to change RLM. |
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| Answers to Question 1D: A. Can there be inter-cell procedures that are common between ICBM and multi-TRP? E.g. do we have common or separate RRC modelling, common or separate PxxCH configuration, common or separate RLM/BFR procedures, etc? | | |
| Company | Common procedures | Separate procedures |
| Ericsson | There are parameters under BM and under mTRP and under other acronyms and it should be clarified if some of those are or are not pending on what TCI state framework was configured, that is if BM or mTRP of Rel-17 was configured. Potential question to RAN1. | TCI state configuration, power control/UL configuration possibly.  There are parameters under BM and under mTRP and under other acronyms and it should be clarified if some of those are or are not pending on what TCI state framework was configured. Potential question to RAN1. |
| Nokia, Nokia Shanghai Bell | Inter-cell PCI/SSB, PxxCH configuration, HO procedure | TCI framework (unified for ICBM, R15/16 for mTRP), RLM/BFR (for each TRP), SI/Short message reception (only for TRP1) |
| MediaTek | RRC configurations for “assisting cell” (PCI, SSB, PxxCH, etc.) | TCI frameworks, RLM/BFR, SI reception. |
| Intel | Beam management including BFR. | TCI frameworks including TCI update procedure, RRC configuration. |
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**Summary 1**: TBD.

**Proposal 1**: TBD.

## 4.2 RRC aspects

This section considers RRC aspects that can help the RAN2 discussion to progress.

**Question 2**: Companies are requested to indicate their views to the RRC aspects, i.e.:

* **RRM:** According to RAN1, there is no impact to the actual RRM measurements. Are there any RAN2-specific aspects (not impacting RAN1) that would need to be considered for RRM?
* **Unified TCI:** The unified TCI state only applies for ICBM without multi-TRP (as per RAN1 decision). As this is new configuration, RRC impacts will be necessary. RAN1 has agreed that the following reference signals may be used as source RS:
  + DL TCI state: SSB, CSI-RS
  + UL TCI state: SSB, CSI-RS, SRS

For DL TCI state, these are the same as for Rel-16 DL TCI state, but UL TCI state has not been allowed before. At least two options for the TCI state structure have been proposed in [R2-2110341], which differ in how they handle the TCI state IDs: Option 1 shares the ID space for both UL and DL, Option2 has separate ID space for UL and DL. More details can be found in [R2-2110341], but to summarise those options:

**Option 1:** Use common ID for all TCI states, i.e. DL-only, UL-Only and joint use the same ID space.

**Option 2:** Use separate IDs for joint, UL and DL TCI states (with some possibly combined)

It's assumed that the unified TCI state can reuse the existing TCI-State IE (with extensions), but RAN2 needs to decide on the best way to configure the unified TCI state: Will there be separate IDs for joint TCIs, UL TCIs and DL TCIs, or are the IDs part of a common ID space?

* **PCI and SSB configuration:** UE may need to receive SSB from TRP1 and TRP2, and both may have different PCIs. How do we configure the beams with the PCI/SSB information:
  + For the TRP with different TRP, where is the added SSB/PCI located - should it be e.g. within *ServingCellConfig* or within dedicated BWP configuration?
  + Can the existing IEs or fields be reused for the PCI/SSB configuration?
  + How is TRP2 configuration associated with TCI state(s)?

**TRP-specific configuration:** As per RAN1 LS, additional PHY configuration for TRP2 is **not** needed and TRP2 will use TRP1 configuration. However, it seems the latest RAN1 parameter excel also indicated some TRP-specific parameters, and the TCI states will be per TRP. How should the TRP-specific parameters be configured (e.g. initial addition, modification, release), and are there any ambiguities in the L1 parameters that would need to be clarified from RAN1?

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| Answers to Question 2A: According to RAN1, there is no impact to the actual RRM measurements. Are there any RAN2-specific aspects (not impacting RAN1) that would need to be considered for RRM? | | |
| Company | Yes/No | Technical Arguments |
| Ericsson | No | Well, potentially there are but we can pretend we don’t see those in Rel-17 😊 |
| Nokia, Nokia Shanghai Bell | Yes | **L3 report including L1 measurements:** When L3 measurement is triggered, network should be allowed to configure that UE includes also L1 measurement result of both TRPs at the same time. This allows CU to be aware of the latest L1 measurements e.g. when making the L3 HO decision.  **L3 report including TRP PCI:** When L3 measurement is triggered, UE should also indicate the used PCI for UL and DL. This allows CU to be aware of the currently used TRP e.g. when making L3 HO decision. |
| MediaTek | No | It’s possible to do some optimization in RAN2, but we don’t have time. So, let’s follow RAN1 suggestions. |
| Intel | No | Some optimization can be considered but not so essential especially considering the limited time and the fact that we assume the UE is still in coverage of serving TRP. |
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| Answers to Question 2B: Will there be separate IDs for joint TCIs, UL TCIs and DL TCIs, or are the IDs part of a common ID space? | | |
| Company | Separate or common ID? | Technical Arguments |
| Ericsson | Separate for UL and DL. Joint common with either DL or UL | If we have common ID space for UL and DL and joint, we need to start explaining somewhere when all space can be used and when not. E.g. if UE is configured with only joint TCI states then the cannot be as much as there should be when UE is configured with UL and DL TCI states. |
| Nokia, Nokia Shanghai Bell | Common | We think it's easier if we have common ID space: Otherwise we will end up having to identify the type of TCI in MAC CEs, whereas with common ID space we can just use the TCI state ID. |
| MediaTek | Separate for UL and DL, “joint” flag with DL | This helps UE be indicated with proper TCI state (e.g., a Joint TCI state applied to both DL and UL, or a DL plus a UL TCI state, but not one DL TCI state only). We anyway need to design new MAC CEs for Rel-17 unified TCI farmeworks.  **NOTE:** We may need to study the co-existence of Rel-17 unified TCI frameworks with legacy ones. If inter-cell BM and multi-TRP use different TCI frameworks, do we need separate TCI state list? How does UE know which framework to use? Or only one type is allowed? |
| Intel | Both should be supported | RAN1 agree to have both joint TCI and separate TCI. So, Id should be defined flexibly. |
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| **Answers to Question 2C: UE may need to receive SSB from TRP1 and TRP2, and both may have different PCIs. How are the beams configured with the PCI/SSB information?**   * **For the TRP with different PCI, where is the added SSB/PCI located - should it be e.g. within ServingCellConfig or within dedicated BWP configuration?** * **Can the existing IEs or fields be reused for the PCI/SSB configuration?**   **How is TRP2 configuration associated with TCI state(s)?** | |
| Company | Company views |
| Ericsson | added SSB/PCI located in ServingCellconfig as it is assumed the added PCI does not vary per BWP but is per serving cell. Then as the added PCI needs certain SSB related parameters given, those can be placed under SSB IE(does not really functionally matter but that seems logical place).  Then the added SSB/PCI has hanle i.e. ID that can be then assopciated to TCI state, CSI, etc. That is, use normal way of configuring these type of things (one can compare Rel-16 TCI states in PDSCH vs PDCCH, or CSI-RS resources and ID of that and where it is used) |
| Nokia, Nokia Shanghai Bell | **SSB/PCI:** We assume most TRP configuration is cell-specific (i.e. within ServingCellConfig) except where indicated by RAN1. As it seems that RAN1 allowed to have multiple PCI/SSB pairs, we assume we can just use SetupRelease-structure for those and use the ID to refer to those in the TCI state configurations. Then we will need an new IE for the joint SSB+PCI configuration that also contains the ID. As always, we should reuse the existing IEs where possible but that will be more easily seen when we start the CR.  **TRP association:** We assume the SSB/PCI ID used in the IE can be used in the TCI states to refer to the TRP being used. Assuming we have 1-8 such IDs, this will just require 3 bits / TCI state for the ID, which is far less than the 9 bits required for just the PCI IE. |
| MediaTek | The configurations of TRP2 SSB/PCI should be in *servingCellConfig*; they may be encapsulated in a structure, e.g., *AssistingCellInfo*, with some IDs. Then the TCI states can be associated with TRP2 configurations via the IDs. |
| Intel | Definitely, we need additional SSB information associated to TRP with different PCI. We can look at the detail signalling structure further. Initial thinking is that it can be added under servingCellConfig and linked in TCI state. |
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| **Answers to Question 2D: How should the TRP-specific parameters be configured (e.g. initial addition, modification, release), and are there any ambiguities in the L1 parameters that would need to be clarified from RAN1?** | | |
| Company | Ambiguities needing LS to RAN1 (Y/N)? | Technical Arguments |
| Ericsson |  | Per TRP configuration in Rel-17 seems to be spread under different IEs like PxxCH, CSI similar to Rel16 and there seems not to be per TRP specific way to do add/mod/release.  What should be clarified with RAN1 is what all can be configured at same time and where there are restrictions. |
| Nokia, Nokia Shanghai Bell | Perhaps | **Configuration:** We assume most TRP configuration is cell-specific (i.e. within ServingCellConfig) except where indicated by RAN1. As it seems that RAN1 allowed to have multiple PCI/SSB pairs, we assume we can just use SetupRelease-structure for those and use the ID to refer to those in the TCI state configurations. That seems both simple and straightforward.  **RAN1 LS:** It's still not clear how the TRP-specific parameters are used: Which are common with mTRP, and which are not? It's clear that unified TCIs are not for mTRP, but are all other ICBM parameters also applicable to mTRP? And what about the mTRP parameters, are those only for mTRP or are some also applicable to the ICBM framework?  That said, we also do think RAN1 will still discuss these and provide updates, so we can also ask later. |
| MediaTek | Maybe | Clarifications about how TRP-specific parameters are used in inter-cell BM may be needed. When UE is “using” TRP2 but serving cell is not change (TRP1), should it apply the *servingCellConfig* of TRP1 or TRP2? Our understanding is that UE should apply the *servingCellConfig* of TRP1, and the necessary TRP2-related parameters (e.g., SSB periodicity) are configured in the *servingCellConfig* of TRP1. However, we can wait for further RAN1 updates. |
| Intel |  | We need to fist take a look at RRC parameter list from RAN1. |
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**Summary 2**: TBD.

**Proposal 2**: TBD.

# 5 Conclusion

TBD.