3GPP TSG-RAN WG2 Meeting #123 R2-2308972

August 21-25, 2023

Source: Session Chair (CATT)

Title: Report from NR MIMO evolution session

## Status of At-Meeting Email Discussions

This subclause is not an Agenda Item. It contains a running summary of the email discussions assigned to take place during the meeting weeks.

* [AT123][850] Organizational - MIMO evo (CATT)

Scope:

* Share plans for the meeting and list of ongoing email discussions
* Share meetings notes and agreements for review and endorsement

Intended outcome: General information sharing about the sessions

Deadline: EOM

## 7.20 NR MIMO evolution

(NR\_MIMO\_evo\_DL\_UL-Core; leading WG: RAN1; REL-18; WID: RP-223276)

Time budget: 0.75 TU

Tdoc Limitation: 3 tdoc

### 7.20.1   Organizational

Rapporteur input, incoming LS etc.

R2-2307018 Reply on LS 2TA for multi-DCI multi-TRP (R1-2306249; contact: Ericsson) RAN1 LS in Rel-18 NR\_MIMO\_evo\_DL\_UL-Core To:RAN2

* Noted

R2-2308342 Running CR for MIMO Evolution Ericsson CR Rel-18 38.331 17.5.0 4242 - B NR\_MIMO\_evo\_DL\_UL-Core

- HW commented about critical ext. and think we should take those into account

* Noted

R2-2308358 Excel in R1-2306271 with rapporteur comments. Ericsson discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

* Noted

Chair: we may go back to detailed proposals in the CB session, taking into account related contributions.

R2-2308273 LS to RAN2 on CBSR for Rel-18 MIMO (R1-2308396; contact: Samsung) RAN1 LSin Rel-18 NR\_MIMO\_evo\_DL\_UL-Core To:RAN2

- Samsung explain that there is no action required right now but we can take into account in RRC spec drafting. Ericsson agree.

* Noted

**Spec rapp assignment suggested by WI rapp:**

38.306/822/331 UE capability related Huawei

38.300 Docomo

**Potential post meeting email discussions:**

- Ericsson suggest to have long email on 331 draft CR

* [Post123][851][MIMOevo] RRC running CR for MIMO evo (Ericsson)

**Scope**: Long email discussions after the meeting, to update the RRC running CR for Rel-18 MIMO evo, taking into account a) current noted running CR R2-2308342, b) related contributions to this RAN2 meeting, and c) additional input from R1 (if needed/if any), as well as comments received during this email discussions

**Intended outcome**: Email discussion report if needed, and updated RRC running CR; can also list some open issues in the email report, as an input to the next step discussions

**Deadline**: Long

### 7.20.2   Two TAs for multi-DCI multi-TRP

RAN2 impacts of two TAs for multi-DCI multi-TRP operation, including output of email discussion [852], and other potential issues if not covered by the email discussion.

R2-2307317 Report of [Post122][852][MIMOevo] 2TAs for multi-DCI multi-TRP Samsung discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

*Proposal 1: each joint/UL TCI state is associated with either TAG1 or TAG2 by RRC configuration.*

*Proposal 2: RAN2 do not assume any restriction on grouping serving cells/TRPs to TAGs unless RAN1 indication comes.*

*Proposal 3: Wait for RAN1 progress on the relation between coreset pool index and TAG.*

*Proposal 4: RAN2 assumes the current 4 TAGs per cell group is sufficient to support Rel-18 mDCI mTRP with 2 TAs.*

- ZTE thinks these are OK. And think P3 is not needed. Samsung is fine with skipping P3.

- CATT think P1 P2 align with R1 LS and are OK. P4 is also OK.

P2:

- Ericsson think P2 should be a WA, and this makes R2 spec complicated. LG has different understanding and think we just agree this as this is according to R1 LS. OPPO agrees.

* Each joint/UL TCI state is associated with either TAG1 or TAG2 by RRC configuration.
* RAN2 do not assume any restriction on grouping serving cells/TRPs to TAGs unless RAN1 indication comes.
* RAN2 assumes the current 4 TAGs per cell group is sufficient to support Rel-18 mDCI mTRP with 2 TAs.

*List the actions to be applied at TAT expiry as follows.*

*1. not perform any uplink transmission except the Random Access Preamble and MSGA transmission;*

*2. flush all HARQ buffers;*

*3. notify RRC to release PUCCH, if configured;*

*4. notify RRC to release SRS, if configured;*

*5. clear any configured downlink assignments and configured uplink grants;*

*6. clear any PUSCH resource for semi-persistent CSI reporting;*

*7. maintain NTA (defined in TS 38.211 [8]) of this TAG;*

*8. consider all running timeAlignmentTimers as expired.*

*Proposal 5: When both TATs for a SpCell are expired, 1-8 are applied to all TRPs of all serving cells.*

*Proposal 6: When both TATs for a SCell are expired (assuming PTAG(s) of the cell group still running), 1-7 are applied to all TRPs associated to the TAG with the expired TAT (including both TRPs of the concerned SCell).*

- Samsung thinks there is consensus on P5 and P6.

- QC think we should first discuss pTAG definition. LG E agree with QC that we should discuss modelling first. APPLE suggests a rewording to P5.

- ZTE think this is OK and details can be left to spec drafting phase.

- DCM agree with Samsung and ZTE, and think we should agree. CATT has similar view. OPPO does not see any issue.

- HW asks if there is a case only a single timer for the case of 2TAG. HW thinks if we have 2 timers then P5 and P6 are applicable.

*List the actions to be applied at TAT expiry as follows.*

*1. not perform any uplink transmission except the Random Access Preamble and MSGA transmission;*

*2. flush all HARQ buffers;*

*3. notify RRC to release PUCCH, if configured;*

*4. notify RRC to release SRS, if configured;*

*5. clear any configured downlink assignments and configured uplink grants;*

*6. clear any PUSCH resource for semi-persistent CSI reporting;*

*7. maintain NTA (defined in TS 38.211 [8]) of this TAG;*

*8. consider all running timeAlignmentTimers as expired.*

* At least when both TATs for a SpCell are expired, 1-8 are applied to all TRPs of all serving cells.
* At least when both TATs for a SCell are expired (assuming PTAG(s) of the cell group still running), 1-7 are applied to all TRPs associated to the TAG with the expired TAT (including both TRPs of the concerned SCell).

*Proposal 7: Select one of the following two options of TAG model:*

*Option 1: 1-PTAG model, i.e., only one TAG of SpCell is PTAG, the other TAG of SpCell is STAG, FFS which one is PTAG*

*Option 2: 2-PTAG model, i.e., both TAGs of SpCell are PTAGs*

- CATT prefer O2, and think this is better performance. Xiaomi also prefer O2 and think with this one we do not need to change the definition of pTAG.

- LG E pefer O1 and think this is simpler from spec point of view.

- DCM think with O2 the spec is not very complex, ZTE agrees.

- Nokia think both work and think we should go to the behaivor upon timer expiry first. APPLE think we should check spec impact first.

*Proposal 8: Regardless of 1-PTAG model or 2-PTAG model, when one TAT for STAG is expired and the other TAT is running for a serving cell (SpCell or SCell), no impact to the TRP with running TAT; 1 and 7 are applied to the TRP with TAT expired, FFS whether 2-6 are applied to the TRP with TAT expired,*

*Proposal 9: For 2-PTAG model, when one TAT for PTAG is expired and the other TAT is running for a serving cell (SpCell or SCell), no impact to the TRP with running TAT; 1 and 7 are applied to the TRP with TAT expired, FFS whether 2-6 are applied to the TRP with TAT expired.*

*Proposal 10: For 1-PTAG model, when the TAT for PTAG is expired and the other TAT is running for a serving cell (SpCell or SCell), 1-8 are applied to all TRPs of all serving cells.*

- Samsung think P8-10 clearly give the intended behaviour of O1 and O2.

- LG E wonders the exact meaning of 2 pTAGs, e.g., will there be any difference btw these two. Samsung think there is no difference.

- IDT see benefit from P9.

- Xiaomi think 1 PTAG is more than what R1 agreed and think we should go to O2. CATT agree.

Chair: no real concern on whether P8-10 describe the options. The comments are mainly about pros and cons of O1 and O2.

**Working assumption:**

* We will use the 2-PTAG model, i.e., both TAGs of SpCell are PTAGs;
	+ - When the TAT for STAG is expired and the other TAT is running for a serving cell (i.e., SCell), no impact to the TRP with running TAT; 1 and 7 are applied to the TRP with TAT expired, FFS whether 2-6 are applied to the TRP with TAT expired,
		- when the TAT for PTAG is expired and the other TAT is running for a serving cell (SpCell or SCell), no impact to the TRP with running TAT; 1 and 7 are applied to the TRP with TAT expired, FFS whether 2-6 are applied to the TRP with TAT expired.

Chair: The following may be discussed in CB session

*Proposal 11: For intra-cell PDCCH order CFRA, wait for RAN1 progress on which TAG to be applied for PRACH and RAR.*

*Proposal 12: For inter-cell PDCCH order CFRA to the additionalPCI,*

*• PDCCH order indicates which additionalPCI’s PRACH configuration to be used (according to RAN1 agreement),*

*• wait for RAN1 progress on which TAG to be applied for PRACH and RAR*

*Proposal 13: For UE initiated CBRA, support SSB partition: for PRACH transmission and TAC in RAR UE applies the TAG that corresponds to the selected SSB.*

- Samsung explains that P11 is already sth agreed in R1. And Samsung added that in R1 agreement it also address TA offset. ZTE agree this is the R1 progress and think we do not need new agreements. Nokia think we should follow R1 agreements. CATT agree and think we can do this in CR drafting. Samsung confirm this has MAC spec impact.

P12:

- Samsung think we can confirm P12, first bullet, and we should discuss 2nd bullet.

- Nokia see no R2 spec with 1st bullet.

- on 2nd bullet, OPPO think we can decide. Nokia want same solution for different cases, i.e., want to resue what R1 agreed already for other case. LG think UE knows based on the RA resources that has been used so no need for other solution. QC agree, but want to discuss CBRA case. ZTE agree. Samsung explain the R1 agreement is for intra cell, and now the issue is for inter cell case, for which there is no R1 agreement.

- Nokia agree with Samsung explanation, but think the bit is already there so could reuse. OPPO think this is not necessary. LG agree and suggest. ZTE agree that 1st bullet is sufficient and the reminding aspects go to spec drafting case.

- CATT prefer to have unified solution from R2 point of view, and want to have the assumption that for inter cell case we also reuse the 1 bit.

- Docomo think R1 already have different solutions for inter/intra cell, so it is not a strong argument here.

* For inter-cell PDCCH order CFRA to the additionalPCI,
* PDCCH order indicates which additionalPCI’s PRACH configuration to be used (according to RAN1 agreement),

*Proposal 13: For UE initiated CBRA, support SSB partition: for PRACH transmission and TAC in RAR UE applies the TAG that corresponds to the selected SSB.*

- Samsung explain that there are 3 solutions in offline, and suggest R2 to discuss CBRA in R2.

- CATT think one reason to use this solution is the potential TA offset for 2TRP but now it is removed based on R1 note, so we do not need this.

- LG want to check whether it is the case that UE send preamble to additional cell?

- Samsung explain this is intra cell case.

- LG think this is only for intra cell case.

- For intra cell, QC do think this is needed. ZTE want to postpone this discussion. Nokia think we should agree based on R1 agreement for CFRA. Ericsson agree with QC and Nokia.

Chair: we can postpone but there is no need to repeat this technical discussion in the future.

* The following is taken as baseline (for intra-cell case): for CBRA, we reuse the mechanism agreed for CFRA case, i.e. use the RA RAR to indicate the TAG.

R2-2307198 Discussion on multiple TAG OPPO discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307224 Discussions on Two TAs for Multi-DCI Multi-TRP CATT discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307316 Discussion on two TAs for multi-DCI multi-TRP Samsung discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307354 Discussion on modeling for PTAG SHARP Corporation discussion NR\_MIMO\_evo\_DL\_UL-Core

R2-2307355 Discussion on two TAs for multiple TRPs SHARP Corporation discussion NR\_MIMO\_evo\_DL\_UL-Core

R2-2307406 Considerations on multi-DCI multi-TRP operation with two Tas Fujitsu discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307465 On 2TA operation Ericsson discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307614 Two TAs for multi-DCI multi-TRP Huawei, HiSilicon discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307673 TAT expiry and TAG modeling Xiaomi discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307805 Discussion on TA maintenance in two TAs for multi-TRP LG Electronics Inc. discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307847 Support of Two TAs for multi-DCI multi-TRP Apple discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307899 Discussion on two TAs for multi-DCI multi-TRP FGI discussion

R2-2307951 Discussion on TAG Management for Multi-TRP NEC Corporation discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308028 Discussion on the impacts of Two TAs for multi-DCI multi-TRP operation Lenovo discussion Rel-18

R2-2308029 Discussion on the UE-initiated RACH procedure in multi-TRP operation Lenovo discussion Rel-18

R2-2308030 Consideration on RLF in multi-TRP operation Lenovo discussion Rel-18

R2-2308414 Discussion on multi-DCI multi-TRP with two TAs Qualcomm Incorporated discussion NR\_MIMO\_evo\_DL\_UL-Core

R2-2308530 UL time alignment in multi-DCI based multi-TRP with two TAs InterDigital discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308816 Open issues on Two TAs for multi-DCI multi-TRP NTT DOCOMO INC. discussion Rel-18

R2-2308842 Consideration on the RRC parameter for 2TA ZTE Corporation,Sanechips discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308843 Further consideration on the PCell Configured with two TA ZTE Corporation,Sanechips discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308928 RA procedure while SpCell is configured with 2 TAGs Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

### 7.20.3   Unified TCI extension to mTRP operation

RAN2 impacts of unified TCI extension to mTRP operation, including the cases for sDCI and mDCI.

R2-2307806 Discussion on impact of multi-TRP on MAC CE LG Electronics Inc. discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

*Proposal 1. For separate TCI mode, the new MAC CE can indicate 4 TCI states per TCI codepoint.*

*Proposal 2. For separate TCI mode, the new MAC CE can indicate that TCI state is partially activated for a TCI codepoint and which sub-set of TCI state is activated.*

*Proposal 3. For separate TCI mode, 4 bits field is introduced per a TCI codepoint to indicate which sub-set of TCI state is activated,*

*Proposal 4. RAN2 consider following format as a baseline for new Unified TCI State A/D MAC CE.*

P2/P3:

- Chair ask what ‘sub-set’ means in P2.

- LG E think it means different cases DL, UL, 1st and 2nd TRP

- HW not sure about P3 on 4 bit fields and think there is room to save some space.

- QC also wonders what is the subset. ZTE explains.

* The following information can be indicated by the MAC CE (for separate DL/UL TCI mode):
	+ - if the unified TCI state is for one of the TRPs (i.e., 1st or 2nd) or for both TRPs,
		- if the indicated TCI codepoint consists of one TCI state, whether the indicated TCI state(s) is for the first or second TRP(s)
		- **if the unified TCI codepoint is for all, or sub-set of {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state}**

R2-2308817 Open issues on Unified TCI framework extension NTT DOCOMO INC. discussion Rel-18

*Proposal 1. Start discussion to introduce fields related to eUTCI to reflect parameters listed in RAN1 parameter list.*

*Proposal 2. RAN2 wait for RAN1 progress before starting discussion on implementation of UE features.*

*Observation 1. A new MAC CE shall include information below:*

*1. Which TCI States this MAC CE indicates, i.e.;*

*- for a serving cell configured with joint TCI mode, all, or sub-set of {first joint TCI state, second joint TCI state}.*

*- for a serving cell configured with separate TCI mode, all, or sub-set of {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state}.*

*2. Mapping of each TCI State to the existing TCI field in a DCI format 1\_1/1\_2.*

*Proposal 3. RAN2 confirm that a new MAC CE for serving cell configured with separate UL/DL TCI States shall include;*

*1. which TCI States this MAC CE indicates, i.e., all, or sub-set of {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state}*

*2. mapping of each TCI State to the existing TCI field in a DCI format 1\_1/1\_2*

*Proposal 4. RAN2 discuss whether separate MAC CEs are introduced for joint TCI State and separate DL/UL TCI States respectively.*

P4:

- DCM think we should introduce separate MAC CEs.

- Samsung think RRC configures the mode and with only one LCID this works. ZTE and CATT agree. CATT think for R17 we didn’t introduce separate MAC CEs.

- OPPO think this impacts signalling overhead, using the same MAC CE would waste 2 byte in some cases. And think this MAC singling is more sensitive to payload size compared with higher layer singling.

- LG agree with Samsung, and prefer one MAC CE.

- vivo and DCM think we do not need a WA but this can be handled in spec drafting.

??Working assumption: separate MAC CEs are introduced for joint TCI State and separate DL/UL TCI States respectively.

Chair: anything to discuss on mDCI?

- there are no suggestions.

R2-2307615 Extension of unified TCI framework for mTRP Huawei, HiSilicon discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

- LG E think this proposal results in less indication bits per each codepoint. HW wants to check.

R2-2307199 Discussion on MAC CE design for mTRP OPPO discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307225 Discussion on Unified TCI Framework Extension for sDCI based Multi-TRP CATT discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307334 Discussion on multi-TRP with unified TCI states Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core Withdrawn

R2-2307466 On uTCI operation Ericsson discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307615 Extension of unified TCI framework for mTRP Huawei, HiSilicon discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2307695 Single-DCI based unified TCI extension to multi-TRP operation Samsung discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308415 Discussion on unified TCI framework extension for mTRP Qualcomm Incorporated discussion NR\_MIMO\_evo\_DL\_UL-Core

R2-2308817 Open issues on Unified TCI framework extension NTT DOCOMO INC. discussion Rel-18

R2-2308844 Further consideration on unified TCI State Extension for SDMT ZTE Corporation,Sanechips discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308920 Design of mDCI MAC CE for Rel-18 MIMO Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308921 Design of sDCI MAC CE for Rel-18 MIMO Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

R2-2308936 Discussion on MAC-CE design for M-TRP CEWiT discussion Late

### 7.20.4   Other

Other issues if not covered by 7.20.1, 7.20.2, and 7.20.3.

This agenda item is of lower priority, i.e., it will be treated if time allows. Depending on the number of contributions/proposals, a summary of this agenda item may be used.

R2-2307464 On other parameters MIMOevo Rel18 Ericsson discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

*Proposal 1 RAN2 to confirm that values for numberOfSDCombinations and numberOfSDCombinations-PS can be derived from list size paramCombination-CJT-L-r18 or paramCombination-CJT-PS-aplha-r18.*

*Proposal 2 RAN2 to confirm that values for Y can be derived from list size delayDSetofLenghtY -r18.*

R2-2307696 Discussion on Rel-18 higher-layers parameter list for MIMO Samsung discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

*Proposal 1: A new RRC parameter (applyIndicatedTCIState-r18) with values {the first, the second, both} in ControlResourceSet is configured along with the Rel-17 followUnifiedTCI-State-r17, i.e. reuse the followUnifiedTCI-State-r17 for Rel-18 sDCI based mTRP operation using the enhanced unified TCI framework.*

*Proposal 2: A new RRC parameter (applyIndicatedTCIState-r18) with values {the first, the second, both} is configured for both PUCCH-resource and PUCCH-ResourceGroup.*

*Proposal 3: RAN2 further consider how to configure the new RRC parameter (applyIndicatedTCIState-r18) to support Rel-18 unified TCI framework on the multi-TRP AP CSI-RS.*

*Proposal 4: For CSI-CJT, one RI restriction is configured in CodebookConfig that applies to all CSI-RS resources in the NZP-CSI-RS-ResourceSet.*

*Proposal 5: For CSI-CJT codebook configuration, configure n1-n2 separated out from n1-n2-codebookSubsetRestriction, only one n1-n2 value is configured for all CSI-RS resources in the NZP-CSI-RS-ResourceSet for CJT.*

*Proposal 6: For CSI-Doppler, one parameter d-m is used to configure values of d and m, i.e., d-m with values {1-1, 1-2, 2-2}.*

*Proposal 7: For combOffsetHoppingWithRepetition field in SRS-Resource, no further combining with another (e.g repetition factor) is needed i.e. implement the RRC parameter what RAN1 suggested.*

*Proposal 8: RAN2 determine the signalling support on codebook type for UL-8Tx with considering the following options.*

*1. Introduce the separate RRC fields for ULcodebookFC-N1N2 and CodebookType based on the RAN1 feature list, respectively. Add the qre-requisition/presence condition for ULcodebookFC-N1N2 (i.e. it is only applicable to CodebookType is set to ‘Codebook1’).*

*2. Use the CHOICE struction for CodebookType and add the configuration of ULcodebookFC-N1N2 in the field what ‘Codebook1’ is selected.*

- Chair: is there anything critical and requiring checking with R1 right now?

- Ericsson and Samsung both think these can be discussed in R2, e.g., as part of RRC review.

- Chair encourages companies to look at the proposals and bring proposals if needed in later stage.

R2-2307616 Intra-UE prioritization for STxMP Huawei, HiSilicon discussion Rel-18 NR\_MIMO\_evo\_DL\_UL-Core

*When two overlapping UL grants are for mDCI STxMP scenario, discuss how to specify the UE behaviour to avoid using only one UL grant.*

*Ask RAN1 whether it is allowed that the STxMP UL grants are overlapping with another single TRP or STxMP UL grant(s). If it is allowed, RAN2 should discuss the intra-UE prioritization rule for STxMP.*

- DCM suggests to look into these issues.

- ZTE think these are mutually exclusive.

Email discussions after the meeting (Long)

* [Post123][851][MIMOevo] RRC running CR for MIMO evo (Ericsson)

**Scope**: Long email discussions after the meeting, to update the RRC running CR for Rel-18 MIMO evo, taking into account a) current noted running CR R2-2308342, b) related contributions to this RAN2 meeting, and c) additional input from R1 (if needed/if any), as well as comments received during this email discussions

**Intended outcome**: Email discussion report if needed, and updated RRC running CR; can also list some open issues in the email report, as an input to the next step discussions

**Deadline**: Long