**3GPP TSG RAN WG1 #108-e R1-2202677**

**e-Meeting, February 21th – March 3rd, 2022**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

**Title:** Moderator Summary#3 for Maintenance on Rel-17 Multi-Beam: ROUND 2

**Document for:** Discussion and Decision

## Introduction

In this summary, the term “item 1” refers to the first item in the Rel.17 NR FeMIMO WID, i.e. multi-beam enhancement:

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| --- |
| 1. Enhancement on multi-beam operation, mainly targeting FR2 while also applicable to FR1:
	1. Identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management for intra-cell and inter-cell scenarios to support higher UE speed and/or a larger number of configured TCI states:
		1. Common beam for data and control transmission/reception for DL and UL, especially for intra-band CA
		2. Unified TCI framework for DL and UL beam indication
		3. Enhancement on signaling mechanisms for the above features to improve latency and efficiency with more usage of dynamic control signaling (as opposed to RRC)
		4. For inter-cell beam management, a UE can transmit to or receive from only a single cell (i.e. serving cell does not change when beam selection is done). This includes L1-only measurement/reporting (i.e. no L3 impact) and beam indication associated with cell(s) with any Physical Cell ID(s)
			1. The beam indication is based on Rel-17 unified TCI framework
			2. The same beam measurement/reporting mechanism will be reused for inter-cell mTRP
			3. This work shall only consider intra-DU and intra-frequency cases
	2. Identify and specify features to facilitate UL beam selection for UEs equipped with multiple panels, considering UL coverage loss mitigation due to MPE, based on UL beam indication with the unified TCI framework for UL fast panel selection
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This summary includes the following:

* Observation and proposal
* Summary of current companies’ positions on each of the aspects within the category

## Summary of companies’ inputs

### Issue 1 (Rel.17 unified TCI framework – note: for intra-cell beam management unless otherwise noted)

Table 1 Summary: issue 1

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| **#** | **Issue** | **Companies’ views** |
| 1.11 | **Proposal 1.G**: For Rel-17 unified TCI framework, for CORESET 0 configured by RRC to apply the indicated Rel-17 TCI state associated with the serving cell, the UE assumes DM-RS antenna port for PDCCH receptions in the CORESET is QCLed with an SSB on the UE identified during a latest RA procedure, not initiated by a PDCCH order that triggers a contention-free random access procedure, if no MAC-CE or DCI indicating a TCI state after the RA procedure.**FL Note**: Revised proposal from Samsung from ROUND 0 | **Support/fine**: Samsung, CATT, Xiaomi, ZTE, Intel, CMCC, Nokia/NSB, Lenovo/MotM **Not support:** Ericsson, Huawei/HiSi |
| 1.12 | **Proposal 1.K**: On Rel.17 unified TCI framework, for Rel-17 unified TCI, for DL channels/signals that share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update), the following option on source RSs and QCL-Types is also supported:* Option 3: CSI-RS for CSI is configured for QCL-TypeA and QCL-TypeD source RS

**FL Note**: It was explained that the so-called “circular” issue is avoided in practice via NW implementation, i.e. NW will not configure the same CSI-RS for CSI both as source and target RSs. **Need conclusion**. | **Support/fine**: Sony, CMCC, Ericsson, Qualcomm, NTT Docomo, Fraunhofer IIS/HHI, Nokia/NSB, TCL, CMCC, CATT, ZTE, Spreadtrum, vivo, Futurewei, Intel, Lenovo/MotM, Samsung, LG, Xiaomi, Huawei/HiSi **Not support:** Apple, IDC (no need, the agreed TRS and CSI-RS for BM are already sufficient) |
| 1.13 | For cross-carrier scheduling **Proposal 1.H**: If the TCI updating DCI has smaller SCS than the applied channel(s), the time gap between DCI and the application time should be no less than the corresponding UE capability plus an additional value to account for extra DCI decoding latency.* Value may reuse the additional beam switching timing delay d defined in 38.214 Table 5.2.1.5.1a-1.

**Proposal 1.I**: If a UE is configured with *CrossCarrierSchedulingConfig* for a serving cell the value of the DCI field ‘*carrier indicator*’ corresponds to the value indicated by *CrossCarrierSchedulingConfig.* The codepoint indicated by the DCI field ‘*Transmission Configuration Indicator*’ is applied to the carrier indicated by the DCI field ‘*carrier indicator*’**FL Note**: New proposals from Qualcomm and Samsung in ROUND 1 | **Proposal 1.H:*** **Support/fine:** Qualcomm, Xiaomi, Huawei/HiSi
* **Not support:** MTK, NTT Docomo, ZTE, CATT, LG, Nokia/NSB, OPPO, Intel, Ericsson, CMCC

**Proposal 1.I:*** **Support/fine:** Samsung, CATT, Xiaomi, Intel, Nokia/NSB, CMCC, NTT Docomo,
* **Not support:** MTK, ZTE, LG, OPPO, Ericson, Huawei/HiSi (clarify), IDC

**Unclear, need TP to discuss**: vivo |
| 1.15 | Support to report virtual PHR based on the power control parameters associated with indicated TCI state for PUSCH/PUCCH transmission. | **Support/fine:** Apple, ZTE, NTT DOCOMO**Not support:** Intel, Samsung, Qualcomm, MTK , CATT, Nokia/NSB, Lenovo/MotM, OPPO, Ericsson, vivo, Huawei/HiSi |

Table 2 Additional inputs: issue 1

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 1**
2. **Share more inputs here if needed**
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| MediaTek | **Proposal 1.G**: We are neutral to this proposal  |
| InterDigital | Our views are updated in the table. Especially for 1.12, we don’t see a necessity to additionally introduce CSI-RS for CSI as a source RS at this maintenance phase, as the agreed TRS and CSI-RS for BM are already sufficient. Can anyone clarify what is a critical use case that only CSI-RS for CSI can provide with benefits, which cannot be achieved by using the agreed TRS and CSI-RS for BM? |
| Qualcomm | For Proposal 1.G, fineFor Proposal 1.I, we think better to have TP to discussTo FL, suggest to add the following proposal to clarify the UE capability new bullet in the agreement* The original intention of the proposed clarification in red below is to address our concern in online session as compromise to agree on CORESET C
	+ It is not intended for UE to not to support CORESET C to accommodate NW vendors’ desire for keeping CORESET C
* To Apple, to our understanding, the proposed capability in red below may not be achieved by the existing UE feature component for supporting R15/16 like TCI signaling
	+ Because we have to support R15/16 TCI signaling for CORESET 0 for inter-cell BM, since CORESET 0 has to stay on serving cell and cannot follow the indicated TCI.
	+ On the other hand, the existing UE feature component copied below is for whether to support the R15/16 TCI signaling for ALL channels/RSs to our understanding.
	+ But our preference is to support the R15/16 TCI signaling only for CORESET 0, while other CORESETs still always follow the indicated TCI
	+ But I am fine to add the proposed capability in red as new sub-component under the existing UE feature component, as long as our preference is supported

**Proposal 1.X**:For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception for a CORESET other than CORESET#0 that is associated with both UE-dedicated and non-UE-dedicated reception on PDCCH in a CC and its respective PDSCH reception,* Whether to apply the indicated Rel-17 TCI state associated with the serving cell is configured per CORESET by RRC – if not applied, use the legacy MAC-CE/RRC/RACH signalling mechanism
* Note: The CSI-RS associated with the Rel-17 TCI state applied to CORESET 0 should be QCLed with an SSB associated with serving cell PCI (same as Rel-15)
* The support of this feature is UE optional
	+ If not supported, UE always applies the indicated Rel-17 TCI state to CORESET(s) other than CORESET#0 that is associated with both UE-dedicated and non-UE-dedicated reception on PDCCH in a CC and its respective PDSCH reception

Existing UE feature component for R15/16 TCI signalingSupport of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH, and SRS reusing the Rel-15/16 signaling/configuration design(s) |
| Apple | 1.11: It seems we do not need to discuss this issue, since all CORESET #0 related aspects are finished and we agreed we will reuse legacy.1.12: We consider this is an optimization1.13: We consider both proposals are optimization1.15: From comments in previous round, we found there were some misunderstandings on this proposal. This is for virtual PHR report instead of actual PHR report. Current virtual PHR is always based on a default power control parameter set, which is useless, since it cannot reflect the situation for current beam indicated by unified TCI. |
| NTT DOCOMO | **1.1 (Proposal 1.G):** we are fine in principle to determine CORESET 0 QCL assumption before MAC CE activation/DCI indication.**1.2 (Proposal 1.K):** Support.**1.3:** We are fine with cross carrier beam indication of proposal 1.I. But, we prefer not to have extra beam switching delay of proposal 1.H.**1.5:** We are fine.**<UE behaviour if UE does not support QCL of CORESET C agreement>****Proposal 1.X:** Support Qualcomm’s proposal. We think it is aligned with UE behaviour for CORESET B if UE does not support “sharing with indicated Rel.17 TCI”, as Apple commented on Thursday online. Since CORESET C is already deployed in commercial network, we should not preclude CORESET C by UE capability. Proposal 1.X is beneficial because gNB can configure CORESET C irrespective of the UE capability.Another alternative commented by Huawei/vivo in the online, was “UE does not expect to be configured with CORESET (other than CORESET0) with both CSS and USS, if UE does not support the FG”. However, in this case, gNB vendors and operators, who already deploy CORESET C, will need to require UE vendors to implement this FG. |
| Samsung | **Issue 1.11 Proposal 1.G**: SupportRegarding Huawei’s comment in the last round, the proposal now says “DM-RS antenna port for PDCCH receptions in the CORESET is QCLed with an SSB ...”, which should address Huawei’s comment: “RA procedure does not provide a TCI state”The phrase “not initiated by a PDCCH …” is used in 38.213 **Issue 1.12 Proposal 1.K**: OK**Issue 1.13 Proposal 1.I:** SupportTo address some of the comments raised we can add the following. (This text can serve as a TP):If a UE is configured with *CrossCarrierSchedulingConfig* for a serving cell the value of the DCI field ‘*carrier indicator*’ corresponds to the value indicated by *CrossCarrierSchedulingConfig.* The codepoint indicated by the DCI field ‘*Transmission Configuration Indicator*’ is applied to the carrier indicated by the DCI field ‘*carrier indicator*’ and corresponds to TCI state configured for that carrier.**Issue 1.15**: Not needed.Based on the current spec a UE calculates the PHR based on the power control parameters associated with PUSCH. When the PUSCH follows the indicated TCI, the power control parameters associated with the indicated TCI state are used. Therefore, we don’t think there is a need for further agreements. |

### Issue 2 (inter-cell beam management)

Table 3 Summary: issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2.1 | For the already agreed NW-controlled inter-cell beam reporting, support reporting L1-RSRP for the subset of configured SSBs detected during the L3 measurement | **Support/fine:** Ericsson, vivo, ZTE**Not support:** Qualcomm, Nokia/NSB (RAN4 issue), Samsung, OPPO, Xiaomi, CMCC, CATT, Spreadtrum, Lenovo/MotM, MTK (supportive but RAN4), Apple (RAN4), IDC |
| 2.5 | For inter-cell cases, default beam mechanism should be determined separately.* + For non-UE-dedicated DL channels/RSs, reuse legacy default beam mechanism defined in Rel-15/16 to obtain their QCL assumption respectively;
	+ For UE-dedicated DL channels/RSs, follow the previous indicated TCI-state-r17;

**FL Note**: ZTE commented: “the question is that UE can NOT realize whether the non-dedicated PDSCH is transmitted when its scheduling offset is less than a threshold!”. Nokia commented “it should be clarified that what is QCL assumption for the PDSCH reception in serving cell in the following configuration:- UE is configured with CORESET B (for CSS only) in serving cell- UE is configured with CORESET A (for USS) associated with PCI different than PCI of the serving cell” | **Support/fine:** vivo, CMCC**Not support:** QC (always use indicated TCI), Samsung, MTK, NTT Docomo, CATT, Intel, Xiaomi, Lenovo/MotM, OPPO, Intel, Ericsson, IDC **Can discuss QCL assumption**: Apple, ZTE, Nokia/NSB |
| 2.6 | For inter-cell case with one TCI pool configured within a set of CCs, when different PCIs are associated with the TCI states in different CCs, it should be allowed that the same TCI state ID can refer to different PCI on different CCs. | **Support/fine:** vivo**Not support:** QC (NW implementation), Samsung, MTK (NW implementation), Apple (not prohibited), NTT Docomo, ZTE, CATT, Intel, Xiaomi, Lenovo/MotM, OPPO, Ericsson, CMCC, Huawei/HiSi, Nokia/NSB |
| 2.7 | PDCCH/PDSCH is rate matched around the SSBs configured for L1-RSRP measurement and SSBs associated with activated TCI states, besides SSBs associated with the same PCI as that of the activated/indicated TCI state of the PDCCH/PDSCH. | **Support/fine:** vivo, QC, Apple, CATT**Not support:** Samsung (non-essential, wasteful), ZTE, Intel, Xiaomi, Lenovo/MotM, OPPO , Ericsson (follow agreements in inter-cell mTRP), CMCC, Huawei/HiSi, Nokia/NSB  |
| 2.8 | For UE with activated with more than one TCI state, 1) if the symbols of paging/short message/SI from serving cell are **not overlapped** with the symbols of DL signals from non-serving cell, UE receives both.2) if at least one symbol of paging/short message/SI from serving cell **is overlapped** with the symbol of DL signals from non-serving cell, UE receives paging/short message/SI. | **For 1),****Support/fine:** NTT Docomo, CATT, Xiaomi, ZTE, CATT, Ericsson, Nokia/NSB, Samsung**Not support:** vivo, MTK**For 2),****Support/fine:** NTT Docomo, Xiaomi, ZTE, Ericsson, Nokia/NSB**Not support:** vivo, MTK (Rel-15 dropping rule suffices) |

Table 4 Additional inputs: issue 2

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| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 3**
	1. **Those opposing 2.5/6/7, please check vivo’s 2nd response below and see if you change your mind**
	2. **Those opposing 2.8, please check Docomo’s response below and see if you change your mind**
2. **Share more inputs here if needed**
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| vivo | **Issue 2.5:** The motivation of separate default beam mechanism is to make UE behaviour clear when non-UE dedicated PDSCH is in the same slot as the non-UE dedicated PDCCH (typical case). @ Qualcomm @ Samsung @Xiaomi @ CATT There is no doubt that for UE-dedicated channels/RSs, their QCL assumption always follow the indicated TCI state as long as beam application time is satisfied. But for non-UE-dedicated channels/RSs, if the PDSCH and PDCCH are within the same slot, which QCL assumption should be used for the reception? Especially considering the non-UE dedicated signals are from another cell. @ OPPO For typical configurations, the non-UE dedicated PDSCH and PDCCH are within the same slot. @ Intel Current specification is unclear about the behaviour you mentioned. 38.214 only states the starting time of the application of indicated TCI.**Issue 2.6:** @Docomo @OPPO @Xiaomi @Samsung @Docomo, The scenario is for the case when reference BWP/CC is configured with only one TCI state pool, thus TCI states are switched from serving cell to the target cells simultaneously. it is not possible to guarantee the targeting PCIs in different CCs to be the same. Our understanding is that different PCI planning strategy would be used for different frequency.**Issue 2.7:** Currently there is not any rate matching behaviour defined for L1/L2 mobility case, we need agreement on this issue.We are fine with Apple’s revision. Simultaneous reception of SSB for L1-RSRP measurement and PDSCH reception on the same symbol/the same REs would imply new measurement behaviour need to be supported. This should have a well aligned understanding and corresponding agreement.@Samsung, @Docomo, L1-RSRP measurement has more stringent requirement than L3 measurement. And measurement restriction in time domain configuration would also be different for L1-RSRP and L3-RSRP. We need clarification and common understanding on this issue.@Lenovo @OPPO we have not agreed any rate matching behaviour for inter cell BM. The basic rate matching behaviour should be agreed.@Xiaomi Rate matching discussion for Agenda 8.1.2.2 is not related to SSBs configured for L1-RSRP measurement, but rather the SSBs configured in non-serving cell PCI information. Measurement related discussion should be conducted here in Agenda 8.1.1 |
| NTT DOCOMO | **Issue2.8:** Thank you for your feedbacks!@vivo, MediaTek, I see you have different views on overlapping case. Do you have concern on **non-overlapping case**? 1) of proposal in issue 2.8 discuss non-overlapping case only. |
| MediaTek | Issue 2.5: The default beam behaviour should be determined based on whether the corresponding CORESET applies the indicated TCI or not, instead of the types of channels, which cannot be known before UE decodes it (as mentioned by ZTE).Issue 2.6: Thanks Yuki’s explanation. We don’t have concern on the non-overlapping case, sorry for the confusion. However, does it cause any spec impact? |
| InterDigital | Our views are added in the table. |
| Qualcomm | For 2.8, * For non-overlapping case, need TP to understand the proposal
* For overlapped case, prefer not to support. We had agreement that for UE receiving from non-serving cell, UE is not expected to receive paging/SI from serving cell on the same symbol

**Agreement**With regards to the below question in RAN2 LS, provide the following response.

|  |
| --- |
| If UE is receiving DL data from *TRP with different PCI* on dedicated channels, is the UE still able to receive short message (e.g. paging) and system information from *serving cell TRP*at the same time? |

**Answer: No, it is not.** |
| Apple | 2.5: We think this issue needs to be clarified.Maybe we can try to list possible alternatives. For inter-cell BM, if we always use indicated TCI as default beam, UE cannot receive non-UE dedicated signals, since the scheduling offset for non-UE dedicated signals cannot be too large. Even if we use indicated TCI as default beam, such behavior itself has spec impact. In addition, we think the default beam should be common across the CCs in a band. We suggest we list alternatives for down-selection as follows:* **For default beam for PDSCH and aperiodic CSI-RS with scheduling offset below a threshold, down-select one of the following options:**
	+ **Option 1: The default beam is based on the indicated TCI applied to dedicated PDSCH/PDCCH in the CC**
	+ **Option 2: The default beam is based on the TCI/QCL for CORESET in the latest slot across CCs within a band**
		- **If there are multiple CORESETs, the one with lowest ID in the CC with lowest CC ID is applied**

2.6: In our view, this proposal is not precluded based on current spec.2.7: We support the proposal. We should notice that RAN1 already told RAN2 in LS that simultaneous reception is not supported for inter-cell BM.2.8: in our view, this needs RAN4’s input, since DL signals from non-serving cell can be SSB, and measurement related aspects now are left to RAN4. |
| NTT DOCOMO | **2.6:** Since we haven’t get reply from vivo in round 1, we copied our comment below.* Thank you vivo, for your explanation. Our assumed scenario is intra-band co-located CA. In that case, we assume the same TCI state ID on different CC should be associated with the same QCL type D RS (at least the same root SSB). It seems your assumed scenario is non-co-located CA, and hence the same TCI state ID in different CC can be associated with different QCL type D RS (i.e. different root SSB). Is this correct understanding?
* Also, does common TCI state ID update in Rel.17 support your assumed scenario? In case of TCI state pool sharing, we think the agreement says QCL type D RS or the root SSB should be the same across all CCs in the CC list. In that case, your problem seems not happen.

----**2.8:** If we understand correctly, MediaTek/vivo are against for overlapping case (2), and they didn’t mentioned concern for non-overlapping case (1). MediaTek confirmed they have no concern on (1) in above.**Re Apple’s comment:** our intention of “DL signals from non-serving cell” is “PDCCH/PDSCH/PUCCH/PUSCH/SRS whose TCI state is associated with non-serving cell PCI” by L1/L2 mobility feature. **Re MediaTek/Qualcomm’s comment:** Since we replied to RAN2 below, we are concerned whether UE can receive paging/short message on different symbols from “PDCCH/PDSCH/PUCCH/PUSCH/SRS whose TCI state is associated with non-serving cell PCI”. If it is not allowed, significantly large MAC CE overhead is expected. Hence, we’d like to clarify that at least TDM operation (1) is allowed. We’d like to clarify it in spec., but we should consider more how to specify it, because in current spec. such limitation does not exist. If companies are OK with TDM operation, we’d like to make an agreement.**Agreement**With regards to the below question in RAN2 LS, provide the following response.

|  |
| --- |
| If UE is receiving DL data from *TRP with different PCI* on dedicated channels, is the UE still able to receive short message (e.g. paging) and system information from *serving cell TRP*at the same time? |

**Answer: No, it is not.** |
| Samsung | **Issue 2.1:** Not needed.The UE should report a subset of SSBs detected during measurement. The subset includes measurements that are within the reporting range. When to perform the measurement can be left for UE’s implementation.**Issue 2.5:** Not support.There is no need for a default beam. The UE follows the dedicated TCI state.Regarding some of the comments raised:ZTE commented: “the question is that UE can NOT realize whether the non-dedicated PDSCH is transmitted when its scheduling offset is less than a threshold!”. If “threshold” refers to the time threshold of whether or not to apply a beam indication, we don’t think that this is applicable in the unified TCI framework. If the indicated TCI state is used the BAT determines the timing of when to follow the new beam. If the indicated TCI state is not used, we think that the TCI state of the PDSCH should follow that of the CORESET scheduling the PDSCH regardless of the scheduling offset.Nokia commented “it should be clarified that what is QCL assumption for the PDSCH reception in serving cell in the following configuration:- UE is configured with CORESET B (for CSS only) in serving cell- UE is configured with CORESET A (for USS) associated with PCI different than PCI of the serving cell”CORESET A follows the indicated TCI state. CORESET B is configured a TCI state following the Rel-15/16 rules.**Issue 2.6:** Not support. A TCI state is associated with a RS, associated with a PCI. There is no need to have the same TCI state refer to different PCIs.**Issue 2.7:** Not support.The PDSCH is only rate matched around the SSB of its serving cell/PCI. For L3 handover, the PDSCH is not rate matched around the PDSCH of other neighbouring cells. Rel-17 L1-RSRP measurements can follow the same principle. Furthermore, rate matching around measurement SSBs from various different PCIs is not resource efficient.**Issue 2.8:**(1) Support(2) We agree in principle that if the paging/short message of SC overlaps UE-dedicated channel of NSC one of them should be drop. Why receive the paging message and not the UE-dedicated channel? |

### Issue 3 (signaling medium)

Table 5 Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3.2 | **Proposal 3.B**: On Rel-17 MAC-CE-based and DCI-based beam indication, regarding application time of cross-carrier (carrier aggregation) beam indication, the BAT is configured per-CC* For CCs in the same CC list, the BAT is the same

**FL Note**: Discussed offline [1]. Super-majority view is Alt1 (similar to Rel-15/16) hence proposed (from FL perspective any of the 3 alternatives works)Summary:* Alt1. The BAT is configured per-CC
* Alt2. Use the same scheme as that with common TCI state ID update, i.e. a common BAT is determined by the smallest SCS among all the applied CC(s) in a band
* Alt3. A BAT list is configured under the cell group config and applied for each CC in the CG. For CCs not configured with a common TCI state ID update, the BAT is determined by the SCS of the active BWP of the CC.

**Alt1**: Huawei/HiSi, NTT Docomo, Xiaomi, Ericsson (no additional restriction), Samsung, CMCC, Intel (when common TCI state ID update is not configured/supported), MTK (also for non-CA case), NEC, CATT, OPPO, LG, CMCC, Nokia/NSB, TCL, IDC, Spreadtrum**Alt2:** Qualcomm, ZTE, Apple, Lenovo/MotM, Lenovo/MotM**Alt3**: vivo, Qualcomm**MTK commented that the proposal doesn’t prevent Alt2 per previous agreement** | **Support/fine**: Huawei/HiSi, NTT Docomo, Xiaomi, Ericsson, Samsung, CMCC, Intel, MTK, NEC, CATT, OPPO, LG, CMCC, Nokia/NSB, TCL, IDC, Spreadtrum, Lenovo/MotM**Not support**: ZTE (Alt2), vivo (Alt3) |
| 3.5 | **Proposal 3.D:** For DCI format 1\_1 and 1\_2 with PDSCH assignment indicating TCI state, the acknowledgement to the TCI state update is the ACK of the PDSCH* FFS which one of indicated TCI states to be updated in case of HARQ-ACK multiplexing
	+ For example, the TCI state(s) indicated in DCI corresponding to last position with ACK value in the HARQ-ACK codebook
 | **Support/fine:** OPPO, Qualcomm, NTT Docomo, NEC, Xiaomi, TCL, CMCC, Intel, ZTE, vivo, Futurewei, Lenovo/MotM, Spreadtrum, Qualcomm (NACK doesn’t work), Apple, LG, Nokia/NSB, **Not support:** Huawei/HiSi (add “or NACK”), Samsung, MTK, CATT, Ericsson (no spec impact) |
| 3.9 | **Proposal 3.F**: Regarding TCI indication by DCI without DL assignment, for type-1 HARQ-ACK codebook determination, virtual PDSCH is assumed in the same slot of the DCI by UE. | **Support/fine**: ZTE, Nokia/NSB, Lenovo/MotM (discuss), Apple (discuss), MTK (discuss)**Not support:** OPPO, TCL, CATT, Intel, vivo, Samsung, CATT, LG |
| 3.10 | **Proposal 3.G**: For DCI formats 1\_1 and 1\_2 without DL assignment, the UCI carrying the HARQ feedback should be mapped to high priority HARQ codebook and PUCCH resources associated with priority index 1 when the UE is configured with two priority indexes. If UE is configured with single priority index, the UCI carrying the HARQ feedback for beam indication should be prioritized over other UCI. | **Support/fine**: Intel**Not support:** Ericsson (not essential), Qualcomm (no need), OPPO, ZTE, vivo, Apple, Samsung, MTK, CATT, Nokia/NSB |
| 3.11 | **Proposal 3.B.1**: On Rel-17 DCI-based beam indication, regarding application time of the beam indication for non-CA, the BAT is configured/determined per-CC | **Support/fine**: MTK, Samsung, Intel, Huawei/HiSi, NTT Docomo, CATT, Ericsson**Not support:** Qualcomm (leave to RAN2) |
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Table 6 Additional inputs: issue 3

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| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 5**
	1. **3.5: Opposing companies please check OPPO’s and NEC’s responses and see if you change your mind**
	2. **3.9: Opposing companies please check ZTE’s 2nd response and see if you change your mind.**
2. **Share more inputs here if needed**
 |
| ZTE | 3.9: As we discussed above, the possible issue of “out of candidate list for semi-static HARQ-ACK codebook generation” should be addressed. Clarification to @Samsung and LG: HARQ-ACK codebook has been designed in current spec, we could reuse it well if we assume the same rules. But the issue is caused by the misalignment in the agreement that “The ACK is reported in a PUCCH k slots after the end of the PDCCH reception where k is indicated by the **PDSCH-to-HARQ\_feedback** timing indicator field in the DCI format”, where definition of k reuses the time between PDSCH to PUCCH (with HARQ-ACK) in DCI, but k is (mis-)used for the time between PDCCH to PUCCH. That would cause problem by using k(which is **PDSCH-to-HARQ**) as the time PDCCH-to-PUCCH. This misalignment may cause the issue above. The simplest way is to consider virtual PUSCH is in the same slot of the DCI by UE.  |
| OPPO | 3.5: Support. Because NR does not define DTX and feedbacking one “NACK” might correspond to the case that the DCI/PDCCH is not correctly received. As specified in 213, when the DCI is not correctly decoded, the UE still feedback ‘NACK’ bit. Thus, the NACK could be wrong indication of receiving beam indication and the consequence is TCI state misalignment. The root reason for that is NR does not define ‘DTX’.@SS: according the specification in 213, if a UE does not receive the DCI/PDCCH correctly, the UE still feedback a NACK bit in the corresponding position in Type-1HARQ codebook. In this case, if NACK is used as acknowledge, the gNB would assume the UE receive the beam indication but the UE actually does not receive the beam indication DCI correctly. Then, it would result in misalignment between system and UE.3.7: Support Alt1. The system should use system implementation to configure properly.3.9: such a restriction is not needed. At least the system implementation should take care of the error case if it exists.3.10: the motivation for prioritizing the beam indication HARQ feedback is not clear. Actually, the HARQ feedback for PDSCH shall have higher priority than that of the beam indication. Dropping the HARQ of PDSCH would cause more resource waste due to the retransmission of whole PDSCH. But beam indication is in DCI and the PDCCH will be transmitted any way.3.11: it intends to say “determined per CC”, right? |
| NEC | Issue 3.5:@MTK. In Rel-15/16, there is no misalignment on understanding between gNB and UE on MAC based TCI activation/update, as MAC is actually carried on PDSCH, if MAC (PDSCH) decoding is correct, UE will report ACK and gNB can know UE’s understanding (TCI update/activation command decoding correctly), and if MAC (PDSCH) decoding or DCI decoding is failed, UE will report NACK, and from UE perspective, UE doesn’t know the TCI update/activation command, and from network perspective, gNB can also know UE’s understanding (not aware of the TCI update/activation command), then gNB will not use new TCI, and can retransmit MAC command, i.e. the understanding between UE and gNB is aligned, as shown in Table 1.**Table 1. Rel-15/16 MAC based TCI update/activation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DCI decoding | PDSCH (MAC CE) decoding | HARQ-ACK feedback(based on PDSCH decoding) | Actual decoding result of MAC  | Network can know UE understanding of MAC command |
| Success | Success | ACK | Success | Success |
| Success | Failed | NACK | **Failed** | **Failed** |
| Failed | Failed | NACK | **Failed** |

But for DCI based TCI update, TCI is carried in DCI, but ACK/NACK is feedback for PDSCH, then there will be misalignment, as listed in following table.**Rel-17 DCI based TCI update**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DCI decoding | PDSCH decoding | HARQ-ACK feedback(based on PDSCH decoding) | Actual result of beam indication | There will be ambiguous at network side on UE’s decoding result of DCI  |
| Success | Success | ACK | Success | Success |
| Success | Failed | **NACK** | **Success** | **Unknown** |
| Failed | Failed | **NACK** | **Failed** |

So we think this should be clarified, especially in case of HARQ-ACK multiplexing, which is a typical use case for HARQ-ACK feedback. And we propose to consider HARQ-ACK multiplexing to determine a unified solution. **Proposal 3.D:** For DCI format 1\_1 and 1\_2 with PDSCH assignment indicating TCI state, the acknowledgement to the TCI state update is the ACK of the PDSCH* **FFS which one of indicated TCI states to be updated in case of HARQ-ACK multiplexing**
	+ **For example, the TCI state(s) indicated in DCI corresponding to last position with ACK value in the HARQ-ACK codebook**
 |
| MediaTek | Proposal 3.B: We are fine with the proposal with one small change: **Proposal 3.B**: On Rel-17 MAC-CE-based and DCI-based beam indication, regarding application time of cross-carrier (carrier aggregation) beam indication, the BAT is configured per-CC* For CCs in the same CC list for common TCI state ID update, the BATs are the same for a given SCS

Note that we already have an agreement in previous meeting on the sub-bullet as follows:**Agreement**On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the UE can assume that one beam application time (BAT) for a given SCS is configured for all the CCs configured with the common TCI state ID update,* Note: It was agreed that the BAT associated with the carrier(s) (hence BWP(s)/CC(s)) on which the beam indication applies is determined based on the carrier with the smallest SCS among the carrier(s) (hence BWP(s)/CC(s)) applying the beam indication
* TBD (maintenance): whether a second configured BAT is also supported, e.g. for MPUE or inter-cell BM
* The detailed signaling of the BAT is up to RAN2
* FFS: For CC(s) not configured with a common TCI state ID update

Issue 3.5: Thanks for NEC’s explanation. However, we still think this is an overoptimization since this issue can be resolved by NW implementation. To avoid the possible ambiguity due to PDSCH decoding failure, NW can schedule the corresponding PDSCH with lower MCS. Moreover, one HARQ-ACK feedback can carry ACK/NACK for multiple scheduling. If these scheduling DCIs carry the same TCI update, NW can confirm UE successfully receives the TCI update, whether these PDSCHs decoded correctly or not, it doesn't matter. |
| Qualcomm | For 3.B, suggest to add “per SCS”. Otherwise, it may imply common BAT for all SCSs**Proposal 3.B**: On Rel-17 MAC-CE-based and DCI-based beam indication, regarding application time of cross-carrier (carrier aggregation) beam indication, the BAT **per SCS** is configured per-CCFor CCs in the same CC list, the BAT **per SCS** is the same |
| Apple | 3.2/3.5/3.9: OK3.10/3.11: We do not think these are needed.  |
| NTT DOCOMO | Regarding to LGE’s comment on Thursday online (i.e. extend MAC CE/DCI based common TCI state ID update to inter-band CA), we support it. It is because we will need to require UE vendors to implement the number of CC list as the same number of bands UE supports CA. However, if common TCI state ID update supports inter-band CA, most probably up to 2 CC list would be enough for UE to implement (e.g. one for FR1 and one for FR2). Note that Rel.16 simultaneous beam update across CCs is supported for both intra-band/inter-band CA from signalling perspective. We also note that we have some FR1 bands (e.g. 2GHz, 3.7GHz, 4.5GHz, etc.), and the current feature of common TCI state ID update is only useful for intra band CA. |
| Samsung | **Issue 3.5:** The need for this proposal is unclear.A NACK can also be considered as an acknowledgment when there is no confusion between NACK and DTX. Or when the UE sends the same TCI state in all DCIs that are mapped to the same codebook. **Issue 3.10:** No supportFor the case when there one priority index, the HARQ-ACK associated with the DCI carrying beam indication can be multiplexed with other UCI information.**Issue 3.11:** Support |

### Issue 4 (MP-UE)

Table 7 Summary: issue 4

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 4.2 | **Proposal 4.B**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection,* From the perspective of UE capability, maximum number of supported UL Tx layers = min{maximum number of SRS ports for a reported set, maximum number of UL Tx layers reported by UE}

**FL Note:** Discussed offline [1]. Spec impact is unclear. This issue will be suspended from discussion in the next round. | **Support/fine**: MTK, Apple, NTT Docomo, NEC, LG (in principle), OPPO, Xiaomi, LG, CMCC, CATT, ZTE, Spreadtrum, Lenovo/MotM, Huawei/HiSi**Not support:** Ericsson (no need to discuss), Samsung, Intel, vivo (spec impact unclear), Qualcomm (no spec impact), IDC, Nokia/NSB |
| 4.6 | **Proposal 4.F**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, regarding acknowledgement mechanism of the reported correspondence from NW to UE, down-select the following alternatives:* Alt-1: Being based on TCI state activation/update mechanism where the activated TCI state includes reported RS (SSBRI or CSI-RS) [and is additionally associated with the index of UE capability value set];
* Alt-2: A dedicated SS can be configured to send the ACK, which is like PCell-BFR.
* Alt-3: A scheme based on the BFR response in SCell BFR
* Alt-4: acknowledgement mechanism is not supported.

**FL Note:** Discussed offline [1]. If there is no consensus, Alt-4 becomes the default outcome. Need to **conclude** this meeting.  | **Alt1**: MTK, Nokia/NSB, Samsung, ZTE, IDC, LG, Lenovo/MotM, NEC, CMCC (2nd)**Alt2**: OPPO, CMCC, Intel, Apple **Alt3**: OPPO, CMCC, Intel, Apple **Alt4**: Ericsson, CATT, Spreadtrum, Huawei/HiSi, vivo, NEC |
| 4.7 | **Proposal 4.G**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, regarding how to update the number of SRS ports according to UE reporting, in RAN1#108-e, down-select the following alternatives:* Alt1: via UL BWP switching where each UL BWP has different number of SRS ports
* Alt2: via SRS resource set selection by DCI [where each set has different number of ports]
	+ Note1: ‘SRS resource set indicator’ is already specified in DCI format 0\_1/0\_2 and it provides functionality to select one SRS resource set by the DCI between two SRS resource sets configured by RRC
	+ Note2: TPMI/TRI mapping for varying number of SRS ports is already specified for fullpowerMode2.
* FFS: Any other RRC parameters, e.g., the maximum number of UL layers, codebook subset, uplink full power mode, configuration of SRS for antenna switching and so on, may need to be updated simultaneously with the number of configured SRS ports.

**FL Note:** Discussed offline [1]. Removed Alt3 since no company is supporting. Some companies (e.g. OPPO, Intel, Nokia) argued that if 4.F is agreed, 4.G is not needed. And perhaps vice versa)  | **Alt1**: Nokia/NSB, vivo**Alt2**: Qualcomm, NTT Docomo, NEC, LG, Samsung, OPPO (only when no ACK mechanism), CMCC, IDC, ZTE, Lenovo/MotM, Spreadtrum, Huawei/HiSi**Not support:** Apple, Ericsson, MTK, CATT, Intel  |
| 4.8 | **Proposal 4.H:** On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, for the agreed reporting of UE capability value set, introduce 'cri-RSRP-SetIndex', 'ssb-Index-RSRP-SetIndex', 'cri-SINR-SetIndex','ssb-Index-SINR-SetIndex' for *reportQuantity* in a CSI reporting setting.**FL Note:** Proposed by MediaTek during EMAIL ENDORSEMENT 1 | **Support/fine:** MTK, ZTE, Samsung, NEC, ZTE, CMCC, Huawei/HiSi**Not support:** Ericsson (ok with proposal but remove ‘Set’) |
|  |  |  |

Table 8 Additional inputs: issue 4

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 7**
2. **Share more inputs here if needed**
 |
| MediaTek | Maybe we can keep “Set” in brackets to address Ericsson’s concern. |
| Qualcomm | For Proposal 4.F, support Alt4 |
| Apple | 4.2: We are fine to make it a conclusion if companies have concern on spec impact. But we think this is a necessary clarification.4.6: We would like to ask one question for companies supporting Alt4. If UE reports a different set index for the beam being used in current indicated TCI, and gNB missed the report and continue to use the incorrect number of SRS ports for communication, what would be the UE behavior?4.7: In our view, to change number of SRS ports only is not sufficient. If we have to choose one alterantive, we would like to choose Alt1.4.8: Support |
| Samsung | Proposal 4.B: no need to discuss since the statement is obvious/trivialProposal 4.H: prefer E///’s suggestion, i.e. to replace SetIndex with CapabilityIndex since set is currently within bracket |

### Issue 5 (MPE)

Table 9 Summary: issue 5

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 5.1 | On Rel-17 enhancements to facilitate MPE mitigation, the SSB/CSI-RS resource set associated with P-MPR reporting should be also associated with L1-RSRP/SINR reporting | **Support/fine**: MTK, Samsung**Not support**: vivo, ZTE, Qualcomm, LG (unclear), Huawei/HiSi (unclear), NTT Docomo, CATT, IDC, Ericsson |
| 5.2 | The Rel-17 P-MPR report is triggered when the P-MPR for indicated UL/joint TCI met legacy condition defined in 38.321, i.e. P-MPR for the indicated TCI is above mpe-Threshold or P-MPR change for this TCI is above phr-Tx-PowerFactorChange | **Support/fine**: Apple, NTT Docomo, ZTE, OPPO (discuss)**Not support**: vivo (change beam to panel), ZTE (already supported), Samsung, Qualcomm, LG (change beam to panel), Huawei/HiSi (RAN2/4), CATT, Ericsson (follow legacy) |
| 5.3 | For PHR report to facilitate MPE mitigation, reported PCMAX, PH and P-MPR parameters can be associated with the cell which the reported SSBRI/CRI is associated with | **Support/fine**: NEC, ZTE**Not support**: vivo, Samsung, Qualcomm, Huawei/HiSi, NTT Docomo, CATT, IDC, OPPO, Ericsson |
| 5.4 | Limit the maximum number of P-MPR value larger than mpe-Threshold and without any available SSBRI/CRI to 1. | **Support/fine**: Xiaomi **Not support**: vivo, ZTE, Samsung, Qualcomm, Huawei/HiSi, NTT Docomo, CATT, IDC, OPPO, ERicsson |
| 5.5 | For the enhanced reporting for MPE mitigation, support N value sets where each set has (Pcmax, PHR, P-MPR, SSBRI/CRI) | **Support/fine**: LG, ZTE**Not support**: Ericsson (not essential) |

Table 10 Additional inputs: issue 5

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 9**
2. **Share more inputs here if needed**
 |
| Qualcomm | For 5.5, support, since P-MPR itself is not sufficient. Other metrics need a separate report |
| Apple | 5.1: We understand the motivation, but it seems this can be RAN4’s work. We would be fine if companies want to send an LS to RAN4.5.2: If companies think this should be left to RAN2/RAN4, we suggest we send an LS to let them know.5.3: Support.5.4: It seems this is not quite necessary.5.5: Support |
| Samsung | 5.5: do not support since this is an optimization hence not essential |
|  |  |

# References