**3GPP TSG RAN WG1 #104-e R1-2101856**

**e-Meeting, January 25th – February 5th, 2021**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

**Title:** Moderator summary#2 for multi-beam enhancement: Round 1

**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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| * Enhancement on multi-beam operation, mainly targeting FR2 while also applicable to FR1:   + Identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management to support higher intra- and L1/L2-centric inter-cell mobility 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)   + 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 |

## Summary and proposals

The summary and proposals are based on the content of the first FL summary R1-2101185.

### Issue 1 (Rel.17 unified TCI framework)

Table 1 Summary: issue 1

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| **#** | **Issue** | **Companies’ views** | **Moderator notes** |
| 1.4 | Additional applicability of the common DL QCL information  Note: UE-dedicated reception on PDSCH and all/subset of CORESETs have been agreed | CSI-RS resource for CSI:   * **Yes**: OPPO, Spreadtrum, Ericsson, vivo, MTK, AT&T, Convida, Samsung, Qualcomm, Lenovo/MoM, Xiaomi, Sony, CATT, NTT Docomo, ZTE (AP-CSI-RS for CSI only), Nokia/NSB, APT * **No**: Apple, Huawei/HiSi, Futurewei (need further discussion)   Some CSI-RS resource(s) for BM:   * **Yes**: OPPO (some), Ericsson (all), AT&T(some), Samsung (some), Qualcomm, Xiaomi(some), Sony, CATT, Convida, NTT Docomo ZTE (AP-CS-RS for BM only) , Nokia/NSB, APT (for CSI-RS-BM with repetition “on”) * **No**: Huawei/HiSi, vivo, Apple, Futurewei (need further discussion, depending on whether the resource is repeated or not)   CSI-RS for tracking:   * **Yes**: Spreadtrum, AT&T, Qualcomm, Sony, Ericsson (aperiodic), Nokia/NSB, APT * **No**: Huawei/HiSi, Apple, MTK, vivo, ZTE, Ericsson (periodic) OPPO, Futurewei |  |
| 1.5 | Additional applicability of the common UL TX spatial filter reference to SRS | Some SRS (resource set(s)) for BM:   * **Yes**: OPPO, Samsung, Sony, CATT, ZTE (also need support for SRS beam sweeping) * **No**: Huawei/HiSi, APT, Qualcomm, MTK, vivo, Spreadtrum, Convida, Futurewei (need further discussion) | Note: SRS for CB/NCB/antenna switching is already agreed as optional |
| 1.6 | PL-RS in relation to UL TCI state and channels | Alternatives:   * **PL-RS included in UL TCI state:** IDC, Ericsson (optional for DL RS), Apple (only valid when SRS is configured for beam indication), vivo (in case of DL RS in TCI state), MTK (for no PL-RS configured, and DL CSI-RS or SSB), Intel, AT&T, OPPO (separate RS), Fraunhofer IIS/HHI (separate RS), Qualcomm, Lenovo/MoM, Xiaomi, NTT Docomo, OPPO, Nokia/NSB (QCL-TypeD RS if periodic and no PL-RS configured /associated), LG * **PL-RS associated with UL TCI state:** Futurewei, Spreadtrum, Nokia/NSB, Huawei/HiSi, MTK, Sony, Qualcomm (separate field in the same DCI), CATT, NTT Docomo, ZTE, CMCC * **PL-RS not associated with UL TCI state:** Ericsson (in case of UL RS in TCI state) * **Use Rel-16 PL-RS framework:** vivo (for UL RS in TCI state)   MAC CE configures association between activated TCI states and PL-RS/PC: CATT, MTK(PL-RS only), Sony(only PL-RS) |  |
| 1.7 | UL parameters (PC, other than PL-RS) in relation to UL TCI state and channels | Alternatives:   * **Other UL parameters included in UL TCI state:** ID, Apple, LGE, Intel * **Other UL parameters associated with UL TCI state:** Nokia/NSB, ZTE, Samsung, CATT, Lenovo/MoM * **Other UL parameters associated with channel and UL TCI state:** Nokia/NSB, ZTE, Sony, Samsung, Qualcomm, Spreadtrum, ZTE, OPPO (not for SRS), Futurewei, NTT Docomo * **Other UL parameters not associated with UL TCI state:** Ericsson, Huawei/HiSi, vivo, MTK, Fraunhofer IIS/HHI OPPO (this option is for SRS only) * **Use Rel-16 framework:** CMCC, MTK   MAC CE configures association between activated TCI states and PL-RS/PC: CATT |  |
| 1.11 | TCI State pool for CA  Alt1: Shared among CCs  Alt2: Individually configured per CC | **Alt1 (14)**: Spreadtrum, Xiaomi, ZTE, vivo, MTK, Intel, Sony, NTT Docomo, Samsung, Qualcomm, Lenovo/MoM, Ericsson (UL TCI), IDC  **Alt2 (12)**: OPPO, Nokia/NSB, CMCC, Huawei/HiSi, CATT, APT, TCL, Ericsson (DL TCI), Futurewei, LG  **QCL Type-A implicitly determined based on CC:** Intel, Samsung, MTK, ZTE |  |
| 1.12 | For separate TCI, UL TCI state pool  Alt1: Shared pool with joint DL TCI state  Alt2: Separate pool | **Alt1 (11)**: Spreadtrum, Xiaomi, ZTE, CATT, vivo, MTK, Intel, Convida, Qualcomm, Samsung, NTT Docomo  **Alt2 (15)**: Futurewei, OPPO, Lenovo/MoM, Nokia/NSB, CMCC, Ericsson, Huawei/HiSi, AT&T, Sony, Lenovo/MoM, APT |  |

**Proposal 1.1**: On Rel.17 unified TCI framework:

* For joint and separate DL/UL TCI, DL large scale QCL properties are inferred from one (qcl-Type1) or two RSs (qcl-Type1 and qcl-Type2) analogous to Rel.15/16
* For joint DL/UL TCI, UL spatial filter is derived from the RS of DL QCL Type D

**Proposal 1.2**: On Rel.17 unified TCI framework, down select or modify by RAN1#104bis-e from the following alternatives:

* Alt1. A UE can be dynamically indicated with either joint DL/UL TCI or separate DL/UL TCI
  + Details are FFS
  + FFS: UE capability for not supporting either joint DL/UL TCI or separate DL/UL TCI
* Alt2. A UE can be configured with either joint DL/UL TCI, separate DL/UL TCI or both via RRC signaling
* Alt3. A UE can be configured with either joint DL/UL TCI or separate DL/UL TCI via MAC CE signaling
  + Details on how this is signaled in relation to TCI activation are FFS

**Proposal 1.3**: On Rel.17 unified TCI framework, decide by RAN1#104bis-e:

* Whether DL or, if applicable, joint TCI also applies to the following signals – and if not, how the UE is provided with the information about the QCL assumptions needed for the reception of the signals:
  + CSI-RS resources for CSI
  + Some CSI-RS resources for BM, if so, which ones (e.g. aperiodic, repetition ‘ON’)
  + CSI-RS for tracking
* Whether UL or, if applicable, joint TCI also applies to the following signals – and if not, how the UE is provided with the information about the QCL assumptions needed for the reception of the signals:
  + Some SRS resources or resource sets for BM

**Proposal 1.4**: On Rel.17 unified TCI framework:

* When a periodic DL RS of QCL Type D is in the UL or, if applicable, joint TCI state, PL-RS is determined according to the periodic DL RS
* When a periodic DL RS of QCL Type D is not configured in the UL or, if applicable, joint TCI state, select one of the following alternatives by RAN1#104bis-e:
  + Alt1A. PL-RS is always included in UL TCI state
  + Alt1B. PL-RS can be included in UL TCI state
  + Alt2. PL-RS can be associated with (but not included in) UL TCI state
  + Alt3. PL-RS can be a DL periodic RS that is a source RS for the RS in the TCI state.

**Proposal 1.5**: On the setting of UL PC parameters except for PL-RS (P0, alpha, closed loop index) for Rel.17 unified TCI framework:

* The setting of (P0, alpha, closed loop index) is at least associated with UL channel or UL RS
* Select one of the following alternatives by RAN1#104bis-e for PUCCH, PUSCH, and SRS separately:
  + Alt1A. The setting of (P0, alpha, closed loop index) is also associated with UL or (if applicable) joint TCI state
  + Alt1B. The setting of (P0, alpha, closed loop index) is included with UL or (if applicable) joint TCI state
  + Alt2. The setting of (P0, alpha, closed loop index) is not associated with UL or (if applicable) joint TCI state

Table 2 Inputs: issue 1

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| --- | --- |
| **Company** | **Input** |
| Moderator | 1.1: Including Xi’s edit. Re Intel’s and LG’s comment on separate DL/UL, UL TX spatial filter reference has been defined in previous agreements, especially in RAN1#103-e:   * *For the separate UL TCI:*   + *The source reference signal(s) in N TCIs provide a reference for determining common UL TX spatial filter(s) at least for dynamic-grant/configured-grant based PUSCH, all or subset of dedicated PUCCH resources in a CC*   + *Optionally, this UL TX spatial filter can also apply to all SRS resources in resource set(s) configured for antenna switching/codebook-based/non-codebook-based UL transmissions*   The pool design for separate DL/UL TCI should not cause a new definition of UL TCI.  Re applicability of QCL Type-D to FR1/FR2 vs FR2 only, this proposal doesn’t address this. Note that this was already agreed in RAN1#102-e:  *On Rel-17 unified TCI framework, to accommodate the case of separate beam indication for UL and DL:*   * *Utilize two separate TCI states, one for DL and one for UL.*    + *FFS: Contents of separate UL TCI state*   + *Note:* ***For FR1, UE does not expect UL TCI to provide a reference for determining common UL TX spatial filter(s), if UL TCI is supported*** *for FR1*   1.2: Not yet discussed in GTW, but stable  1.3: Just as the source RS issues, we need to conclude this by RAN1#104bis-e  1.4/1.5: Based on the summary in issue 1.6/1.7, this is a reasonable starting point. Please note we need to narrow down alternatives in this meeting for better decision making in the next meeting. |
| Qualcomm | For Proposal 1.1   * The previous agreement seems only mentioned for UL TCI. This proposal is for joint TCI, i.e. whether its QCL-TypeD can determine UL spatial filter in FR1. But we are fine to discuss this later.   For Proposal 1.3   * For the 2nd bullet, our understanding is that DL TCI cannot be applied to UL signal. Not sure if we really understand the proposal.   For Proposal 1.4   * For the 2nd bullet, same issue should also exist for joint TCI state. Suggest to replace “UL TCI state” with “UL and joint TCI state”   For Proposal 1.5   * For both bullets, “UL PC parameters” might be replaced with “UL PC parameters except for PL RS”, since PL RS is discussed in Proposal 1.4 * For the 2nd bullet, same issue should also exist for joint TCI state. Suggest to replace “UL TCI state” with “UL and joint TCI state”   {Mod: added ‘or (if applicable) joint’ because in some cases some DL or UL RS may not be applicable for joint TCI} |
| Apple | Support proposal 1.1  Support proposal 1.2. We think either Alt1 or Alt3 should be fine. Alt2 may have a problem if network chooses a joint TCI but MPE happens. Network may need to decide whether to scarify DL performance or UL performance.  Support proposal 1.3, our understanding is that we may need a 3rd QCL indication for QCL-TypeB or QCL-TypeC if CSI-RS is included.  For proposal 1.4, I am not sure whether I misunderstood anything, but I think if DL RS is included in TCI, this RS can be used for pathloss calculation. Should it be modified as follows?  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When a DL RS is in the UL TCI state, reuse Rel-16 PL-RS framework * When an UL RS is in the UL TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state   Support proposal 1.5 |
| Futurewei | Proposal 1.1: Support the proposal.  Proposal 1.2: Ok. We support Alt. 1.  Proposal 1.3: Support the proposal.  Proposal 1.4: Ok. On the second bullet, we support Alt. 2.  Proposal 1.5: Ok. On the second bullet, we support Alt. 1. |
| OPPO | Proposal 1.1: support  Proposal 1.2: we do not support Alt.2  Proposal 1.3: support.  Proposal 1.4: We suggest to make the following change.  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When an DL RS is in the UL TCI state, the DL RS is used as the PL RS * When a UL RS is in the UL TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state   The issue for “reuse rel-16 PL RS framework” is it does not work for unified TCI framework. The PL RS shall be associated with UL Tx beam In Rel16, the pathloss RS for PUSCH is associated with SRI codepoints. But in unified TCI framework, the SRI codepoint will not be associated with UL Tx beam. Therefore, we have to change the design to associated PL RS with UL TCI state.  Proposal 1.5: We believe whether UL PC parameter shall be associated with UL TCI state shall be decided for each of PUSCH, PUCCH and SRS separately. For that in our view, we shall reuse the rel15/rel16 design: for PUSCH and PUCCH, the UL PC parameters shall be associated with each UL TCI state too, but for SRS, the UL PC parameters is only associated with each SRS resource set.  Thus suggest to change proposal 1.5 as follows. Furthermore, it is suggested to list the PC parameters clearly here.  **Proposal 1.5**: On Rel.17 unified TCI framework:   * The setting of UL PC parameters (P0, alpha, closed loop index) is at least associated with UL channel * Select one of the following alternatives by RAN1#104bis-e for PUSCH, PUCCH and SRS separately:   + Alt1. The setting of UL PC parameters (P0, alpha, closed loop index) is also associated with UL TCI state   + Alt2. The setting of UL PC parameters (P0, alpha, closed loop index) is not associated with UL TCI state |
| Samsung | Support proposal 1.1. Agree that UL spatial filter for separate UL TCI state is already covered by the RAN1#103-e agreement.  Proposal 1.2 is fine, we can most probably combine Alt1 and Alt3 as DCI and MAC CE can be viewed as different design options for dynamic signaling.  Support proposal 1.3.  Don’t support 1.4.   * In general, it is desirable to have the same framework whether DL-RS or UL-RS is included in the TCI state. * There are three cases to consider:   + TCI state has a periodic DL source RS 🡺 PL-RS is a periodic DL source RS   + TCI state has an aperiodic DL source RS 🡺 PL-RS is a periodic DL RS that is QCLed (TypeD) with the aperiodic DL source RS   + TCI state has an UL source RS 🡺 PL-RS is a periodic DL RS that is QCLed (TypeD) with the UL source RS * Proposal 1.4 should apply for UL TCI state, as well as joint DL/UL TCI state (else there should be an FFS for joint DL/UL TCI state).   Updated proposal:  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When an UL RS is in the UL TCI state or Joint DL/UL TCI State, select one of the following:   + Alt1: reuse Rel-16 PL-RS framework   + Alt2: a DL periodic RS that is a source reference signal for the UL RS * When a DL RS is in the UL TCI state or Joint DL/UL TCI State, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state   + Alt 3: A DL periodic source RS of QCL TypeD included in the TCI state, or a DL periodic RS TypeD-QCLed with a source RS of QCL TypeD   For proposal 1.5, we suggest the following update:  **Proposal 1.5**: On Rel.17 unified TCI framework:   * The setting of UL PC parameters is at least associated with UL channel * Select one of the following alternatives by RAN1#104bis-e:   + Alt1. The setting of UL PC parameters is also associated with UL TCI state or joint DL/UL TCI state.   + Alt2. The setting of UL PC parameters is not associated with UL TCI state or joint DL/UL TCI state.   + Alt3. The setting of the UL PC parameters is also included in UL TCI state or joint DL/UL TCI state.   {Mod: Sorry for the confusion, the first version wa faulty and pointed out by Apple/OPPO/ZTE. Please check the revised version and re-comment} |
| MediaTek | Proposal 1.1: Support this proposal. Applicability of joint DL/UL TCI for UL in FR1 could be discussed later even we think it should be aligned with separate UL TCI in FR1.  Proposal 1.2: Support.  Proposal 1.3: Support but the TCI applied to SRS should be UL not DL.  Proposal 1.4: Sorry we are a bit confused on this proposal.   * When a DL RS is included in an UL TCI state (as a source RS), does Alt1 mean the DL RS is used as a PL-RS or a separate RS will be configured in the UL TCI as PL-RS? * When an UL RS is included in an UL TCI state (as a source RS), we don’t see the reason to reuse Rel-16 framework, at least this may not work well in many cases.   We suggest the following update:  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When the source RS for determining spatial Tx filter in the UL TCI state is a periodic CSI-RS or an SSB, select one of the following alternatives by RAN1#104bis-e:   + Alt1. The source RS is used as PL-RS   + Alt2. The source RS is used as PL-RS, if no PL-RS is included in/associated with the UL TCI state * When the source RS for determining spatial Tx filter in the UL TCI state is neither a periodic CSI-RS nor an SSB, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state   {Mod: Sorry for the confusion, the first version wa faulty and pointed out by Apple/OPPO/ZTE. Please check the revised version and re-comment}  Proposal 1.5: Support |
| ZTE | Proposal 1.1: Support  Proposal 1.2: Support with the following minor modification for Alt2. Alt1+Alt2 is our preference. Specifically, if both of joint DL/UL TCI and separate DL/UL TCI is enabled by RRC (Alt2), the UE can be dynamically switched between joint DL/UL TCI and separate DL/UL TCI (Alt1).   * Alt2. A UE can be configured with either or both of joint DL/UL TCI and separate DL/UL TCI via RRC signaling   Proposal 1.3: Support  Proposal 1.4: To be honest, we do not exactly know what is the Rel-16 PL-RS framework. Determining a PL RS according to periodic DL RS? If so, some clarification is needed. ‘UL/joint TCI state’ seems to a better wording. Therefore, we have the following modification(on top of QC and OPPO’s version):  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When a periodic DL RS is in the UL/joint TCI state, PL-RS is determined according to the periodic DL RS. * When a periodic DL RS is not configured in the UL/joint TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL/joint TCI state   + Alt2. PL-RS is associated with (but not included in) UL/joint TCI state   Besides, Alt2 above is our preference.    Proposal 1.5: Support with the following modification  **Proposal 1.5**: On Rel.17 unified TCI framework:   * The setting of UL PC parameters except for PL RS is at least associated with UL channel/RS * Select one of the following alternatives by RAN1#104bis-e:   + Alt1. The setting of UL PC parameters except for PL RS is also associated with UL/joint TCI state   + Alt2. The setting of UL PC parameters except for PL RS is not associated with UL/joint TCI state |
| Spreadtrum | Proposal 1.1: support the proposal  Proposal 1.2: support the proposal  Proposal 1.3: support the proposal in principle. same as Qualcomm pointed out, there might be an typo in the second bullet, ‘DL TCI’ should be replaced by ‘UL TCI’  Proposal 1.4: we prefer to define a unified PL RS configuration for either UL RS or DL RS is in the UL TCI state. Further, we can define default PL RS when it’s not configured, if needed. Therefore, we suggest to modify Proposal 1.4 as follows  **Proposal 1.4**: On Rel.17 unified TCI framework:   * Select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state * FFS: Default PL-RS when it’s not configured   {Mod: Sorry for the confusion, the first version wa faulty and pointed out by Apple/OPPO/ZTE. Please check the revised version and re-comment}  Proposal 1.5: support the proposal |
| Intel | **Proposal 1.1:** Since both sub-bullets correspond to the case of joint DL/UL TCI, it should be moved to main bullet i.e., “On Rel.17 unified TCI framework, for joint DL/UL TCI” and delete from 2nd sub-bullet.  {Mod: The first bullet also holds for separate DL/UL TCI (inheriting from Rel.15/16), so “for joint DL/UL TCI” should be kept in 2nd sub-bullet}  **Proposal 1.2:** Support Alt 1 in principle but the indication can also be a combination of MAC-CE and DCI. Therefore, we prefer to remove the e.g., part in the sub-bullet and keep only “Details are FFS”.  Note that this is different from Alt 3, which uses MAC-CE to configure either joint or separate DL/UL TCI and codepoints configured are homogeneous.  **Proposal 1.3:** We are listing options for down selection; maybe the two sub-bullets can be combined since the text is identical?  **Proposal 1.4:** Ok with ZTE’s version as a starting point and we prefer Alt. 1 for the 2nd bullet  **Proposal 1.5:** We agree with OPPO that ULPC parameters for different channels can be treated differently. Our understanding is that, similar to *PUCCH-SpatialRelationInfo*, ULPC for PUCCH can be optionally included in the UL and joint DL/UL TCI states. Therefore, we suggest the following wording on top of ZTE’s version.  On Rel.17 unified TCI framework:   * The setting of UL PC parameters except for PL RS is at least associated with UL channel/RS * Select one of the following alternatives by RAN1#104bis-e:   + Alt1. The setting of UL PC parameters except for PL RS is also associated with or included in the UL/joint TCI state     - FFS: Applicable channels for ULPC parameters   + Alt2. The setting of UL PC parameters except for PL RS is not associated with UL/joint TCI state |
| Xiaomi | For proposal 1.1, we want to clarify the meaning of “one RS of DL QCL Type D” in the 2rd bullet. It means there are more than one RS of DL QCL Type D in each joint DL/UL TCI for single TRP?  {Mod: No, ‘one’ refers to the second RS of QCL Type D. Wording is changed to clarify}  For proposal 1.2, we slightly prefer Alt 1 and Alt 3.  For proposal 1.3, the 2rd bullet, we have same understanding with QC. DL TCI means separate DL/UL TCI, thus the DL TCI can’t be used for UL signals.  For proposal 1.4, is that a DL RS in the UL TCI state can be used as PL-RS?  For proposal 1.5, support. |
| CMCC | Proposal 1.1: support  Proposal 1.2: support  Proposal 1.3: Not sure if our understanding is correct. The issue is for both separate and joint TCI. We suggest the following update:  **Proposal 1.3**: On Rel.17 unified TCI framework, decide by RAN1#104bis-e:   * Whether separate DL/joint TCI also applies to the following:   + CSI-RS resources for CSI   + Some CSI-RS resources for BM, if so, which ones (e.g. aperiodic, repetition ‘ON’)   + CSI-RS for tracking * Whether separate UL ~~DL~~/joint TCI also applies to the following:   + Some SRS resources or resource sets for BM   {Mod: added ‘if applicable’ since an RS can be used for joint TCI only if it is valid for both DL and UL TCI}  Proposal 1.4: suggest the following modification based on MediaTek’s update:  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When the source RS for determining spatial Tx filter in the UL/joint TCI state is a periodic CSI-RS or an SSB, select one of the following alternatives by RAN1#104bis-e:   + Alt1. The source RS is used as PL-RS   + Alt2. The source RS is used as PL-RS, if no PL-RS is included in/associated with the UL TCI state * When the source RS for determining spatial Tx filter in the UL/joint TCI state is neither a periodic CSI-RS nor an SSB, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is included in UL TCI state   + Alt2. PL-RS is associated with (but not included in) UL TCI state   {Mod: Sorry for the earlier confusion, please check the latest version and re-comment if needed}  Proposal 1.5: We suggest the PC parameters((P0, alpha, closed loop index)) for PUCCH/PUSCH/SRS should reuse the Rel-15/16 design. |
| Docomo | Proposal 1.1: Support.  Proposal 1.2: Support. We support Alt.1.  Proposal 1.3: Support.  Proposal 1.4: Support. We support Alt.1.  Proposal 1.5: Support. We support Alt.1. |
| LG | Support proposals from 1.1 to 1.5 |
| Nokia/NSB | Proposal 1.1: Support  Proposal 1.2: We didn’t make any agreement where there could be a UE capability not supporting any of DL TCI or UL TCI. For the progress, we are O.K. to put this part as FFS, but we don’t want to agree on at this moment. And some further modification is also preferred to clarify that ‘switching like’ operation between joint/separated TCI would not be always essential. Please see our suggestion below:   * Alt1. A UE can be dynamically indicated either by ~~switched between~~ joint DL/UL TCI or ~~and~~ separate DL/UL TCI without RRC/MACE CE based switching ~~if UE is capable of both joint DL/UL TCI and separate DL/UL TCI.~~   + FFS: UE capability not supporting any of joint DL/UL TCI or separated DL/UL TCI   + Details are FFS, e.g. whether dedicated L1 signaling is needed for the dynamic switching   Proposal 1.3: Support  Proposal 1.4: Support in principle, but we may need to consider the case when PL-RS is not configured, as supported case in Rel-15/16. So let me propose like this:   * When a DL RS is in the UL TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is always included in UL TCI state   + Alt2. PL-RS can be ~~is~~ associated with (but not included in) UL TCI state |
| Moderator | Content of proposal 1.1, 1.2, and 1.3 are stable (only editorial)  Proposals 1.4, 1.5 need a bit more discussion. |
| Fraunhofer IIS/HHI | Proposal 1.1, 1.2, 1.3 and 1.5: Support the proposals  Proposal 1.4: We would like to add an alternative from Samsung’s revision for PL RS if TCI does not contain a DL RS - a DL periodic RS that is a source reference signal for the UL RS.  {Mod: Please check the latest version (the previous version from SS was based on my previous faulty wording.} |
| CATT | Proposal 1.1: Support  Proposal 1.2: Support  Proposal 1.3: Support  Proposal 1.4:We are fine with Alt 2 of the second bullet.  Proposal 1.5: On the second bullet, we are fine with Alt 1. |
| Convida Wireless | Proposal 1.1: Support.  Proposal 1.2: Support, with a preference for Alt.1.  Proposal 1.3: Support.  Proposal 1.4: Support.  Proposal 1.5: Support. |
| APT | Proposal 1.1: support  Proposal 1.2: support. We echo Apple’s concern that Alt.2 does not react to MPE issue well.  Proposal 1.3: support  Proposal 1.4: we do not understand the original wording. We are okay to start from ZTE’s version, but with the concern that the number of PL RS may go large if not limited.  Proposal 1.5: support. |
| AT&T | Support FL proposals  Proposal 1.2: support Alt. 1.  Proposal 1.4: support Alt. 1 |
| Ericsson | Proposal 1.1: The RS with QCL-TypeD is not necessarily qcl-type2 – this is a misunderstanding. Suggest to remove.  {Mod: Yes, done}  Proposal 1.2: Support  Proposal 1.3: We think this needs to be amended – if the unified TCI is not applicable to these channels, how is the UE provided with the information about the QCL assumptions that are needed for the reception of the signals in question? Companies that say no to these suggestions must then indicate how the QCL assumptions would be provided.  {Mod: Good point, added this issue on proposal}  Proposal 1.4: Need to add which periodic RS is intended: is it the TypeD RS?  {Mod: Added}  Proposal 1.5: Support |
| Lenovo/MoM | Proposal 1.1: Support  Proposal 1.2: Support Alt2 or Alt 3. When switching between joint DL/UL TCI and separate DL and UL TCI, all the TCI codepoints are likely to change as well (switching from joint TCI pools to separate DL and UL TCI pools). This is impossible with just L1 signal.  Proposal 1.3: Support.  Proposal 1.4: Support the 1st bullet. For the 2nd bullet, we support Alt 2.  Proposal 1.5: Support the first bullet. For the 2nd bullet, we support Alt A. |
| IDC | Proposal 1.1: Support  Proposal 1.2: We are fine with the proposal and prefer Alt2. Based on the previous discussion on joint DL/UL TCI and separate DL/UL TCI, the motivation to introduce separate DL/UL TCI is to consider gNB/UE implementations which do not share TX/RX antennas. While we sympathize the motivation, we also believe that this condition does not dynamically change. In that sense, RRC signaling should be used for the configuration.  Proposal 1.3: We prefer to keep FFS bullets in the previous version.  Proposal 1.4: We support Alt1 with the following update:  o Alt1. PL-RS can be included in UL TCI state  For example, according to Ericsson’s proposal, DL RS for QCL Type-D can be used as PL-RS if configured. If not, additional PL-RS can be configured.  {Mod: Added Alt1B for this}  Proposal 1.5: We are fine with the proposal and support Alt1B. |
| Intel | **Proposal 1.1:** Based on response from Moderator, we think it’s better to align wording on both bullets i.e., the following wording should be used:   * For joint DL/UL TCI and separate DL TCI, DL large scale QCL properties are inferred from one (qcl-Type1) or two RSs (qcl-Type1 and qcl-Type2) analogous to Rel.15/16   {Mod: Looks good, yes sir!}  Additionally, we agree with Ericsson’s comment that QCL Type D need not necessarily be associated with qcl-Type-2 and this can be removed from the second bullet.  **Proposal 1.2:** We are not OK with current wording on Alt. 1. The issue being discussed in this proposal is the **usage indication** of the configured TCI state in a DCI codepoint i.e., whether the configured TCI state is applicable for joint DL/UL beam indication, separate DL or separate UL beam indication or 2 TCI states in a codepoint one indicating DL beam and the other indicating UL beam for separate DL/UL beam indication. Alt. 2 and 3 assume that either joint or separate TCI states only can be configured to the DCI codepoints based on RRC or MAC-CE configuration respectively. Similarly, the intention with Alt. 1 is that the either joint or separate TCI states may be configured to DCI codepoints (by MAC-CE) and UE is indicated dynamically by DCI, the codepoint index for the TCI state to be applied. However, pending further discussion on shared or separate pool for joint DL/UL and UL-only TCI state, there may be the need for additional indication for UE to understand how to apply the configured TCI states of the indicated DCI codepoint. For example, if joint TCI state pool is assumed, the joint DL/UL TCI state and UL TCI state may share the same pool and usage indication may be necessary for the UE to understand whether the codepoint implies a joint TCI or separate UL TCI when a joint TCI state is configured to the indicated codepoint. Alternately, if separate pool is assumed, the enhanced mTRP MAC-CE with 2 TCI states per codepoint may be used for separate DL/UL beam indication and the UE needs usage indication to differentiate this from 2 DCI TCI states as in mTRP. Such information may be optionally configured as part of MAC-CE itself and the dynamic indication is same as in Rel-15/16 i.e., the codepoint index is signaled in DCI. Based on this example, we think current wording of Alt.1 is precluding the option that MAC-CE based configuration of usag indication along with DCI based indication of codepoint index is used. Therefore, we prefer the following wording:  {Mod: I tend to agree with you}  **Proposal 1.2**: On Rel.17 unified TCI framework, down select or modify by RAN1#104bis-e from the following alternatives:   * Alt1. A UE can be dynamically indicated with either joint DL/UL TCI or separate DL/UL TCI ~~without RRC or MAC CE~~.   + Details are FFS   + FFS: UE capability for not supporting either joint DL/UL TCI or separate DL/UL TCI   **Alternately**, a separate alternative should be listed which captures the aforementioned intention i.e.,  **Proposal 1.2**: On Rel.17 unified TCI framework, down select or modify by RAN1#104bis-e from the following alternatives:   * Alt4. A UE can be indicated with either joint DL/UL TCI or separate DL/UL TCI, where the usage of joint or separate DL/UL TCI for a DCI codepoint can be configured by MAC-CE and the codepoint index can be indicated by DCI   + Details are FFS   + FFS: UE capability for not supporting either joint DL/UL TCI or separate DL/UL TCI   {Mod: reworded}  **Proposal 1.3:** We would like to clarify the intention of the wording “if applicable, joint TCI” in both bullets. What is condition for it not to be applicable to joint TCI?  {Mod: The decision on which types of source RS are supported are not yet finalized. I added this for safeguard. For instance, for joint TCI, before SSB is agreed for DL QCL, we cannot use it even if it can be used for UL spatial relation (UL-only TCI)}.  **Proposal 1.4, 1.5:** Ok with current wording |
| Samsung2 | We support proposals 1.1, 1.2,1.3 and 1.5  For proposal 1.4, we would like to clarify how the association between PL-RS and UL TCI state is done (for Alt2). Does this involve explicit configuration or can the association be implicit?  We would like to include a third alternative:  Alt3. PL-RS can be a DL periodic RS that is a source RS for the RS in the TCI state.  Furthermore for proposal 1.4, an editorial change is to remove “UL” (~~UL~~ TCI state) in the description of Alt1 and Alt2 (this is already there in the main 2nd bullet), or to add “joint” (UL or, if applicable, joint TCI state) |
| Spreadtrum2 | For the updated proposal 1.4, it reads like UE will search for the default PL RS first, which is a periodic DL RS in the UL/joint TCI. And if it’s not found, UE will further check the explicit PL RS configuration. There’s a clarification issue on whether to allow PL RS being associated with/included in UL TCI state (i.e. explicit PL RS configuration) while there’s a periodic DL RS in the same UL TCI state (i.e. default PL RS assumption). In our views, in an UL TCI state, PL RS should not be explicitly configured when there’s a periodic DL RS. If not, it’s more straightforward that UE should follow the explicit PL RS configuration. This configuration restriction should be included into the proposal to void ambiguity.  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When a periodic DL RS is in the UL or, if applicable, joint TCI state, PL-RS is determined according to the periodic DL RS * When a periodic DL RS is not configured in the UL or, if applicable, joint TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is always included in UL TCI state   + Alt2. PL-RS can be associated with (but not included in) UL TCI state   In an UL or joint TCI state, PL RS should not be configured when there’s a periodic DL RS  {Mod: Thanks, this additional restriction can be further discussed in the future and should not affect the current proposal – note that the current proposal is simply an attempt to set up down selection in the next meeting. So including this in the current proposal is too early since it has not been discussed. Please raise this issue in the next meeting after/when the down selection is done.} |
| Moderator | Proposals 1.1, 1.2, 1.3, 1.5 are quite stable (only editorial), ready for primetime (some wordsmithing may be needed for 1.2 Alt1.).  Proposal 1.4 is almost stable. |
| OPPO2 | In proposal 1.2: Do not support to add “or both ” in Alt2. How come we can configure “both” in RRC? If we configure ‘Both’ in RRC, it would means we are going to use DCI or MAC CE to dynamically select one. That will be Alt 1 or Alt 3. Suggest to delete “Both”   * Alt2. A UE can be configured with either joint DL/UL TCI, separate DL/UL TCI or both via RRC signaling   On proposal 1.4: we prefer to limit to the QCL-TypeD RS in joint TCI state to be always a periodic CSI-RS resource so that we can always use the same RS as DL TCI, UL TCI and also PL RS. It can also be used as BFD RS.  So prefer to update proposal 1.4 as follows  **Proposal 1.4**: On Rel.17 unified TCI framework:   * In joint TCI state, the RS of DL QCL TypeD is a periodic DL RS and the PL-RS is determined according to this periodic DL RS. * When a periodic DL RS is in the UL or, if applicable, joint TCI state, PL-RS is determined according to the periodic DL RS * When a periodic DL RS is not configured in the UL or, if applicable, joint TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1. PL-RS is always included in UL TCI state   + Alt2. PL-RS can be associated with (but not included in) UL TCI state |
| vivo | We are fine with proposals 1.1, 1.2, 1.3 and 1.5  For proposal 1.4, we would like to add another alternative by reusing legacy PL-RS configuration framework.  **Proposal 1.4**: On Rel.17 unified TCI framework:   * When an UL periodic DL RS is in the UL or, if applicable, joint TCI state, reuse Rel-16 PL-RS frameworkPL-RS is determined according to the periodic DL RS * When a DL periodic DL RS is not configured in the UL or, if applicable, joint TCI state, select one of the following alternatives by RAN1#104bis-e:   + Alt1A. PL-RS is always included in UL TCI state   + Alt1B. PL-RS can be included in UL TCI state   + Alt2. PL-RS can be associated with (but not included in) UL TCI state   + Alt3. PL-RS can be a DL periodic RS that is a source RS for the RS in the TCI state.   + Alt4. Reuse legacy procedure to indicate PL-RS for UL transmission. |
| Sony | **For proposal 1.1**, support in principle. Just in case that there is only one RS (qcl-Type1, rather than QCL-TypeD) configured in joint TCI state, would it be better to add “if any” for safety as  “For joint DL/UL TCI, UL spatial filter is derived from one RS of DL QCL Type D if any”  **For proposal 1.2**, we share the same view with ZTE that there are mutual dependency between alternatives. For instance, in order to support DCI dynamically indicated joint TCI or separate UL/DL TCI (Alt.1), these joint TCI and separate UL/DL TCI should be configured via RRC signaling in advance (very similar to Alt.2 where either joint TCI or separate TCI is configured via RRC). So, we would like to ask besides down selection, whether merging among alternatives is possible for next meeting.  **For proposal 1.3**, we share same concern with Qualcomm and MediaTek that to the 2nd bullet (DL TCI applies to UL RS, i.e. SRS), should the DL TCI be changed to UL TCI? We are now okay with the revised version.  **For proposal 1.4**, support in principle and it seems by far the refined version from CMCC is the most reasonable which somehow captures main comments and suggestions.  **For proposal 1.5**, support in principle. Just a reminder that UL PC parameters we discuss here don’t include PL RS which is captured in proposal 1.4. Moreover, the UL PC parameters (rather than PL RS) also apply to joint TCI state. |
| Huawei, HiSilicon | Our comments are based on proposals in v32.  Proposal 1.1: Ok  Proposal 1.2: As Alt-2/3 are for RRC/MAC-CE respectively, we suggest adding ‘by DCI’ after ‘dynamically switched’ in Alt-1. It is strange to say ‘UE capability for not supporting something’, and we suggest removing this FFS point.  Proposal 1.3: We don’t understand why there is need to discuss the case of ‘if not’ - in our understanding, Rel-15/16 design automatically applies if nothing is changed. So we suggest removing the descriptions starting from ‘if not’. It is also strange to say ‘QCL assumptions’ for SRS for BM, which does not exist.  Proposal 1.4: We are not sure about the meaning of ‘PL-RS is determined according to the periodic DL RS’ in the first bullet. Is some sort of mapping being proposed here? In the second bullet, why QCL Type D (‘spatial Rx parameters’) is configured in UL TCI state? Need more time to understand the alternatives.  Proposal 1.5: Ok |

### Issue 2 (L1/L2-centric inter-cell mobility)

**Conclusion 2.1**: On the Rel.17 support for L1/L2-centric inter-cell mobility, no further discussion in RAN1 related to applicable scenarios.

**Proposal 2.2**: On Rel.17 multi beam measurement/reporting enhancements:

* A quality of up to K beams associated at least with non-serving cell(s) can be reported in a single CSI reporting instance
  + For each beam, the UE can report at least: (1) a Measured RS Indicator, and (2) a Beam Metric associated with the Measured RS Indicator
  + FFS: Maximum value of K
  + FFS: If K is fixed, configured, reported by UE capability, or dynamically selected
  + FFS: The type of beam metric (e.g. L1-RSRP, L3-RSRP, or hybrid L1/L3-RSRP)
* FFS: Whether or not beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance

Table 3 Inputs: issue 2

|  |  |
| --- | --- |
| **Company** | **Input** |
| Moderator | 2.1: Not yet discussed in GTW, but stable. Also added the more controversial RAN2-specific issues in the second bullet. Note that the inter-DU will require not only RAN2, but also RAN3   * Implication: RAN1 can focus on completing measurement/reporting and QCL issues   2.2: Not yet discussed in GTW, but stable |
| Qualcomm | For Proposal 2.1   * For 2nd bullet, suggest to add “Whether a serving cell can be configured with multiple PCIs” in the list for RAN2 to decide. The benefit is that UE can completely move outside the coverage of one PCI without serving cell change. * Suggest to add a new 3rd bullet on FFS whether same or different TA is assumed across different PCIs at least for single TRP operation. This is an important assumption to clarify as well   {Mod: There as already an agreement in RAN1#102-e:   * + - UL-related enhancements, e.g. related to RA procedure including TA}   For Proposal 2.2   * For the last FFS, is “Activation/deactivation for the CSI-reportConfig” done by MAC-CE? Good to clarify the meaning |
| Apple | Support both proposals.  For proposal 2.2, to reply Qualcomm’s question, I think the answer should be yes.  {Mod: This FFS is removed for now per other companies’ comments. We can discuss separately.} |
| Futurewei | Proposal 2.1: Support the proposal.  Proposal 2.2: Support the proposal. |
| OPPO | Proposal 2.1: support and suggest to add the following FFS point.  **Proposal 2.1**: On Rel.17 enhancements for L1/L2-centric inter-cell mobility:   * Intra-DU only is assumed (i.e. no inter-DU) * The following issues will be discussed in RAN2 (FL to send an LS to RAN2 when the time comes):   + Whether RRC reconfiguration is needed and if needed, what information would be included in the minimum RRC reconfiguration, for example PCI of target cell, RRM configuration, minimum system information, etc.   + Whether a change in serving cell can occur   + Whether C-RNTI can change   Proposal 2.2: we are not ok with the last FFS sub-bullet. “CSI-reportConfig” is used in L1 CSI/BM measurement and report. Adding such a FFS point implies we are going to support L1 measurement. We prefer to resuse L3-RSRP measurement. Suggest to delete it.  **Proposal 2.2**: On Rel.17 multi beam measurement/reporting enhancements:   * A quality of up to K beams associated with non-serving cell(s) can be reported in a single CSI reporting instance   + For each beam, the UE can report at least: (1) a Measured RS Indicator, and (2) a Beam Metric associated with the Measured RS Indicator   + FFS: Maximum value of K   + FFS: If K is fixed, configured, reported by UE capability, or dynamically selected   + FFS: The type of beam metric (e.g. L1-RSRP, L3-RSRP, or hybrid L1/L3-RSRP) * FFS: Whether beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance |
| Samsung | Support proposal 2.1  Support proposal 2.2 |
| MediaTek | Proposal 2.1: Support  Proposal 2.2: Support. However, on the fifth sub-bullet, we don't quite understand why we need this FFS. A CSI report setting can be either activated/deactivated by MAC-CE if it is SP reporting, or dynamically triggered by DCI if it AP reporting. If this feature will be a part of CSI framework then this functionality will be naturally supported. Or, are we going to re-design CSI framework for this feature? |
| ZTE | Proposal 2.1: Support the proposal  Proposal 2.2: Regarding “FFS: Activation/deactivation for the CSI-reportConfig”, we need to firstly clarify whether this is an aperiodic reporting. Therefore, the following FFS part is suggested to be added.  FFS: Above is an aperiodic CSI reporting. |
| Spreadtrum | Proposal 2.1: support the proposal  Proposal 2.2: support the proposal |
| Intel | **Proposal 2.1:** Ok with only the first sub-bullet. For the second sub-bullet we do not think that we need to list what RAN2 has to work on. It should be left up to RAN2. Additionally, the LS should be sent to RAN2 as early as possible rather than “when time comes” since RAN2 would benefit from the advance notice to plan their work accordingly.  **Proposal 2.2:** Ok with OPPO’s version of the first bullet. For the second bullet, once reporting capability is enabled (as in 1st bullet), it should be up to network to decide how to configure. |
| Xiaomi | Support both proposal 2.1 and 2.2. |
| CMCC | Proposal 2.1: Support the proposal in principle, and suggest to include the following：  **Proposal 2.1**: On Rel.17 enhancements for L1/L2-centric inter-cell mobility:   * Intra-DU only is assumed (i.e. no inter-DU) * The following issues will be discussed in RAN2 (FL to send an LS to RAN2 when the time comes):   + Whether RRC reconfiguration is needed   + Whether a change in serving cell can occur   + Whether C-RNTI can change   + Whether RACH is needed for TA update   Proposal 2.2: suggest to delete the last bullet “Activation/deactivation for the CSI-reportConfig”. |
| Docomo | Support both proposal 2.1 and 2.2. |
| LG | Support proposal 2.1 and 2.2. |
| Nokia/NSB | Proposal 2.1: we are not OK to agree with anything not in the RAN1 scope. RAN2 can certainly know what to do while if we need to send an LS, that should contain RAN1 progress/agreements or clarifications needed from RAN2 in order to achieve RAN1 progress.  As response to Oppo’s suggestion, we do not want to send detailed information about the RRC configuration at this moment. Since RAN1 does not have agreement on required RRC configuration even to support non-serving cell beams.  Proposal 2.2: OK |
| Moderator | Proposal 2.1 is removed.  Proposal 2.2 is stable |
| Ericsson | Proposal 2.2: support  Proposal 2.1: could we have a conclusion “No further discussion in RAN1 related to applicable scenarios”  {Mod: yes, we should} |
| Lenovo/MoM | Support Proposal 2.2 except the last FFS. Activation/deactivation for CSI-reportConfig shall follow R16. |
| IDC | Proposal 2.1: Support removing proposal 2.1 and fine with Ericsson’s suggested conclusion.  Proposal 2.2: We suggest the following update as we don’t see the need to have a dedicated CSI reportConfig only for non-serving cell(s):  On Rel.17 multi beam measurement/reporting enhancements:   * A quality of up to K beams associated with serving cell(s) and/or non-serving cell(s) can be reported in a single CSI reporting instance   + For each beam, the UE can report at least: (1) a Measured RS Indicator, and (2) a Beam Metric associated with the Measured RS Indicator   + FFS: Maximum value of K   + FFS: If K is fixed, configured, reported by UE capability, or dynamically selected   + FFS: The type of beam metric (e.g. L1-RSRP, L3-RSRP, or hybrid L1/L3-RSRP) * ~~FFS: Whether beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance~~   {Mod: This was already proposed before in the original wording on x1185. But several companies have expressed that they are not ready to agree on mixing SC and NCS reports. That’s why the last FFS is added. This can be discussed in the next meeting. I added “at least” to emphasize what you and some other companies propose is not precluded.} |
| Intel | We would still prefer to clarify that only intra-DU is in scope since this has not been agreed yet and send an LS to RAN2 to clarify the scope of RAN1 work.  **Proposal 2.2:** We think the FFS point in the 2nd bullet can be up to implementation, however for progress, we accept the following wording:   * FFS: Whether or not beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance   {Mod: It is not an implementation issue since there is no agreement on supporting mixing SC and NSC. But anyway your suggestion is good.} |
| Moderator | Added conclusion 2.1.  Proposal 2.2 is stable and ready for primetime. |
| vivo | We would like to update as following. For each of these metric, we would also like to study whether legacy measurement behavior for each of these metric need to be adapted for the L1 report.  **Proposal 2.2**: On Rel.17 multi beam measurement/reporting enhancements:   * A quality of up to K beams associated with non-serving cell(s) can be reported in a single CSI reporting instance   + For each beam, the UE can report at least: (1) a Measured RS Indicator, and (2) a Beam Metric associated with the Measured RS Indicator   + FFS: Maximum value of K   + FFS: If K is fixed, configured, reported by UE capability, or dynamically selected   + FFS: The type of beam metric (e.g. L1-RSRP, L3-RSRP, or hybrid L1/L3-RSRP) and related measurement behavior.   + FFS: Activation/deactivation for the CSI-reportConfig * FFS: Whether beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance |
| Sony | **For Proposal 2.1**, supportive.  **For Proposal 2.2**, support in principle.  Same concern as MediaTek that the benefits of FFS on activation/deactivation for CSI-ReportConfig may need to be further clarified and justified. Intuitively, the current Rel.16 CSI framework on SP CSI reporting can be activated or deactivated with existing signaling. Since now it’s removed in updated version, we are fine. |
| Huawei, HiSilicon | Conclusion 2.1: It is a bit unfortunate that RAN1 cannot reach consensus on what was agreed to discuss in last meeting. It appears all these aspects, which are important for L1/L2-centric inter-cell mobility in our view, will be left for RAN2/RAN3 to decide. In this regard, we would suggest sending an LS to RAN2/RAN3 to inform the situation (i.e., the FFS points agreed in RAN1#103-e and possible conclusion above, if agreed).  Proposal 2.2: We don’t see why the main bullet is generalized into beam measurement/reporting, which is not limited to L1/L2-centric inter-cell mobility. We suggest making it clear in the main bullet that beam reporting associated with non-serving cell(s) is used for L1/L2-centric inter-cell mobility purpose. |

### Issue 3 (beam indication signaling medium)

Table 4 Summary: issue 3

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| --- | --- | --- | --- |
| **#** | **Issue** | **Companies’ views** | **Moderator notes** |
| 3.1 | Beam application time definition:  Alt1: Measured from DCI reception  Alt2: Measured from ACK transmission | **Alt1 (DCI) (7):** Spreadtrum, Xiaomi, Ericsson, CATT, MTK, NEC, Samsung  **Alt2 (ACK) (17):** IDC, Lenovo/MoM, Fujitsu, Nokia/NSB, CMCC, Apple, Huawei/HiSi, ZTE, vivo, Intel, Sony, Qualcomm, NTT Docomo, APT  **Alt1 and Alt 2:** OPPO (Since Alt1 considers the requirement of UE and Alt2 considers the requirement of gNB side), LG | Other aspects mentioned for next-level details: when TCI state is unknown, panel activation/deactivation, PUCCH repetition |
| 3.2 | Configurability of beam application time  Alt1: UE capability  Alt2: Fixed in spec | **Alt1 (UE capability) (21):** IDC, Fujitsu, Nokia/NSB, Xiaomi, Ericsson, Apple, ZTE, CATT, vivo, MTK, Intel, Qualcomm, NTT Docomo, Samsung, Sony, Spreadtrum, Lenovo/MoM, LG, NEC  **Alt2 (fixed):** Lenovo/MoM, Huawei/HiSi  **Alt1+Alt2:** OPPO (The application time is determined based on both Alt1 and Alt 2 in 3.1. Therefore for Alt1 of 3.1: fixe in Spec and Alt2 of 3.1: UE capability) |
| 3.4 | Support for additional DCI formats for Rel.17 unified TCI framework beam indication (TCI state update) | DCI formats 1\_1/1\_2 without DL assignment:   * **Yes (18)**: OPPO, Fujitsu, Spreadtrum, Nokia/NSB, CATT, vivo (at least for UL-only TCI), MTK, Qualcomm, Samsung, Apple (ACK/NACK mechanism is needed), vivo, Lenovo/MoM, Convida, NTT Docomo, ZTE (ACK/NACK is needed), NEC (ACK/NACK needed) * **No (4)**: Ericsson, Huawei/HiSi, LG   DCI formats 0\_1/0\_2 with UL grant:   * **Yes (10)**: IDC, Nokia/NSB, Xiaomi (at least for UL-only TCI), ZTE (at least for UL-only TCI), MTK, LGE, Intel, Sony (Study), Qualcomm * **No (12)**: OPPO, CMCC, Ericsson, Huawei/HiSi, Convida, Apple, vivo, Spreadtrum, CATT, NTT Docomo, NEC   Dedicated DCI format for beam indication, with dedicated ACK based on SPS PDSCH release:   * **Yes (15)**: Futurewei, ZTE, CATT, Intel, Sony, NTT Docomo(keep the same DCI payload as existing DCI format), OPPO (based on format 1\_0 without DL assignment), Samsung, Nokia/NSB (based on format 0\_1/0\_2 without UL grant), Qualcomm, Lenovo/MoM, APT (based on SPS or CG release DCI), NEC * **No (8)**: Ericsson, MTK, Convida, Apple, vivo, Huawei/HiSi, LG   **Support extending existing DCI formats for UL-only TCI**: APT |  |

**Proposal 3.1**: On the beam application time for Rel.17 DCI-based beam indication, the beam application time can be configured by the gNB based on UE capability

* Support a UE capability for the minimum value of beam application time
* FFS: the exact minimum values of beam application time supported by UE
* FFS: whether existing UE capability can be reused as this UE capability.
* FFS: whether different beam application time values are supported for uplink and downlink
* FFS: whether UE capability needs to be introduced for the maximum value of beam application time
* FFS: the reference for defining the UE capability (e.g. from DCI reception or ACK transmission)
* FFS: whether a UE is allowed to report more than 1 values in case of MPUE
* FFS: the application time when DCI and applied channel(s) are on different CCs with same/different SCS(s)s

**Proposal 3.3**: On the Rel.17 DCI-based beam indication:

* Support using DCI formats 1\_1 and 1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI
  + Support DCI acknowledgment mechanism based on SPS PDSCH release
  + FFS: How to distinguish between DCI formats 1\_1/1\_2 with DL assignment (including usage for SPS PDSCH release or SCell dormancy) and DCI formats 1\_1/1\_2 without DL assignment

Table 5 Inputs: issue 3

|  |  |
| --- | --- |
| **Company** | **Input** |
| Moderator | 3.1: Not yet discussed in GTW, but stable  3.2: Considering the pros and cons of Alt1 and Alt2, the proposal from LG could be a good starting point for compromise.  3.3: We need to close the DCI format issue as soon as possible since there are detailed issues. Given the situation (pros and cons, as well as supporting companies) summarized in issue 3.4 (table), this is a good compromise. |
| Qualcomm | For Proposal 3.1   * Suggest to add one FFS: the application time when DCI and applied channel(s) are on different CCs   For Proposal 3.2   * We do not support it. We can discuss either after DCI or after ACK for all channels, even fine for majority view. But we highly NOT prefer that some channels are after DCI and some channels are after ACK. UE has to maintain two application time for the TCI update. This will unnecessarily complicate the implementation. |
| Apple | Support proposal 3.1  We have similar concern as Qualcomm for proposal 3.2. we suggest a unified timing.  For proposal 3.3, we support the general idea and suggest an FFS on how to differentiate beam indication and SPS release as follows:  **Proposal 3.3**: On the beam application time for Rel.17 DCI-based beam indication:   * Support using DCI formats 1\_1 and 1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI   + Support DCI acknowledgment mechanism based on SPS PDSCH release   + FFS: how to differentiate DCI for beam indication and DCI for SPS PDSCH release * No other additional DCI format is supported in Rel.17 |
| Futurewei | Proposal 3.1: Support the proposal.  Proposal 3.2: Need further discussions on the potential added UE complexity.  Proposal 3.3: Not support the proposal. Additional DCI format should be considered in Rel. 17. |
| OPPO | Proposal 3.1: support  Proposal 3.2: we do not support.  First of all, we do not support to apply different application time on different channels/signals. That is not right technically. We shall apply a single application time on all the channels/signals in the scope of unified common TCI.  Secondly, we think both the time location of DCI and ACK shall be included in application time because either one of them consider the time requirement from UE or gNB. Assume one DCI indicating TCI is received at slot n and the ack to the TCI indication is sent at slot n+m:     * At the UE side: the minimum time the UE need to switch to the new TCI state include: a time used to decode the DCI and a time used to prepare the new Rx beam (or even including activating the new Rx panel). So the earliest time point when the UE can switch to the new TCI state is t1 after the DCI. * At the gNB side: the gNB switch to new TCI state only after receives the ack from the UE. The time length the gNB needs include (1) the time decode the ACK and (2) the time used to switch the Tx beam. Overall, the earliest time point that the gNB can apply the new Tx beam is t1 after the ack.   Therefore, the earliest time point when both gNB and UE can switch to the new Tx beam/TCI state is the time point that can meet both conditions:   * Condition 1: at least t1 after the DCI, which is the UE capability. * Condition 2: at least t1 after the ack, which considers the gNB requirement.   So suggest to change proposal 3.2 to:  **Proposal 3.2**: On the beam application time for Rel.17 DCI-based beam indication, the beam application time is the first slot that meet both conditions   * at least X1 ms or Y1 symbols after the DCI with beam indication * at least X2 ms or Y2 symbols after the acknowledgment for the beam indication   Regarding proposal 3.3: we support in general. |
| Samsung | Support proposal 3.1  OK with proposa1 3.2, to clarify that this is not a down-selection of alt1 and alt2, we suggest the following small update:  **Proposal 3.2**: On the beam application time for Rel.17 DCI-based beam indication, support both of (cf. the definition of Alt1 and Alt2 as agreed in RAN1#102-e):   * Alt1 (defined after DCI reception) for PDSCH reception associated with the DCI that signals the TCI state update   + DCI-to-PDSCH time gap is determined by UE capability beamSwitchTiming (BST) analogous to Rel.15/16 * Alt2 (defined after acknowledgment transmission) for other channels/signals   Regarding proposal 3.3, our first preference is to support a dedicated DCI format for beam indication with ACK mechanism without any additional unnecessary overhead (including without DL assignment/UL grant) and without increasing the number of blind decodes (therefore the payload will be matched to one of the existing DCI formats a UE is required to search).  Note that DCI formats 1\_1 and 1\_2 are defined in 38.212 as “used for the scheduling of PDSCH in one cell”, implying that DL assignment is present. So the FL proposal “Support using DCI formats 1\_1 and 1\_2 without DL assignment” needs the following clarification:   * Does the resulting payload size match the original DCI formats 1\_1/1\_2 (with DL assignment)? * Compared to a newly designed (optimized) dedicated DCI, what are the advantages of reusing DCI formats 1\_1/1\_2 without DL assignment? |
| MediaTek | Proposal 3.1: Support.  Proposal 3.2: We have a strong concern on this proposal since UE is required to maintain to two different timelines. Prefer a unified application time in this unified TCI framework, either measured from DCI reception or measured from HARQ-ACK transmission.  Proposal 3.3: Support Moderator’s suggestion and this proposal. Share similar view with Apple that validation manner should be defined later, update based on Apple’s revision on the FFS part:   * + FFS: how to differentiate a DCI format 1\_1 or 1\_2 without DL assignment is used for beam indication rather than indicating SPS PDSCH release or SCell dormancy |
| ZTE | Proposal 3.1: we share the same views with QC, and cross-CC case should be studied. To make it general, I have the following minor update:   * FFS: the application time when DCI and applied channel(s) are on different CCs with same/different SCS(s).   In short, we need to consider whether we need to have a common time point to update beam across a CC group or have a respective time point for each CC.  Proposal 3.2: We do see the motivation of this this proposal, but we have the same concerns with Apple and QC that a unified time is beneficial for both UE and gNB implementation.  Proposal 3.3: Support. Although we are a fan of a new DCI format, we can compromise to this proposal for progress. |
| Spreadtrum | Proposal 3.1: support the proposal  Proposal 3.2: similar as Qualcomm and Apple, we also have concern on having different application time for different channels. Besides, we don’t have an agreement on whether DL TCI/joint TCI can be applied to the scheduled PDSCH. In order to make progress, we suggest defining that beam application time starts after DCI reception and ends at the beginning of symbol M of slot N, and further specify that symbol M of slot N should be after ACK.  **Proposal 3.2**: On the beam application time for Rel.17 DCI-based beam indication, support (cf. the definition of Alt1 and Alt2 as agreed in RAN1#102-e):   * The application time starts after DCI reception and ends at the beginning of symbol M of slot N   + Symbol M of slot N is later than ACK   Proposal 3.3: support the proposal |
| Intel | **Proposal 3.1:** OK  **Proposal 3.2:** We do not think this is a good starting point. We do not see any reason to selectively apply different timing for different channels. Therefore, we prefer the following version as the starting point of discussion with our preference being Alt 2.  **Proposal 3.2**: On the beam application time for Rel.17 DCI-based beam indication, the beam application time is the first slot   * Alt-1: at least X1 ms or Y1 symbols after the DCI with beam indication * Alt-2: at least X1 ms or Y2 symbols after the acknowledgment for the beam indication   **Proposal 3.3:** We think additional details are required for DCI format 1\_1, 1\_2. Additionally, we do not see why we have to preclude all other DCI formats at this time. Therefore, we prefer the following wording:  **Proposal 3.3**: On the beam application time for Rel.17 DCI-based beam indication:   * Support using DCI formats 1\_1 and 1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI   + Support DCI acknowledgment mechanism based on SPS PDSCH release   + FFS: How to differentiate DCI formats 1\_1,1\_2 without DL grant used for beam indication only from DCI formats 1\_1, 1\_2 with DL grant used for beam indication.   ~~No other~~ FFS: If additional DCI format is supported in Rel.17 |
| Xiaomi | For proposal 3.1, support it.  For proposal 3.2, we prefer a unified beam application time for different channels/signals.  For proposal 3.3, we prefer to support UL DCI format to indicate at least UL TCI state. If DCI formats 1\_1 and 1\_2 are used for UL TCI state, two DCIs are necessary to schedule a PUSCH. One for UL TCI state indication and the other one for UL assignment. It will increase the BD times, the scheduling latency and may result in a lower efficiency. |
| CMCC | For proposal 3.2, we suggest a unified beam application time. |
| Docomo | Proposal 3.1: support. Also fine with ZTE’s update.  Proposal 3.2: support the proposal. We think this is a good compromise between Alt.1 and Alt.2. But, there may be another PDSCH which is not scheduled by the beam indication DCI, and this another PDSCH should be categorized in Alt. 2. Although, “associated with” may intend this, we propose the following clarification:   * Alt1 (defined after DCI reception) for PDSCH reception ~~associated with~~ scheduled/triggered by the DCI that signals the TCI state update   We support Samsung’s update (i.e. support both of).  Proposal 3.3: support. We would like to add following FFS, because HARQ transmission behavior is different between the two cases.   * FFS: how to distinguish between DCI formats 1\_1/1\_2 with DL assignment and DCI formats 1\_1/1\_2 without DL assignment |
| LG | On proposal 3.1: Support the proposal.  On proposal 3.2: Support the proposal.  We don’t quite understand the logic of proponents of Alt2. If Alt2 is supported, is it correct understanding that PDSCH beam should be updated **after ACK for the PDSCH**, i.e. disregarding the TCI in DCI for PDSCH reception? That design is worse than Rel-15/16 because PDSCH beam can be updated by DCI in Rel-15/16. We do not understand the benefit of changing PDSCH beam update timeline compared with legacy. Only delta in Rel-17 is when PDSCH beam is updated by TCI in DCI, beams for other associated DL/UL channels are also updated, and it may be risky to update beam for other associated channels before the confirmation at UE side. So, the proposed solution is the best one as long as we understand.  On proposal 3.3: Not support the proposal.  In order to avoid impact on HARQ, gNB may send a known/dummy data sequence, e.g. all zeros, on the scheduled PDSCH (this method can be used for UL only TCI update as well). Also, it is natural to use UL DCI formats such as 0\_1/0\_2 for UL only beam update at least when there is UL-SCH to send to gNB, analogous to the agreed DL TCI update mechanism. |
| Nokia/NSB | Proposal 3.1: O.K. in principle  Proposal 3.2: We may better agree on the outlines first, whether TCI indication DCI and N/Ack via PUCCH should be delivered via the same beam/TCI, or N/Ack on PUCCH can be delivered by new beam. And whether to support PDSCH beam/TCI switching via DCI even within the same slot which is supported by Rel-15/16.  For those two points, we think always the same beam/TCI should be applied for TCI indication DCI and acknowledge PUCCH should be associated with the same(legacy) TCI, while it is O.K. or even beneficial to support fast TCI update for PDSCH.  Proposal 3.3: Support |
| Moderator | Proposal 3.1 is stable.  Proposal 3.2 is removed for now. More detailed technical discussion on pros and cons is needed in round 2 (after Wednesday). Too many objections on the proposal.  Proposal 3.3 is a compromise (middle ground) between those proposing dedicated DCI and those not wanting any more DCI. If we keep this issue open indefinitely, we will risk not completing the work in time. Some issues to be clarified further by proponents:   1. DCI payload size, whether it is identical or less than with DL assignment 2. How to dynamically switch between the format with and without DL assignment |
| CATT | Proposal 3.1: Support  Proposal 3.2: A unified solution is preferable.  Proposal 3.3: OK with the compromise, although we think an additional DCI format would be beneficial. |
| Convida Wireless | Proposal 3.1 and 3.3: Support.  Regarding Proposal 3.2, we share the concern with two timelines for different channels. |
| APT | Proposal 3.1: support  Proposal 3.2: similar with quite a few companies, we also prefer a unified definition of application time.  Proposal 3.3: we agree with the general direction, but we are not sure companies have same understanding on “DCI acknowledgment mechanism based on SPS PDSCH release”. Additionally, we think there are still quite many open questions to be addressed. It seems too early to conclude that DCI formats 1\_1 and 1\_2 without DL assignment suffices and rule out new format. |
| Ericsson | Proposal 3.1: Support  Proposal 3.3: Do not support. We should have only one signaling mechanism for unified TCI. If the already agreed mechanism is not good enough, we should revert the agreement, of fix it – not implement a parallel solution. We are very much concerned that this topic is taking far too much time, leading to no or little benefit, and we sincerely appreciate the moderator efforts to close this issue, but just looking at the responses, there seem to be quite a few open issues/FFS, and there is nothing that points to these can be easily fixed.  {Mod: From FL perspective, I very much sympathize with this. Given the large number of companies who would like to support an additional DCI format (and as the FL I cannot dismiss this), the current form of 3.3 is a compromise attempt. I fully agree that we should not spend too much time on this. If this proposal is agreed, } |
| Lenovo/MoM | Proposal 3.1: Support.  Proposal 3.3: Do not support. Group common DCI format shall be at least studied. |
| IDC | Proposal 3.1: We propose to add one more FFS bullet in the below:   * FFS: When to apply the beam application time   {Mod: This FFS is on beam application time itself (not so much on UE capability) and relevant for the proposal 3.2 (currently removed, but will be discussed in the next round, I will add this FFS there when we start}  Proposal 3.2: We also prefer a unified beam application time definition.  Proposal 3.3: We agree with LG. In order to minimize the specification impact, keeping PDSCH transmission is preferred. In addition, using DCI formats 0\_0 and 0\_1 are better solutions for UL transmission as described in our contribution. |
| Intel | **Proposal 3.3:** We still think it is too premature to exclude all other DCI formats (including 0\_x) before we finalize beam indication framework. For example, discussion is still pending on whether DCI based beam indication can be applicable to a subset of channels/RSs or to individual channels RSs as in agreements from last meeting:   * FFS: Whether the Rel.17 beam indication can also apply to beam indication for single channel (e.g. PDSCH only, single CORESET) or a subset of channels   Agreeing to this bullet now would preclude options which lead to significant changes/additions to format 1\_1/1\_2. Therefore we are not ok with removing the FFS for the last bullet. |
| Samsung2 | For proposal 3.3, our preference is a new DCI format for beam indication, we think that this is a cleaner design. We can compromise on the proposal to use DCI Format 1\_1 or 1\_2 with no DL assignment. We noticed that many companies expressed preference for a new DCI format (granted that a good number of companies are against it). Rather than closing the door for all other DCI proposals, we can still keep an FFS for that.  On the current proposal 3.3, the need for the first FFS in unclear. The second FFS may be sufficient. Could Apple/MediaTek elaborate on this? |
| Moderator | Proposal 3.1 is stable.  Proposal 3.3 needs more discussion. Removed 2nd bullet |
| vivo | For proposal 3.3, we would like to further study the ack/nack mechanism for using DCI formats 1\_1 and 1\_2. Since in proposal 3.1, the timing for beam switch is still unclear. If the beam switch is from the PDCCH, ACK/NACK may not seem necessary.   * FFS: the reference for defining the UE capability (e.g. from DCI reception or ACK transmission)   Moreover, there are some other signals that can be triggered by the PDCCH which could provide additional benefit compared to ACK/NACK.  Based on above comments, we would like to update as following.  **Proposal 3.3**: On the beam application time for Rel.17 DCI-based beam indication:   * Support using DCI formats 1\_1 and 1\_2 without DL assignment, applicable for joint TCI as well as separate DL/UL TCI   + FFS: Support DCI acknowledgment mechanism e.g. based on SPS PDSCH release, based on triggered SRS.   FFS: How to distinguish between DCI formats 1\_1/1\_2 with DL assignment and DCI formats 1\_1/1\_2 without DL assignment |
| Sony | **For proposal 3.1**, we are supportive.  **For proposal 3.2**, like many others, we also think a unified beam applicable timing is necessary for all channels/signals.  **For proposal 3.3**  It seems too early to preclude DCI formats other than DL DCI 1\_1 or 1\_2. As mentioned by Xiaomi, when indicating UL TCI or joint TCI associated with PUSCH, the DL DCI either with DL assignment or not seems cumbersome. So at the moment, we at least should further study other DCI formats as captured in Intel’s re-wording of proposal 3.3. Now it’s removed in updated version, we are supportive. |
| Huawei, HiSilicon | Proposal 3.1: We still think agreeing on one fixed value for one use case (intra-cell beam switching, UE panel switching) would be the cleanest design (smallest efforts on handling different timelines at both NW and UE). But if everyone else is fine with Proposal 3.1, we can live with it.  Proposal 3.3: Do not support. Similar as Ericsson, we don’t see enough justification for the proposed solution, and we don’t understand the meaning of ‘based on SPS PDSCH release’. |

### Issue 4 (MP-UE)

Table 6 Summary: issue 4

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| --- | --- | --- | --- |
| **#** | **Issue** | **Companies’ views** | **Moderator notes** |
| 4.1 | Entity pertaining to an UL panel for the purpose of UE-initiated panel selection (of one) and activation (of ≥1)  Note: support for UE-initiated panel selection/activation was agreed (but spec support is still FFS – see 4.2) | Alternatives:   * Newly defined panel ID(s): Lenovo/MoM (study), LGE, Xiaomi, NTT Docomo, Qualcomm, Spreadtrum, ZTE, Huawei/HiSi (virtual concept without mandating physical UE panel implementation), IDC, APT, CMCC   + Not needed: AT&T, CATT, Ericsson, OPPO, Nokia/NSB * SSBRI(s)/CRI(s) or CSI-RS resource set ID(s): IDC, Samsung, MTK(SSBRI(s)/CRI(s)), Xiaomi, CATT * SRI(s) or SRS resource set ID(s): vivo, Qualcomm, Xiaomi, Sony (SRS resource set ID(s)), Fraunhofer IIS/HHI, Huawei/HiSi, APT * Antenna port group: Apple, Qualcomm, Nokia/NSB |  |
| 4.2 | Spec support for UE-initiated panel selection and activation | Potentially new beam reporting format, including enhanced beam-group reporting (indicator(s) depending on the outcome of issue 4.1 + beam metric(s)):   * **Yes**: ZTE, APT, NTT Docomo, Samsung, MTK, vivo, Qualcomm, Xiaomi, Spreadtrum, Nokia/NSB, Huawei/HiSi, LG, CMCC * **No**: CATT, OPPO   UE-initiated reporting mechanism (beyond NW-configured P/SP/AP reporting, including switching event):   * **Yes**: Huawei/HiSi, Samsung, CATT, IDC, MTK, NTT Docomo, Fraunhofer IIS/HHI, Sony, Xiaomi, Apple, Lenovo/MoM, Qualcomm, Nokia/NSB, APT, AT&T, LG * **No**: MTK, Spreadtrum, ZTE (motivation is unclear), Ericsson, OPPO   gNB confirmation (hand-shake) of UE panel choice:   * **Yes**: IDC, Huawei/HiSi, Qualcomm (UE decides which panel to activate), NTT Docomo, LG * **No**: MTK (confirmation according to TCI stat activation), Spreadtrum, CATT, ZTE (same views with MTK), Ericsson (same view as MTK), OPPO, Nokia/NSB |  |
| 4.3 | Support for NW-initiated UL panel selection and activation | NW-initiated UL panel selection (of one) and activation (of ≥1)   * **Yes**: IDC, Huawei/HiSi, ZTE, LGE, NTT Docomo,CMCC * **No**: OPPO, Fraunhofer IIS/HHI, CATT, MTK, Intel, Sony, Xiaomi, Qualcomm (NW can initiate selection within active panels but not activation), Spreadtrum, Nokia/NSB   NW-to-MPUE signaling of panel selection/activation:   * **Yes**: NTT Docomo, Lenovo/MoM, Xiaomi, APT, IDC (panel ID in TCI state), Samsung (in case of MPE), CATT, APT, vivo, Qualcomm (NW can signal which active panel to use but not activation), Spreadtrum (select among active panels), Nokia/NSB, Huawei/HiSi (with UE confirmation/rejection), LG, CMCC * **No**: OPPO |  |

**Conclusion 4.1**: On Rel.17 enhancements to facilitate UL beam selection for MP-UE, the following terms are used at least for the purpose of discussion and reaching agreements:

* ‘Panel activation’ (at least for DL/UL measurement): activating L out of P available UE panel(s) at least for the purpose of DL and UL beam measurements (e.g. reception of DL measurement RS, transmission of SRS)
* ‘Panel selection’ (for UL transmission): selecting 1 out of L activated UE panel(s) for the purpose of UL transmission
* Note: UE-initiated panel activation and selection have been agreed in RAN1#103-e

Table 7 Inputs: issue 4

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| --- | --- |
| **Company** | **Input** |
| Moderator | 4.1: Not yet discussed in GTW, but stable  4.2: Apple’s proposal is a good starting point, but so far supported only by 4 companies. I’d appreciate of other companies can comment on the proposal and build on it. |
| Qualcomm | We are fine for both Proposal 4.1 and 4.2 |
| Apple | Support proposal 4.1 and 4.2 |
| OPPO | Proposal 4.1: do not support. Recalling the discussion in rel16, we spent much time and effort discussing the “panel”. And now it looks like we are repeating the same discussion again. In the system, the system only indicates some UL TCI state or spatial relation info to the UE for determining UL Tx beam. How to choose a Tx beam or panel is up to UE implementation. Panel activation or panel selection is also part of UE implementation. We do not see the reason why we will discuss something that will not have impact on spec.  {Mod: Per MTK’s suggestion this is now changed to conclusion. Similar to the conclusion for item 1, this helps companies to discuss and reach agreement to avoid misunderstanding}  Proposal 4.2: do not support. The beam selection in FR2 is not related with antenna ports. For instance, we can apply different Tx beams (i.e., different UL TCI state) on different PUSCH transmission but we still use the antenna ports on those PUSCH transmission. Same for SRS and PUCCH.  {Mod: This is to gauge whether there is a need for defining new panel ID, etc. } |
| Samsung | Support proposal 4.1  OK with proposal 4.2. |
| MediaTek | It is good to have conclusions to align the understanding on the terminologies. Note that these terminologies are already used in the previous agreements.  Support proposal 4.1 as a conclusion since there is no spec impact.  **Agreement**  [Issue 4] For Rel.17 NR FeMIMO, on MP-UE assumption to facilitate fast UL panel selection:   * The following assumptions are used:   + In terms of RF functionality, a UE panel comprises a collection of TXRUs that is able to generate one analog beam (one beam may correspond to two antenna ports if dual-polarized array is used)   + UE panels can constitute the same as well as different number of antenna ports, number of beams, and EIRP   + No beam correspondence across different UE panels   On proposal 4.2, we are not sure whether it is needed. We already agreed on some assumptions on UE panel in RAN1#102e, including how the antenna ports, beams, and TXRUs map to a UE panel.  For Issue 4.1, before introducing any entry pertaining to an UL panel for the purpose of UE-initiated panel selection and activation, we would like to confirm/clarify whether/why spec support is needed first. At least from our understanding, if UE only activates one panel (L=1), the panel must be selected as the UL panel and spec support is not needed for this case. If UE activates more than one panels (L>1) and one of the active panels are selected as an UL panel, spec support would be needed to indicate (from UE to NW):   * What is the feasible beam pair link(s) for UL transmission on the UL panel and/or; * Which panel(s) is selected as the UL panel out of the L active panels   Then, after we have a common understanding on what functionalities in specification are needed for UE-initiated panel selection and activation, we can further discuss how to use those entries to achieve the functionalities. Thus, we suggest to have a following agreement first:  **Proposal 4.X**: On Rel.17 UE-initiated panel selection and activation to facilitate UL beam selection for MP-UE, if a UE activates L>1 panels and selected one UL panel out of the L>1 activated panels, specification support is needed for the following:   * UE indicating to NW the feasible beam(s) for UL transmission on the selected UL panel * UE indicating to NW which panel(s) is selected as the UL panel out of the L active panels   {Mod: This is a good starting point for next round. I will use this.} |
| ZTE | Proposal 4.1: Support.  Proposal 4.2: How to define a panel has been discussed in Rel-16, including this potential definition of ‘port group’, and we do not see much difference. Alternatively, we think that the candidate ID in group based reporting (e.g., **an ID corresponding to a group of multiple DL RS(s) to be reported**) can be considered, if some opponent companies has concerns on panel ID or antenna port group ID. |
| Spreadtrum | Support proposal 4.1.  For proposal 4.2, support in principle. There’s one clarification issue, since we already agreed that UL Tx panel(s) are assumed to be a same set or subset of DL Rx panel(s), whether the activated UL Tx panel(s) are also assumed to be a same set or subset of activated DL Tx panel(s)? |
| Intel | **Proposal 4.1:** can be a conclusion similar to terminology definition in Issue 1. |
| Xiaomi | For proposal 4.1, support.  For proposal 4.2, support. |
| CMCC | Support the proposals. |
| Docomo | Support both proposals |
| LG | On Proposal 4.1: Support the proposal.  On Proposal 4.2: Support in principle. It may need further clarify that different antenna port group can comprise different group of UL/DL resources. For example, each PUCCH resource group introduced in Rel-16 for simultaneous spatial relation update can be mapped to each UE panel. For another example, each SRS resource set for BM can be mapped to each UE panel. We suggest to add PUCCH resource group as one of the examples. |
| Nokia/NSB | Proposal 4.1: we propose the following updates: On Rel.17 enhancements to facilitate UL beam selection for MP-UE, the following terms are used at least for discussion  Proposal 4.2: We are O.K. to discuss further, but the described definition looks vague enough. Note that group-based operation exists in specification, hence such a notion of panel already exists. Is the current definition bringing anything new w.r.t the existing group-based operation? We do not see a need for such an agreement unless it differentiates way better than the current spec. |
| Moderator | Both proposals are now proposed conclusions.  Conclusion 4.1 is stable.  Conclusion 4.2 needs more discussion. |
| Fraunhofer IIS/HHI | Support both conclusions |
| CATT | Proposal 4.1: Support the proposal.  Proposal 4.2: We are not sure if the proposal, when used together with Proposal 4.1, may introduce misconception. For instance we think “activation of UE panels” (proposal 4.1) should not be understood as “activation of DL/UL antenna ports” (proposal 4.2). Maybe the misinterpretation may not always happen, but it is good to avoid.  {Mod: Good point, this needs tobe discussed} |
| APT | Proposal 4.1: support  Proposal 4.2: do not see the need. Since panel is a conceptual term, not sure why we need to define it. We think proposal from ZTE is reasonable. |
| AT&T | Proposal 4.1: Support  Proposal 4.2: we are ok with this conclusion in principle. No need to define a new ID, and we can use it as a starting point to discuss spec support. |
| Ericsson | Conclusion 4.1: we still fail to see the benefit of this, but we are OK to agree for progress  Conclusion 4.2: Don’t support. An antenna port is where a reference signal is inserted. Isn’t it so that one or two RSs would be inserted for a panel, but not more?  The definition of a panel should be functional: how is it used.  {Mod: Tend to agree, but this has been done in the last meeting for use case and we ended up with a long list. } |
| Lenovo/MoM | Support proposals 4.1 and 4.2. |
| IDC | Conclusion 4.1: We are fine with the conclusion.  Conclusion 4.2: We think that further discussion is needed. |
| Intel | **Conclusion 4.2:** In Rel-15, SRS is used to correct beam correspondence error and can be flexibly mapped to any panel of the UE depending on DL measurements. We are not sure that SRS resource set can be used to uniquely identify a panel of a UE. |
| Moderator | Conclusion 4.1 is stable and ready for primetime.  Conclusion 4.2 is removed. I sympathize with the arguments from both sides. I think we can skip the discussion on what a panel entails (which is what I tried to do before ☺). At least we have seen that repeating the discussion we had in Rel.16 (what panel is etc.) is fruitless. In the next round, I will return to my original proposal in x1185 and see how we can progress from there by filling in details. |
| OPPO2 | **Conclusion 1:** Do not support. Failed to see the benefit and motivation to make such a conclusion. Panel activation and Panel selection is purely UE implementation behavior. For spec, we do not specify the panel behavior. Furthermore, in the agreement of RAN1#103e, we have “FFS: Whether specification support for this feature is necessary…”. There is still no clear justification for supporting the feature of UE panel selection in spec. We do not support to agree that before we can define the motivation and justification clearly.  **Conclusion 2:** Do not support.The term of “antenna port” has been used in LTR and NR for so many years. It has special meanings. The description in proposed conclusion 2 would cause some trouble and confusion to the term of antenna port itself. Furthermore, regarding the panel ID: we do not think there shall be panel ID defined in the spec. That has been discussed a lot in rel16 discussion. For beam indication, we only use some RS ID or TCI state ID. |
| vivo | We are fine with the conclusion. |
| Sony | **For proposal 4.1**, it seems no harm to further clarify UE panels for discussion and agreement purpose, and though there seems some redundancy with previous description, even back to the ones made in Rel.16, it is aligned with companies’ understanding on panel implementation, thus we support it.  **For proposal 4.2**, support in principle. And the bullet may need to be refined as  FFS the relation ~~with~~ between panel(s) and RS, e.g. CSI-RS resource set, SRS resource set. But now it’s totally removed, we are fine to discuss that later. |
| Huawei, HiSilicon | Conclusion 4.1: Support |

### Issue 5 (MPE mitigation)

Table 8 Summary: issue 5

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| --- | --- | --- | --- |
| **#** | **Issue** | **Companies’ views** | **Moderator notes** |
| 5.1 | Reporting of P-MPR report based on Rel.16 framework | Alternatives:   * **Not supported**: Ericsson * **Beam-level (7)**: Intel (already supported by RAN2/RAN4 PHR MAC-CE), Apple, Qualcomm, ZTE OPPO (for each activated UL TCI state), Nokia/NSB * **Panel-level (12)**: vivo, Sony, Spreadtrum, NTT Docomo, ZTE, Lenovo/MoM, Huawei/HiSi (2nd preference), IDC, APT, NEC |  |
| 5.2 | Reporting SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating:   * Alt1: alternative UE panel(s) or TX beam(s) for UL transmission * Alt2: feasible UE panel(s) or TX beam(s) for UL transmission taking the MPE effect into account | Alternatives:   * **Not supported**: vivo, OPPO, Huawei/HiSi, APT * **Beam-level (**with L1-RSRP/SINR**) (9)**: Ericsson, Intel (without L1-RSRP/SINR), MTK, Apple, Qualcomm, NTT Docomo, ZTE, Nokia/NSB * **Panel-level (**with L1-RSRP/SINR**) (12)**: Samsung, IDC, CATT, Xiaomi, LG   + **Alt1**: Samsung, Qualcomm, LG   + **Alt2**: Nokia/NSB, Sony, MTK (but not limited to MPE mitigation), Apple, Qualcomm, Xiaomi, ZTE, LG |  |
| 5.3 | Any additional reporting content:   * Alt0: no additional reporting content * Alt1: Additional reporting content | **Alt0**: Ericsson, Intel, Xiaomi, MTK, Spreadtrum, Lenovo/MoM, Huawei/HiSi, APT  **Alt1**:   * CRI/SSBRI + L1-RSRP/L1-SINR + P-MPR: OPPO, MediaTek, Nokia/NSB, IDC * CRI/SSBRI + L1-RSRP/L1-SINR + virtual PHR: Nokia/NSB, Apple, Convida, CMCC * CRI/SSBRI + L1-RSRP/L1-SINR + panel ID: LG, CMCC * CRI/SSBRI + virtual PHR: ZTE, Convida * CRI/SSBRI + UL RSRP + panel ID: Qualcomm * CRI/SSBRI + new/additional param. (indicating MPE): CMCC * P-MPR + panel-ID: vivo, Sony (panel-specific), IDC * P-MPR + alternative panel or UL TX beam: Nokia/NSB * ID of preferred/non-preferred panel: LGE |  |

**Proposal 5.1**: On Rel.17 enhancements to facilitate MPE mitigation,

* On further enhancing the P-MPR report in Rel.16 (already agreed RAN4 framework, including triggering), decide in RAN1#104bis-e to focus study on either beam-level or panel-select reporting
* On SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating, decide in RAN1#104bis-e to focus study on either of the following:
  + Reporting of at least SSBRI(s)/CRI(s): additional reporting quantities are FFS
  + Reporting of at least an indicator associated with an UL ‘panel’: additional reporting quantities are FFS

Table 9 Inputs: issue 5

|  |  |
| --- | --- |
| **Company** | **Input** |
| Moderator | 5.1: We need to start narrowing down options for study. From the summary, this could be a good starting point |
| Qualcomm | Support Proposal 5.1 |
| Apple | Support proposal 5.1 |
| OPPO | Ok with Proposal 5.1 |
| Samsung | Support proposal 5.1 |
| ZTE | Support Proposal 5.1 with following modification, since several companies are interested in PHR   * On SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating, decide in RAN1#104bis-e whether to focus study on either of the following:   + Beam-level reporting of feasible UL TX beam(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR/virtual PHR   + Panel-level reporting of feasible UE panel(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR/virtual PHR |
| Intel | **Proposal 5.1:** OK with current wording |
| MediaTek | Support proposal 5.1. However, regarding the wording “UL TX beam(s)”, even it has been captured in the previous agreement, we still don't prefer to use it since SSBRI(s)/CRI(s) is used to indicate gNB beam(s) instead of UE beam(s). We suggest the following update:  **Proposal 5.1**: On Rel.17 enhancements to facilitate MPE mitigation,   * On P-MPR report based on Rel.16 framework, decide in RAN1#104bis-e whether to focus study on either beam-level or panel-select reporting * On SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating, decide in RAN1#104bis-e whether to focus study on either of the following:   + Beam-level reporting of feasible ~~UL TX~~ gNB beam(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR   + Panel-level reporting of feasible UE panel(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR |
| Xiaomi | Support proposal 5.1. |
| CMCC | Support the proposals. |
| Docomo | Support proposal 5.1 |
| LG | Support the proposal 5.1. |
| Nokia/NSB | Support proposal 5.1 with MediaTek & ZTE version |
| Moderator | Proposal 5.1 could be stable. |
| CATT | Support proposal 5.1. |
| Convida Wireless | Support with ZTE’s addition of virtual PHR. |
| Ericsson | As it looks now, we do not support. Comments:   * we suggest splitting this in two proposals – they seem unrelated * what does “P-MPR report based on Rel.16 framework” mean? Is it the PHR MAC CE that is intended? * The second part is quite confusing. We have an agreement on “SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating…” We will report SSBRI(s)/CRI(s) and/or panel, so why do we add options on “beam level” and “panel-level”? Can we write:   On UE reporting for MPE mitigation for Rel-17, decide in RAN1#104bis-e to focus on either of the following:   * Reporting of SSBRI(s)/CRI(s) – additional reporting quantity FFS * Reporting of panel ID – additional reporting quantity FFS |
| Lenovo/MoM | Support proposal 5.1. |
| IDC | We are fine with proposal 5.1. |
| Intel | We are not sure what the current wording implies. In the first bullet, we should start with solution adopted in RAN4 and RAN2 as the baseline. Additional reporting can be further discussed. Similarly, in the second bullet, index reporting i.e., SSB-RI/CRI should be the baseline that is supported and the need for additional metric can be further discussed. Therefore, we are not ok with current wording. The following is suggested instead:  **Proposal 5.1**: On Rel.17 enhancements to facilitate MPE mitigation,   * ~~On~~ At least P-MPR report based on Rel.16 framework (RAN4 framework, including triggering) is supported   + Decide in RAN1#104bis-e whether to focus study on either beam-level or panel-select reporting * ~~On~~ At least support reporting SSBRI(s)/CRI(s)   + FFS: whether additional metric should be reported and if so, is it panel or beam level |
| OPPO2 | Do not support the term “virtual PHR”. Suggest to change to “information of PHR” |
| vivo | We have concerns on a novel framework enhancement of MPE mitigation based on SSBRI(s)/CRI(s). We would like to further study the necessity of SSBRI/CRI report.  **Proposal 5.1**: On Rel.17 enhancements to facilitate MPE mitigation,   * On P-MPR report based on Rel.16 framework, decide in RAN1#104bis-e whether to focus study on either beam-level or panel-select reporting * On SSBRI(s)/CRI(s) and/or indication of panel selection for the purpose of indicating, decide in RAN1#104bis-e whether to focus study on either of the following:   + Beam-level reporting of feasible UL TXgNB beam(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR/virtual PHR   + Panel-level reporting of feasible UE panel(s) for UL transmission taking the MPE effect into account, with companion L1-RSRP/SINR/virtual PHR   + Necessity of designing a new framework in addition to Rel.16 P-MPR report framework. |
| Sony | Support proposal 5.1. |
| Huawei, HiSilicon | Proposal 5.1: In our understanding, this proposal does not imply support of either P-MPR reporting or SSBRI/CRI reporting, and suggest making it clear in the main bullet or as a note. And, as the first check-point is Wednesday in the first week of a 2-week meeting, we don’t quite understand why not to discuss this topic in this meeting, but rush to postpone the discussion on whether to narrow-down some scope of study (not even real down-scoping) to next meeting… |

### Issue 6 (beam refinement/tracking)

Table 10 Summary: issue 6

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| --- | --- | --- | --- |
| **#** | **Issue** | **Companies’ views** | **Moderator notes** |
| 6.1 | Group 1: beam measurement/reporting via RACH for initial access (e.g. RO for measurement and MSG3 for reporting, impact of MPE mitigation) | Perform study and, if needed, specify:   * **Yes**: AT&T, Qualcomm, Nokia/NSB, Samsung, Xiaomi, Sony * **No**: OPPO, ZTE, Huawei/HiSi, Apple, vivo, Convida, Ericsson, Futurewei, LG, NEC |  |
| 6.2 | Group 2: faster joint DL TX and RX beam refinement/tracking (P2+P3) | Perform study and, if needed, specify:   * **Yes**: Apple (CSI-RS based), Samsung (CSI-RS based), Intel (using SRS/CRI), Nokia/NSB (P3 only), Futurewei * **No**: vivo, Qualcomm, Ericsson, Huawei/HiSi, LG |  |
| 6.3 | Group 3: Beam management with reduced DL signaling (e.g. beam update based on reporting, beam measurement and report triggered by beam indication, multi-SSB indication, semi-static beam switch) | Perform study and, if needed, specify:   * **Yes**: Futurewei, MTK, Samsung, OPPO, Apple, Intel, NTT Docomo, Qualcomm, Ericsson, IDC * **No**: vivo, Huawei/HiSi |  |
| 6.4 | Group 4: Reducing activation delay of TCI states (other WGs, e.g. RAN4) | Perform study and, if needed, specify:   * **Yes**: Ericsson, ZTE, Samsung, Apple (RAN1), vivo (RAN1), NTT Docomo, Futurewei (RAN4), Huawei/HiSi (send to RAN4) * **No**: |  |

**Proposal 6.1**: On Rel.17 enhancements based on the unified TCI framework, perform study and, if needed, specify the following:

* Beam management with reduced DL signaling (e.g. beam update based on reporting, beam measurement and report triggered by beam indication, multi-SSB indication, semi-static beam transition configuration, UE-initiated beam update/activation)
* Reducing activation delay of TCI states (including other WGs, e.g. RAN4)

Note: Given its dependence on the maturity of other issues (1 to 5), when to start the work and how much work is done on issue 6 should depend on the progress on the other issues.

Table 11 Inputs: issue 6

|  |  |
| --- | --- |
| **Company** | **Input** |
| Moderator | 6.1: Based on the views on companies, this could be a good starting point for issue 6 |
| Qualcomm | For Proposal 6.1   * For 2nd bullet, to be aligned, can someone explain the issue and corresponding RAN4 LS if any? Cannot find any description in previous summary. To our understanding, all LSs are under discussion in other sessions. We prefer to remove 2nd bullet if the motivation is unclear. |
| Apple | Support proposal 6.1 |
| Futurewei | We are in general ok with Proposal 6.1. On the second bullet “Reducing activation delay of TCI states”, this item should be performed by RAN4, instead of RAN1. So we suggest removing this bullet. |
| Samsung | Support proposal 6.1 |
| MediaTek | Support proposal 6.1 with adding one example:  **Proposal 6.1**: On Rel.17 enhancements based on the unified TCI framework, perform study and, if needed, specify the following:   * Beam management with reduced DL signaling (e.g. beam update based on reporting, beam measurement and report triggered by beam indication, multi-SSB indication, semi-static beam switch, UE-initiated beam update/activation) * Reducing activation delay of TCI states (including other WGs, e.g. RAN4) |
| ZTE | Firstly, we suggest that the discussion of this issue should be postponed to RAN1#105 after other 5 issues are stable.  Then, regarding proposal 6.1, we are fine with the second bullet, but still can NOT see a clear motivation for first bullet. |
| Spreadtrum | OK with proposal 6.1. Prefer to discuss it after finalizing the other issues. |
| Intel | Support Proposal 6.1 |
| Xiaomi | Support proposal 6.1. |
| Docomo | Support. But, could you update as below? This is our intention of the proposal. The reason is that our proposal assumes semi-static beam transition configuration, but the beam switch is done based on the UE’s measurement. So, this is not semi-static beam switch.   * Beam management with reduced DL signaling (e.g. beam update based on reporting, beam measurement and report triggered by beam indication, multi-SSB indication, semi-static beam ~~switch~~ transition configuration) |
| Nokia/NSB | We are O.K. with the 1st bullet  We do not sure whether 2nd bullet belongs to RAN1 issue. We prefer further clarification |
| Moderator | Proposal 6.1 needs more discussion.  Re bullet 2, for the RAN4-related parts, the study can be done in RAN1. If it is concluded beneficial, an LS can be sent to RAN4. So perhaps it is beneficial to keep the second bullet. Proponents can further elaborate. |
| Convida Wireless | OK, but we also prefer to start this discussion after the other issues are stable. |
| Ericsson | Support |
| Lenovo/MoM | Support Proposal 6.1 |
| IDC | We are fine with the proposal. |
| Moderator | Proposal 6.1 is relatively stable.  Added a sentence on the dependence on other issues. I understand that some proponents are sensitive to this but this is actually quite fair. The group should not spend too much time on aspects that are still very much contingent because some topics especially on issue 1 and 3 are still not finalized yet. |
| vivo | The scope of Group3 is scary. With MB already crowded with quite a bunch of issues, we are concerned on how to move the study forward smoothly. |
| Huawei, HiSilicon | Proposal 6.1: Do not support the first bullet as a mixture of 5 different solutions. Shared same concern as vivo/ZTE. The word load from the first 5 issues is unhealthy for the delegates already (FL summary reached v58 before first GTW session). Ok to send the second bullet to RAN4. |