**3GPP TSG RAN WG1 #104b-e- R1-210xxxx**

**e-Meeting, April 12th – 20th, 2021**

Source: moderator (vivo)

Title: Feature lead summary#2 on Enhancements on Multi-TRP inter-cell operation

Agenda Item: 8.1.2.2

Document for: Discussion and Decision

1. Introduction

In this contribution, contributions submitted in AI 8.1.2.2 are summarized. In section 2, the points raised in the contributions are listed and tentative proposals are provided.

1. 1. Item 1: Clarification on “non-serving cell”

Updated proposal 1-1:

There are slightly different versions as in Alt1 and Alt2 below. Either of the two alternatives should be fine.

Alt1: For discussion purposes related to L1/L2-centric inter-cell mobility and inter-cell mTRP, a channel or RS received from a non-serving cell is QCLed [directly or indirectly] to an SSB with a PCI different from the serving cell PCI.

Alt2: From UE perspective, “PDSCH/PDCCH from non-serving cell (PCI)” is, PDSCH/PDCCH transmitted from serving cell, and QCLed with CSI-RS for tracking/CSI-RS for CSI/CSI-RS for BM from serving cell, which are further QCLed with SSB associated with PCI other than the serving cell.

According to proposals in contributions, two alternatives are provided above. Please indicate your preference or provide revision, if any.

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| Company | comments |
| OPPO | For Alt1, the definition of “non-serving cell RS” is also unclear to us. To make it clear, we support the following Alt1-1:  Alt1-1: A PDCCH/PDSCH from non-serving cell is the PDCCH/PDSCH directly or indirectly QCLed to non-serving cell SSB. |
| QC | Agree with OPPO.  We do not understand Alt2. Is it just a terminology change? |
| Ericsson | We need all signals and channels, e.g. TRS. So we prefer such formulation for Alt.1 (don’t see the need for Alt.2 terminology)   * For RAN1 discussion, a channel or RS received from a non-serving cell is QCLed directly or indirectly to an SSB with a PCI different from the serving cell PCI |
| DOCOMO | Further revision based on Ericsson.   * For RAN1 discussion, a channel or RS received from a non-serving cell is QCLed directly or indirectly to an SSB with a PCI different from the serving cell PCI   + The channel or RS at least includes PDSCH, PDCCH on USS, CSI-RS, [PDCCH on Type3 CSS] |
| ZTE | Support Alt. 1, sightly prefer E///’s version. |
| Xiaomi | Support Alt 1 with Ericsson’s revision or DOCOMO’s revision. |
| LG | Support Ericsson’s revision. Regarding DOCOMO’s revision, which channel and RS can be QCLed to SSB with neighbor cell PCI can be discussed separately. |
| Nokia | Ok with E/// suggestion |
| APT/FGI | We support Ericsson’s formulation for Alt.1. Hence, we are OK with the proposed conclusion. |
| CMCC | Support Alt 1.  Agree with LG, which channel and RS can be QCLed to SSB with neighbor cell PCI is another issue. |
| Lenovo, MotM | We prefer Ericsson’s version. The applicable channel(s)/signal(s) need further discussion. |
| MediaTek | Support updated proposal 1-1 |
| Huawei, HiSilicon | We are informed by our RAN2 colleagues that RAN2 is confused by this non-serving cell and serving cell concept from RAN1, and will have some online discussions today and offline discussions this week, and possibly ask questions back to RAN1… And here are some views from our side:  First of all, the spec has a clear definition of “serving cell”, and all cells not serving the UE are considered non-serving cells. There’s indeed no such thing called a channel (i.e., PDSCH/PDCCH) from a non-serving cell. From UE perspective, the channel it can “see”, is from the serving cell. The discussion here is to clarify ambiguous phrasing used in previous agreement, not to define a new term. So the formulation from Alt1 or Ericsson still looks unclear to us as the channel (i.e., PDSCH/PDCCH) should be from the serving cell anyway.  Second, in the last meeting, we have agreed to reuse Rel-15/16 QCL rules, so it’s better to follow the conclusion and clearly mention the channels/RS involved in Rel-15/16 QCL rules. Whether other channels will be included is another discussion point, but let’s not broaden the discussion for now.  In short, we suggest the following formulation considering the agreed QCL rules/chains:  From UE perspective, “PDSCH/PDCCH from non-serving cell (PCI)” is, PDSCH/PDCCH transmitted from serving cell, and QCLed with CSI-RS for tracking/CSI-RS for CSI/CSI-RS for BM from serving cell, which are further QCLed with SSB associated with PCI other than the serving cell.  **Conclusion in 104-e**  Reuse Rel-15/16 QCL rule between the source and target RS/channel for non-serving cell RS/channel.    **Agreement in RAN1#104-e**  Agree on scheme1   * Scheme1: PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around non-serving cell SSB with the same PCI * FFS: whether PDSCH /PDCCH from serving cell (PCI) is rate matched around non-serving cell SSB   FFS: whether PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around serving cell SSB |
| Futurewei | OK with Ericsson’s or DOCOMO’s revision, but the current formulation is only focused on DL. What about UL? Maybe with Proposal 6, and at least for RAN1 discussion convenience, UL channels and signals can also be included with the generalized “QCL” concept. For example, assuming Proposal 6 or the like:   * A UE may receive / transmit a DL / UL channel or RS QCLed directly or indirectly to an SSB with a PCI different from the serving cell PCI   + For RAN1 discussion, the cell associated with the PCI may be called a non-serving cell |
| Samsung | The direction from Ericsson’s wording seems ok. Suggest to revise as follows for further discussion:  For discussion purposes related to L1/L2-centric inter-cell mobility and inter-cell mTRP, a channel or an RS received from a non-serving cell is QCLed directly or indirectly to an SSB with a PCI different from [ALT1: a serving cell PCI] [ALT2: all PCIs associated with the serving cell]  Note that:   * This should apply not just in RAN1, but also in RAN2/3/4. It doesn’t make sense to have different definition related to non-serving cell in RAN1. As pointed out by, e.g. Huawei, this could lead to confusion. Otherwise, this would not only be pointless, but also detrimental. * While it is fine to have a definition for discussion purposes, we also agree with, e.g. Intel, that the term non-serving cell has been used in RAN1/2 and clearly understood. In this sense, before the above is agreed, we should discuss in what sense the above definition is helpful beyond the current understanding of non-serving cell in RAN1/2/3/4. * It has been pointed that one cell may employ multiple PCIs. This also needs to be taken into account. We need to discuss ALT1 vs ALT2. |
| CATT` | Ericsson’s revision is preferred, and Alt 2 is not needed.  However, it’s noted that QCL is defined as the relationship between RS. So, the following revision can be considered:  For RAN1 discussion, a ~~channel or~~ RS received from a non-serving cell is QCLed directly or indirectly to an SSB with a PCI different from the serving cell PCI |

* 1. Item 2: Indication/association of non-serving cell information with TCI state

Updated Proposal 2 after GTW on Monday

Given the responses from companies below, there is no consensus on number of configured non-serving cells for intercell MTRP operation and CORESETPoolIndex. It can be further discussed in RAN1, can be captured in LS to RAN2 that these two issues are being discussed in RAN1.

For indication/association of non-serving cell information with TCI state, following issues are identified as RAN1 related

1. number of configured non-serving cells TRPs for intercell MTRP operation
   1. Alt1: Max number =1 (supported by: OPPO, QC, ZTE, Xiaomi, MediaTek, CMCC, CATT)
   2. Alt2: Max number >1 (supported by: DOCOMO, LG, Nokia)
2. For Rel-17 intercell MTRP, whether it should be defined based on CORESETPoolIndex
   1. Alt1: Yes (supported by: QC, DOCOMO, ZTE, Nokia, MediaTek, APT/FGI, CMCC, Lenovo/MotM)
   2. Alt2: No (supported by: LG, Futurewei, Samsung, CATT, Ericsson, Huawei/HiSilicon)
   3. Alt3: Intercell M-TRP operation is based PCI and CORESETPoolIndex may be optionally supported
3. The channels/signals QCLed to one PCI directly or indirectly shall not be QCLed to another PCI directly or indirectly. (supported by: Futurewei)

Don’t support 1) and 2): Ericsson, Huawei/HiSilicon

Please indicate your preference and provide reasoning, if possible.

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| Company | comments |
| OPPO | For 1), we think the argument is whether more than 1 non-serving cell is supported, not more than 2.  We support Alt 1 with only one non-serving cell considered in Rel-17, which is consistent with the number of TRPs in Rel-16.  For 2), we don’t have strong view on PCI based or CORESETPoolindex based. |
| QC | For 1) and 2), we support Alt1 (assuming OPPO’s modification)  In multi-DCI, TRP differentiation is based on CORESETPoolIndex.  If it helps the progress and as a compromise, we can accept “non-serving cell” within a CORESETPoolIndex as an additional feature, which is optional for a UE supporting inter-cell mTRP. If intra-CORESETPoolIndex case is not supported, Alt1 should be the behaviour for both 1) and 2). |
| Ericsson | Don’t support the proposal. We don’t see the need for any restriction in the max number and we don’t see why it must be a relation to pool index.  We would like to follow the Rel.16 multi-DCI operation with the difference that an SSB can have a non-serving cell PCI.  Hence, the maximum number of TRPs is the same as the number of possible TCI states (64), just as in Rel.16 multi-DCI.  For activated TCI states, in Rel.16 multi-DCI, MAC CE can activate 2\*8=16 TCI states if the UE support it, hence Rel.16 supports 16 TRPs. We don’t see why Rel.17 should only support 2, why? |
| DOCOMO | We’d like to support a unified configuration framework regarding non-serving cell for MTRP inter-cell and L1/L2 inter-cell mobility in AI 8.1.1.  Hence, for 1), we think more than 1 non-serving cell can be RRC configured to provide the non-serving cell configuration, e.g., SSB time domain position, SSB transmission periodicity, SSB transmission power, etc. And gNB can configure multiple non-serving cells for L1 beam reporting.  But when configuring the association between non-serving cell and QCL configuration, for MTRP inter-cell, we agree that at most 1 non-serving cell can be configured associated with a CORESETPoolIndex.  Hence, we support Alt.2 for 1), and Alt.1 for 2). |
| ZTE | We believe the number of configured non-serving cell TRPs should be 1, and Rel-17 inter-cell MTRP should be defined based on CORESETPoolIndex.  In general, it can be the common that Rel-17 inter-cell MTRP is based on Rel-16 MDCI (intra-cell) MTRP, and where only two TRPs can be used. Therefore, it is natural to support only one non-serving cell TRP for this WI. On the other hand, CORESETPoolIndex with values 0 and 1 was introduced in Rel-16 MDCI MTRP to support TRP specific configurations towards two TRPs, such as CRS pattern, HARQ-ACK codebook, data scrambling, default beam, power control, etc. With that in mind, it makes sense to define Rel-17 inter-cell MTRP based on CORESETPoolIndex. Besides, the updated proposal 2-2 raised by Nokia in the last round of discussion may can be regarded as the starting-point for reaching an agreement, if any. |
| Xiaomi | In order for the progress, we can support the number of configured non-serving cell for inter-cell Multi-TRP is 1 as a starting point.  While for 2), we think we are discussing about TCI state associated with non-serving cell PCI, why to define association between TCI state with CORESETPoolIndex? The motivation is not clear, |
| Ericsson | **Reply To ZTE,** you wrote **“….**Rel-16 MDCI (intra-cell) MTRP, and where only two TRPs can be used. “  Where is this restriction found in specifications?  In Rel-16, if the UE support 8 active TCI states, how to prevent the network to configure these by TRS transmitted from 8 different TRPs?  There is no way the UE can tell whether the TRS in those 8 TCI states are from same or different TRPs. Note that the spec is transparent to “TRP”, it only talks about TCI states.  This just even more highlight that the proposal is irrelevant, if anything, it should discuss the number of TCI states that may contain a non-serving cell SSB or a CSI-RS which is indirectly QCLed with a non-serving cell SSB. |
| LG | For 1), we have the same view with DOCOMO. The answer depends on whether it means the number of non-serving cell to be RRC configured or associated with a CORESEPoolIndex. If it means RRC configuration more than 1 non-serving cell can be configured as MTRP candidates but if it means non-serving cell associated with a CORESEPoolIndex, it should be one non-serving cell since up to two TRPs can be supported in Rel-16. For 2) non-serving cell does not have to be defined based on CORESET pool index. UE can differentiate serving cell and non-serving cell based on PCID. |
| Nokia | Alt.2 for first part and Alt.1 for second part. |
| APT/FGI | For issue 1), we share similar views with DCM and LG. It is better to clarify first what does “configured non-serving cell” mean.  For issue 2), we support Alt. 1. |
| CMCC | In our view, only two-TRP is supported for M-TRP in Rel-16, and one CORESETPoolindex is associated with one TRP. We think it is also the common understanding in other MIMO agenda, for example, in BM for MTRP.  Hence, we support Alt.1 for 1), and Alt.1 for 2). |
| Lenovo, MotM | For 1) we share the same view with DOCOMO and LG. If we are talking about the number of nun-serving cells associated with a same CORESETPoolIndex, it should be 1. However, the number of non-serving cells associated with the RRC configured TCI state may be larger than 1.  For 2) Yes. |
| MediaTek | Support Alt1 for 1)  Support Alt1 for 2) |
| Huawei, HiSilicon | Similar view as Ericsson. The non-serving cells are transparent to the UE and the UE only need to know what SSB to be detected for QCL tracking purpose. It is enough with configured/simultaneously tracked TCI state reporting. |
| Futurewei | 1) : Open to discuss further.  2): No. PCI based (i.e., SSB based) is sufficient, and CORESETPoolIndex based is redundant. For example, for one serving cell and one non-serving cell, two groups can be formed based on QCL and without CORESETPoolIndex as follows:  SSB1 (PCI1) --- RS1 --- channel1 --- resource1 …  SSB2 (PCI2) --- RS2 --- channel2 --- resource2 …  Note that **PCI based approach does NOT mean the PCI needs to be included in a TCI state / QCL info**, as the above two groups can be configured separately. We do not see any issue with this approach, but please let us know if we missed anything.  @QC: Thank you for the suggested compromise. If we understand correctly:  intercell M-TRP is PCI based (CORESETPoolIndex may be optionally supported), and  intracell M-TRP is CORESETPoolIndex based.  This may be acceptable.  Also related to the previous round of discussion, we suggest this be considered:   * The channels/signals QCLed to one PCI directly or indirectly shall not be QCLed to another PCI directly or indirectly. |
| Samsung | For issue 2, it is unclear to us why we need to agree on whether CORESETPoolIndex is linked to non-serving cell(s) or not given that this will also impact the non-serving cell information/association with the TCI state.  Besides, as we have commented during the 1st GTW session, the full PCI indication/association with TCI state and the reduced-overhead non-serving cell information indication/association with TCI state have different impacts on beam measurement/indication for the inter-cell operation, e.g., necessary configuration/indication design accounting for the overhead and etc. This is obviously RAN1 related. |
| CATT | For 1), Alt 1 is supported. Since only two TRPs are considered in Rel-16.  For 2), using CORESETpoolindex for serving/non-serving cell differentiation is not needed. If NW thinks that the TCI associated with the same non-serving cell information should be associated with the same CORESETPoolIndex, this can still be realized in implementation. |
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* 1. Item 3: Other non-serving cell information

Proposal3 after Round0:

Majority of companies support the proposal to clarify the term “SSB time domain position” which was agreed in RAN1#104e

* Clarify that “SSB time domain position” for non-serving cell SSB consists of “halfFrameIndex” and “ssb-PositionsInBurst”
* FFS: other non-serving cell information, e.g. centre frequency, SCS, and SFN offset

Support: OPPO, Ericsson, ZTE, DOCOMO(with change on FFS), QC(with change on FFS), Xiaomi(with change on FFS), MediaTek, Nokia, APT/FGI, CMCC, Lenovo/Motorola Mobility(with change on FFS), Futurewei, Samsung, CATT

Note: companies proposing revision of FFS are basically proposing “centre freq / SCS / SFN should be the same across serving cell and non-serving cell”

Not support: LG, Huawei/HiSilicon,

Please provide your comments whether above proposal is acceptable

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| Company | Comments |
| OPPO | Support the proposal. |
| QC | Support.  Instead of FFS, we suggest to make it clear that centre freq / SCS / SFN should be the same across serving cell and non-serving cell. |
| Ericsson | ssb-PositionsInBurst is ok. We follow Rel.16 multi-DCI assumptions, so it is obvious to us that SCS must be the same. |
| DOCOMO | Support the proposal and agree with QC. |
| ZTE | Support FL’s proposal.  On the part of FFS, we believe that center frequency, SCS and SFN offset should be included based on our previous elaboration (copy-pasted as follows). It can also be fine to further discuss/study.  **Center frequency:** It is typical that the non-serving cell SSB should be one of the SSB(s) that configured in *MeasObjectNR*, but there can be multiple SSBs for measurement with different center frequency which configured for one cell (identified by one PCI) according to the current specs. Thus, center frequency of SSB in MO should be provided.  **SCS**, **SFN offset:** When MTRP inter-cell in CA or inter-frequency operation, both of SCS and SFN can be different among serving cell and non-serving cell. Correspondingly, SCS and SFN offset of non-serving cell SSB should also be provided. |
| Xiaomi | Support the proposal and share same view as QC |
| LG | Not support. Smtc in MeasObject provides SSB time domain position for QCL measurement. Why is that halfFrameIndex and ssb-PositionsInBurst is needed for QCL measurement?  Moderator: What RAN1 need to agree on is what non-serving cell information is needed and let RAN2 do their job. In RAN1#103e, different options were discussed including SSB-Configuration-r16/ssb-InfoNcell-r16 and/or MeasObject, and new RRC IE, how to design signaling is RAN2 job. |
| Nokia | Ok with the Fl version. |
| APT/FGI | Support this proposal. |
| CMCC | Support the proposal. |
| Lenovo, Motorola Mobility | Support FL proposal and agree with QC’s clarification. |
| MediaTek | Support the proposal |
| Huawei, HiSilicon | Not support the proposal.  Multi-DCI works in the same BWP/SCS, so intra-frequency is assumed. We don’t see the need to extend it to inter-frequency scenario which is covered by CA case. |
| Futurewei | Generally OK with the proposal and QC’s clarification.  But we are a bit confused by whether we should add ssb index here. For a particular TRS QCLed to the SSB, generally it needs a ssb index, correct? Or maybe it is a common understanding that the ssb index will be configured when configuring a TRS? Exactly which step of configuring non-serving info are we discussing here? Please clarify.  Moderator: in my understanding, it is a common understanding among the group that the ssb index will be configured  Also the question raised by LG should be addressed.  Moderator: please see response to LG |
| Samsung | We are OK with the clarification on the SSB time domain position of a non-serving cell |
| CATT | Support |

* 1. Item 4: Other RS

Updated proposal4:

From the responses from companies, majority of companies support the proposal below, however there is no consensus.

* Do not support non-serving cell RS other than non-serving cell SSB as QCL source for intercell MTRP operation

Support: OPPO, QC, Ericsson, DOCOMO, Xiaomi, Nokia, MediaTek, APT/FGI, Lenovo/Motorola Mobility

Not support: ZTE, LG, Huawei/HiSilicon, CATT

Please provide your comments whether above proposal is acceptable

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| Company | comments |
| OPPO | Support the proposal in principle. It would be better to add “other than non-serving cell SSB” to make it clear. |
| QC | Ok. |
| Ericsson | Support OPPOs suggestion. |
| DOCOMO | Support OPPO’s suggestion. |
| ZTE | Do NOT support this proposal. As we elaborated in previous round of discussion (copy-pasted as follows), there are many benefits to use CSI-RS for mobility as QCL source from non-serving cell, it cannot be seen the logical to penalize other non-serving cell RS, esp. CSI-RS for mobility.   1. Same as SSB for mobility, the UE can use RX beam or other large-scale channel parameters derived from CSI-RS for mobility to receive signal from non-serving cell;   ii) Compared with SSB for mobility, CSI-RS for mobility has larger bandwidth, which can provide more accurate QCL derivation and can be implemented with narrower beam, especially it is more suitable to be QCL source of PDSCH in terms of TypeD since PDSCH usually uses narrow beam for transmission;   1. CSI-RS for mobility can be QCL source to speed up UE Rx beam sweeping, save power of UE, reduce overhead of eighbour and reuse measurement signal transmitted from gNB;   iv) Using CSI-RS for mobility as QCL source can support more flexible scenarios, especially when considering some non-serving cells only transmit CSI-RS for mobility but does not transmit SSB. |
| Xiaomi | Support OPPO’s suggestion |
| LG | Since mobility CSI-RS can have narrower beams and more flexible configuration than SSB, it provides finer QCL sources for eighbour cell DL RS. |
| Nokia | Ok with Oppo’s suggestion. |
| APT/FGI | Support. OPPO’s revision is OK to us. Hence, we support the revised updated Proposal 4. |
| Lenovo, Motorola Mobility | Support OPPO’s suggestion. |
| MediaTek | Support updated proposal 4 |
| Huawei, HiSilicon | We do not support the proposal. As mentioned by ZTE and LG, CSI-RS for mobility is clearly one alternative tool besides SSB, for inter-cell measurement and QCL tracking. It’s natural to reuse CSI-RS for mobility as one non-serving cell QCL source. |
| Futurewei | The description here seems a bit confusing. A non-serving cell TRS (which is QCLed to a non-serving cell SSB) may be a QCL source for a DMRS. Does it really mean the following:   * Do not support non-serving cell RS not QCLed to a non-serving cell SSB as QCL source for intercell MTRP operation   Moderator: the discussion point is whether, e.g. CSI-RS for mobility, can be QCL source while it is QCLed with non-serving cell SSB |
| CATT | Not support. CSI-RS for mobility should also be considered due to its UE-specific property. |
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* 1. Item 5: TCI state association with CORESET

Proposal5 after Round0:

All companies who responded support the proposal below, while there is some concern on the term “direct” since there is no agreement 5 options in item2 hence it is put in square bracket for now.

* For Type 1 and Type 2 PDCCH CSS, the UE is not expected to be configured a common search space to a CORESET configured with a TCI state associated [directly or indirectly] with an non-serving-cell SSB
  + FFS: Type3 PDCCH CSS

Please provide your comments whether above proposal is acceptable

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| Company | comments |
| OPPO | We support the proposal for Type 1 and Type 2 PDCCH CSS. It should be FFS for Type 3 PDCCH CSS. |
| QC | We also think only Type3-CSS should be FFS. |
| Ericsson | Support |
| DOCOMO | Agree with OPPO and QC. |
| ZTE | Only need to FFS Type3-PDCCH CSS. |
| Xiaomi | Support |
| LG | Support |
| APT/FGI | Support |
| Lenovo, MotM | Support |
| MediaTek | Support |
| Huawei, HiSilicon | In principle, ok with the proposal. Still, according previous conclusion of reusing R15/R16 QCL relation, it is not allowed to explicitly indicate any SSB as direct QCL source for a CORESET, so there is no need to mention ‘direct’ case at all. |
| Futurewei | Support, and agree with Huawei’s comment |
| CATT | Support |

* 1. Item 6: UL spatial relation info and PL-RS

Proposal6 after Round0:

Majority companies support the proposal below, while there are few companies do not support

* Support configuration of non-serving cell SSB as QCL source RS with existing QCL relation, UL-DL relation, and SRI relation for UL SRS, PUCCH, and PUSCH transmission
  + FFS other non-serving cell RS

Support: QC, DOCOMO, ZTE, Xiaomi, Nokia, MediaTek, APT/FGI, Lenovo/MotM, CATT

Not support: OPPO, LG, Huawei/HiSilicon

Please provide your comments whether above proposal is acceptable

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| Company | Comments |
| OPPO | Not support. It can be discussed in 8.1.1 or at least PUSCH should be precluded. |
| QC | Support. |
| DOCOMO | Support. |
| ZTE | Support FL’s proposal. |
| Xiaomi | Support |
| LG | Not support. It should be discussed in 8.1.1. |
| Nokia | Support |
| APT/FGI | OK with this proposal. |
| Lenovo, MotM | Support. |
| MediaTek | Support |
| Huawei, HiSilicon | We do not support the proposal. Based on current specs, there’s no “QCL” source for uplink. If uplink TCI is what is being talked about, the discussion should go to agenda 8.1.1. |
| Futurewei | We think this should include other non-serving cell RSs, e.g., TRS, CSI-RS, etc., that are QCLed to a non-serving cell SSB directly or indirectly. Also we think this should include all existing DL-UL relation, such as PL RS relation, spatial relation, associated CSI-RS relation, etc. SRI relation between SRS and PUSCH may also be included. So we suggest   * Support configuration of non-serving cell RS directly/indirectly QCLed to a non-serving cell SSB as QCL source RS with existing QCL relation, UL-DL relation, and SRI relation for UL SRS, PUCCH, and PUSCH transmission   + FFS other non-serving cell RS   Moderator: “RS directly/indirectly QCLed to a non-serving cell” this is related to item4, can be discussed after we conclude item4. |
| CATT | Support |

* 1. Item 7: Rate matching

Proposal7 after Round0

Few companies support and few companies do not support the proposal below.

* No additional rate matching for PDCCH/PDSCH from serving cell (or non-serving cell) around non-serving cell (or serving cell) SSB is needed

Support: OPPO, DOCOMO, Huawei/HiSilicon

Not support: ZTE, LG, CATT

Please provide your comments whether above proposal is acceptable

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| Company | Comments |
| OPPO | The proposal is unclear to us. PDSCH/PDCCH can still be rate-matched on other signal than SSB. We propose the following to make it clear:   * No additional rate matching for PDCCH/PDSCH around non-serving cell (or serving cell) SSB is needed |
| DOCOMO | Suggest following revision:  No additional rate matching for PDCCH/PDSCH from serving cell (or non-serving cell) around non-serving cell (or serving cell) SSB is needed. |
| ZTE | Do NOT support this FL’s proposal.  In reality, when the NCJT UE receives multiple downlink signals from different cells, due to the serious interference, the resource of SSB should be rate matched for PDSCH/PDCCH from another cell. Specifically, once serving cell PDSCH/PDCCH and non-serving serving cell SSB are overlapped by part or all of the resources, the PDSCH/PDCCH should perform rate matching around the SSB, and vice versa. |
| LG | Not support. we have same view with ZTE |
| Huawei, HiSilicon | Support revised version from OPPO. |
| Futurewei | Suggest to have more study. Maybe rate matching is not needed at least for FR2? |
| CATT | Not support. Same view as ZTE and LG. |

1. Reference

**Previous agreements**

**In RAN1 #102e meeting**, the following agreements were made:

**Agreement**

Study the following aspects of QCL /TCI-related enhancement to enable inter-cell multi-DCI based multi-TRP operation.

* Details on configuration of non-serving cell RS;
* Allowed source and target RS types for RS transmitted from the non-serving cell TRP ;
* Allowed QCL types for RS transmitted from the non-serving cell TRP ;
* Measurement and reporting related to QCL /TCI enhancement except for that in 8.1.1, if any;
* Clarification on potential UE behavior for associating/multiplexing non-serving cell RS with other RS/channels;
* Other details not precluded.

**In RAN1#103e meeting**, further agreements were made as below:

**Agreement**

For QCL /TCI related enhancement for enhanced inter-cell multi-TRP operations, support RRC configuration of non-serving cell information

* Non-serving cell information can be associated with the TCI state and/or QCL -info at least when “neighbor cell SSB” is used as “QCL referenceSignal ”
  + FFS : Whether beam indication enhancement is needed in addition to QCL -info enhancement
  + FFS : Whether the association is explicit or implicit

**Agreement**

The information provided by SSB-Configuration-r16/ssb-InfoNcell-r16 and/or MeasObject can be starting point for providing non-serving cell information

**For future meetings**

Consider rate matching behavior related to non-serving cell SSB.

**In RAN1#104e meeting**, further agreements were made as below:

**Agreement**

Non-serving cell information at least includes non-serving cell PCI to support inter-cell multi-DCI multi-TRP operation

* FFS: Whether the indication of PCI is implicit or explicit

**Conclusion**

Reuse Rel-15/16 QCL rule between the source and target RS/channel for non-serving cell RS/channel.

**Agreement**

At least following non-serving cell SSB information are needed in inter-cell MTRP operation

* SSB time domain position
* SSB transmission periodicity
* SSB transmission power

FFS: Other non-serving cell information

FFS: Whether indication of these information is implicit or explicit

**Agreement**

For inter-cell MTRP operation, further discuss following options and down select in RAN1#104bis-e

* Option1: Indicate/associate non-serving cell PCI in the TCI state
  + FFS other non-serving cell information
* Option2: Introduce a flag to indicate whether a TCI state/QCL information is associated with non-serving cell information or serving cell
  + FFS: how the flag is linked to non-serving cell
* Option3: Explicit or implicit grouping of TCI states associated with non-serving cell information corresponding to the serving cell and the non-serving cell respectively.
  + FFS: Each group is associated with a CORESETPoolIndex value.
  + FFS: how to link the group of TCI states to non-serving cell.
* Option4: Re-index the non-serving cell RS, e.g., in the TCI state/QCL-Info, so that the UE can differentiate between a serving cell RS and a non-serving cell RS
  + Example: serving cell RSs are indexed from #0, #1, …, #N-1, while non-serving cell RSs are re-indexed from #N, #N+1, …
  + FFS: detailed re-indexing rule(s) of non-serving cell RSs
* Option5: Introduce a new indicator (e.g., re-index the non-serving cell) to indicate the non-serving cell information that a TCI state/QCL information is associated with
  + FFS: how the indicator is linked to non-serving cell
  + Note: when there is only one non-serving cell, it means the same as Option2.

**Agreement**

Agree on scheme1

* Scheme1: PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around non-serving cell SSB with the same PCI
* FFS: whether PDSCH /PDCCH from serving cell (PCI) is rate matched around non-serving cell SSB
* FFS: whether PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around serving cell SSB

**Conclusion**

The UE may assume received DL transmission from multiple TRP within a CP in FR1 and FR2.

* Note: This does not imply that RAN1 intends to ask RAN4 to tighten network synchronization requirements.