**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”

**Observation1:** There are few contributions proposed to clarify the term “non-serving cell”,

Based on above observation, a tentative proposal is made below.

**Proposal1**: Discuss whether such clarification is needed.

|  |  |
| --- | --- |
| Company | comments |
| QC | Clarification may be needed, but this also depends on the outcome of Proposal 2-2. We suggest to discuss this proposal after we have an agreement on Proposal 2-2. |
| ZTE | Ok to discuss it. |
| Ericsson | It may be good to discuss for a common understanding in RAN1 but we may not need a strict definition to be agreed. We are not sure inter-cell for mTRP will be visible in RAN1 specifications, it may only be visible in RRC specifications 38.331. In our view, RAN1 specifications are (mostly) agnostic to whether an SSB has serving cell PCI or another PCI (at least for the discussions in this agenda). There may be some impact on the rate matching section though, but how to deal with this can be left to editors. |
| OPPO | We think “non-serving cell SSB” is sufficient for RAN1 discussion. Other non-serving cell channel/signal can be described by “QCLed to non-serving cell SSB”. We don’t need to define each channel/signal from non-serving cell respectively.  |
| Huawei, HiSilicon | Clarification is good, only for better interpretation of previous agreements. However, since the spec has clear definition of serving cell and any remaining cell will be regarded as non-serving cell, we don’t need to re-define the term “non-serving cell” in RAN1.  |
| Futurewei | Clarification is necessary at least for RAN1 discussion clarity; whether it needs to be reflected in the specs may be a different issue. |
| InterDigital | Support FL proposal |
| Samsung | We are OK to discuss whether a clarification is needed or not for inter-cell mTRP. In addition, some discussion on how/whether this should differ from L1/L2-centric inter-cell mobility in AI 8.1.1 (MB) is needed. Note that it has been agreed that measurement/reporting for inter-cell mTRP is covered in AI 8.1.1 (MB), e.g. some agreements applied for both have been made and the term “non-serving cell” is used (see below). If the same definition of non-serving cell should be used for both inter-cell mTRP and L1/L2-centric mobility, then this is a common issue that needs to be discussed for both 8.1.1 and 8.1.2.2.**Agreement**:On Rel.17 multi beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP:* 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) and related measurement behavior
	+ FFS: Whether or not beam reporting associated with non-serving cell(s) can be mixed with that with serving-cell in one reporting instance

**Agreement**:On Rel.17 multi beam measurement/reporting enhancements for L1/L2-centric inter-cell mobility and inter-cell mTRP:* Rel.15 L1-RSRP is used as reporting quantity for measurement and reporting of non-serving-cell(s)
	+ Support SSB as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP, and Rel.15 SS-RSRP calculated from SSB of non-serving cell(s)
		- FFS: Whether the measurement for SS-RSRP is limited within SMTC
		- FFS: Detailed reporting method, e.g. via including existing L1-RSRP report, UE-initiated report etc.
	+ FFS: Whether or not to support CSI-RS (for e.g. mobility and/or tracking) of non-serving cell(s) as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP. If the support of CSI-RS (for e.g. mobility and/or tracking) of non-serving cell(s) as a measurement RS for L1/L2-centric inter-cell mobility and inter-cell mTRP is confirmed, Rel.15 CSI-RSRP is also supported
		- Whether the support applies to CSI-RS with or without QCL source, or both
	+ FFS: The number of non-serving cell(s) for measurement/reporting
	+ FFS: time behavior of the reporting, i.e. periodic, semi-persistent, aperiodic, or UE-initiated
* FFS: If other reporting quantities are supported, e.g. L3-RSRP, hybrid L1/L3-RSRP
* FFS: Dynamic activation/deactivation/selection of the beam measurement on the RS(s) associated with non-serving cell(s) via MAC CE

FFS: Timing assumption (e.g. time of arrival and time of the measurement) for measurement of non-serving cell RS measurement |
| Xiaomi | It is better to clarify it.  |
| Intel | We are not sure what we are agreeing to in the proposal. Serving cell is used in specifications, therefore non-serving cell conceptually should be clear. |
| CATT | We are fine with the clarification. |
| DOCOMO | It is good to clarify it, both in mTRP inter-cell and L1/L2-centric inter-cell mobility. And when sending LS to RAN2 (if needed), it is better to also include such clarification in the LS, since serving cell and non-serving cell have clear definition in RAN2. |
| Lenovo, Motorola Mobility  | Fine to discuss it to have a common understanding in RAN1 for further discussion. |
| Nokia/NSB | Ok to have it. |
| CMCC | Ok to clarify it for RAN1 discussion purpose. |
| LG | Support the proposal |
| Apple | We agree the term “non-serving cell” is confusing, but we suggest we should not discuss it online. It can be up to editor or we can try a better term offline, e.g. assistant cell |

Observation1 after Round 0:

* + Majority of companies see it is beneficial to clarify the meaning if ‘non-serving cell’ which is used in both 8.1.1 and 8.1.2.2 AIs, which is also beneficial to capture in LS to RAN2 to avoid different understanding.

Proposal1-1: “non-serving cell” is clarified as following

Alt1: A PDCCH/PDSCH from non-serving cell is the PDCCH/PDSCH transmitted with TCI states with QCL source RS as a non-serving cell RS

Alt2: For inter-cell multi-TRP enhancement, replace the term “non-serving cell” with “cooperating cell” or the like

Updated proposal 1-1

Conclusion:

* + 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.

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

|  |  |
| --- | --- |
| 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.  |

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

**Observation2:** following observations are made based on contributions

1. There are different views on whether to support explicit or implicit indication/association of non-serving cell PCI in the TCI state, i.e. selecting one of the options from RAN1#104e
2. Few companies proposed that a new RRC IE can be introduced to configure the non-serving cell information
3. Few companies proposed that *MeasObjectId* is associated with TCI state, that means neighboring cell (PCI) is one of the PCI reported by UE based on MeasObject
4. Few companies proposed that TCI states are grouped, e.g. CORESETPoolIndex value 0 and 1 to have TCI states associated with non-serving cell and serving cell PCI, while one company proposed that CORESETPoolIndex is not necessary
5. Few companies proposed to send LS to RAN2 informing them about the RAN1 agreement on indication/association of PCI to TCI state is needed for inter-cell MTRP operation, how to design the signalling is up to RAN2.

Based on above observation tentative proposal is made below

**Proposal 2-1:**

* Send LS to RAN2 informing them on necessity of indication/association of non-serving cell information in the TCI state for inter-cell MTRP operation, and detailed signaling design is up to RAN2

|  |  |
| --- | --- |
| Company | comments |
| QC | LS can be sent as part of normal procedures (to inform RAN2 about the agreement, and not specific to this issue). We think RAN1 still needs to agree on some more details such as the number of non-serving cells, etc. In addition, in the agreement with five options in the previous meeting, we had “further discuss following options and down select in RAN1#104bis-e”. Moderator: The agreement as highlighted is true, however looking at diverging proposals I am not sure it would be worthwhile discussing same thing again.Yes, we can discuss on number of configured non-serving cells TRPs in RAN1 |
| ZTE | Although it can be RAN2’s business to determine the association/indication between non-serving cell info and TCI state/QCL-info, we think the following issues should be addressed in RAN1 first:1. How many non-serving cell TRPs can be configured for inter-cell MTRP operation?

As per our view, the number of configured non-serving cell TRP should be 1. With respect to MTRP inter-cell operation is based on Rel-16 MDCI MTRP scheme, it means up to two TRPs can be used for this operation. Then, it is natural that one out of the two TRPs is deployed in the serving cell, and the other TRP is deployed in the non-serving cell. Moderator: please see response to QCii) What kind of other information of non-serving cell SSB is needed?This is related to item 3 where our response can be found accordingly.Moderator: yes, it can be discussed in item 3 |
| Ericsson | **Support the proposal.** Moreover, we don’t understand the need to agree on a restriction of the number of non-serving cell TRPs, perhaps ZTE and Qualcomm can elaborate on what the issue is that requires a restriction.  |
| OPPO | We agree with QC and ZTE that we should at least agree on the number of non-serving cell in RAN1, e.g. whether multiple non-serving cells are allowed, before sending LS. Without this information, RAN2 is not able to design the corresponding signaling, e.g. the maximal number of IEs for non-serving cell information. Moderator: please see response to QC |
| Huawei, HiSilicon | Support FL proposal. |
| Futurewei | Support this proposal in principle. However, we think in order to arrive to this proposal, RAN1 needs to first agree on necessity of indication/association of non-serving cell information in the TCI state for inter-cell MTRP operation, and then discuss LS to RAN2. So we suggest to consider the following revision:**Suggested Proposal 2-1:** * Support indication/association of non-serving cell information in the TCI state for inter-cell MTRP operation
	+ FFS signaling: e.g., details up to RAN2 and send LS to RAN2

Moderator: this revision should be fine, my original intention is to let RAN2 know that there should be “indication/association of non-serving cell information in TCI state” |
| InterDigital | First, we need to have a clear agreement on one of the options. In our view, Options 1,2 and 5 are very different from Options 3 and 4, and so they have different impact on RAN2 design.Moderator: please see response to QC, and for any impact on RAN2 design is up to RAN2. |
| Samsung | We sympathize with the views of QC, OPPO, and ZTE.Basically, whether the full PCI value (0~1007) or certain reduced (lower overhead) non-serving cell information such as a flag, re-indexed non-serving cell RSs and etc. needs to be associated with the TCI state does not seem to be an RAN2 issue. This should first be discussed and agreed in RAN1 because it will impact beam measurement and beam indication signaling design. It is obviously not a RAN2 issue. Furthermore, as agreed in RAN1# 104-e, we need to discuss the five options in this meeting. Prior to fully addressing the above issues related to RAN1, it is unclear to us what a LS to RAN2 is about.We suggest that the five options be discussed and down-selected first.Moderator: please see response to QC, and I am sure RAN2 will take signalling overhead into account in their design, or such a note in LS to RAN2 can be added. |
| Intel | We don’t think Proposal 2-1 provides sufficient information to RAN2 to create detailed design. Non-serving cell information should be clarified, max number of TCI states can be up to 64 or 128 while max PCI range is 1008 – we need to give them more information by describing the desired possible mappings from PCI to TCI state. RAN2 design can be very different if 2 PCID is mapped to 2 mutually exclusive groups of TCI states vs a fully flexible mapping.Moderator: on number of non-serving cell TRPs please see response to QC, and for any impact on RAN2 design is up to RAN2. |
| CATT | RAN1 may agree on explicit indication or implicit indication first. Then the detailed signaling may be designed by RAN2.Moderator: Please see response to QC |
| DOCOMO | Suggest more discussions in RAN1 on the number of non-serving cells to be RRC configured, on the number of non-serving cells to be associated with CORESETs from the same CORESETPoolIndex.Suggest setting up a deadline (e.g., RAN#104b-e) for association signalling design discussion. If there is still no consensus in RAN1 till the deadline, send an LS to RAN2 and let RAN2 decide it. The LS to RAN2 can include the agreements so far, the five options for association signalling design, the number of non-serving cells to be RRC configured, and the number of non-serving cells to be associated with CORESETs from the same CORESETPoolIndex.Moderator: on number of non-serving cell TRPs please see response to QC, yes we can keep this discussion until Friday(?), it is up to Chair. |
| Nokia/NSB | Not needed to send an separate LS as the LS sent within 8.1.1 had questions related to inter-cell multi-TRP operation. Moderator: Yes, let’s see if there is any additional information on previous LS is needed. |
| CMCC | We agree with QC, OPPO, ZTE, and Samsung. Discussion on the number of non-serving cells is necessary.Moderator: please see response to QC |
| Apple | We suggest we try some discussion first. We think option 2/3/5 are fundamentally the same.Moderator: please see response to DOCOMO |
| Lenovo, MotM | We can support FL proposal. Regarding to the number of non-serving cells, as we are discussing the TCI state associated with a non-serving PCI, those TCI states may be the TCI-state configured by RRC or the TCI-state activated for PDCCH or for PDSCH. If we are discussing inter-cell multi-TRP based on the multi-DCI multi-TRP framework, we think the number of non-serving PCI associated with the activated TCI states should be one. The number of non-serving PCI associated with the configured TCI-states in a cell can be further discussed. |

Observation2-1 after Round0:

* More discussion is needed on potential down selection from 5 options, and LS to RAN2 if necessary.

**Proposal 2-2:**

* Discuss whether to specify the limitation between CORESETPoolIndex and non-serving cell information.
	+ The TCI associated with the same non-serving cell information should be associated with the same CORESETPoolIndex
	+ UE does not expect channels associated with CORESETPoolIndex value 0 and 1 to have TCI states associated with non-serving cell and serving cell PCI, respectively

|  |  |
| --- | --- |
| Company | comments |
| QC | Support the proposal. We do not see why TCI states associated with a given PCI should be used across both CORESETPoolIndex values. |
| ZTE | Support FL’s proposal. |
| Ericsson | No need to discuss this, we don’t see why there should be a relation between pool index and TCI states associated with ns-cell and s-cell. This sounds like an artificial restriction.  |
| OPPO | Support the 1st sub-bullet of the proposal. We agree that serving cell and non-serving cell should be associated with different values of *CORESETPoolIndex*, but the restriction on value 0 for serving cell and value 1 for non-serving cell seems unnecessary.  |
| Huawei, HiSilicon | Support FL proposal. |
| Futurewei | Do not support this proposal. We have not agreed that the non-serving cell has to be associated with a CORESETPoolIndex.However the proposal may be revised to state that the channels/signals QCLed to one PCI directly or indirectly shall not be QCLed to another PCI directly or indirectly. |
| InterDigital | Don’t support. A solution based on *CORESETPoolIndex* was one of potential ways for implementing Option3. Since we have not had any agreement for this option, we are not sure why we are discussing such detail. |
| Samsung | It is unclear to us how the association between a CORESETPoolIndex and TCI states is important here. If it is related to non-serving cell information associated with TCI, then the discussions should be under item 2.1 |
| Xiaomi | It is better to discuss on the motivation to associate the TCI and the CORESETPoolIndex first. |
| Intel | Support, seems to be a natural consequence of multi-DCI multi-TRP with non-serving cell information |
| CATT | In our view this proposal is equivalent to option3. This proposal should not be discussed before we have agreement on proposal 2-1.  |
| DOCOMO | Support the 1st sub-bullet. |
| Lenovo, Motorola Mobility  | Support FL proposal. |
| Nokia/NSB | We think multi-TRP operation should be defined based on CORESETPoolIndex, otherwise a new behaviour should be discussed from the scratch on how the M-TRP operation applied. We see that some companies see that it is not essential to configure, but this issue was discussed also last time. We suggest companies who assume the Rel-16 M-TRP operation without CORESETPoolIndex to clarify the operation. **Proposal 2-2:** * Discuss whether to specify the limitation between CORESETPoolIndex and non-serving cell information.
	+ Alt.1: When CORESETPoolIndex value is configured similar to Rel-16, the TCI associated with the same non-serving cell information should be associated with the same CORESETPoolIndex. The UE can follow Rel-16 defined M-TRP operation.
	+ Alt.2: When CORESETPoolIndex value is not configured and the TCI associated with serving cell and non-serving cell information, discuss how the M-TRP operation applied.
		- Option 1: The serving cell shall be associated with CORESETPoolIndex =0 and non-serving cell shall be associated with CORESETPoolIndex = 1 in order to follow Rel-16 defined M-TRP operation.
		- Option 2: ..
		- Option 3: ..
	+ UE does not expect channels associated with CORESETPoolIndex value 0 and 1 to have TCI states associated with non-serving cell and serving cell PCI, respectively
 |
| CMCC | We agree with Nokia’s clarification. |
| LG | Support  |
| Apple | We support the linkage, but from companies’ comments, it seems better we can firstly reach a consensus on the following issues:* The maximum number of non-serving cells that can be associated with TCI states configured by RRC
* The maximum number of non-serving cells that can be associated with TCI states activated by MAC CE
* The maximum number of non-serving cells that can be associated with TCI states applied for each DL channel/RS
 |

Observation2-2 after Round0:

* There is no consensus on whether such discussion is needed, and it is also related to one of the options being discussed in item 2-1.

Updated Proposal 2 after GTW on Monday

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)
	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: DOCOMO, ZTE, Nokia)
	2. Alt2: No (supported by: LG, )

Don’t support 1) and 2) : Ericsson

Please indicate your preference and provide reasoning, if possible.

|  |  |
| --- | --- |
| 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. |

* 1. Item 3: Other non-serving cell information

**Observation3:** There are few contributions proposed to support other non-serving cell SSB information and clarification on “SSB time domain position”

Based on above observation, a tentative proposal is made below.

**Proposal3**: Discuss whether other non-serving cell SSB information are needed. Clarify “SSB time domain position” for non-serving cell SSB consists of “halfFrameIndex” and “ssb-PositionsInBurst”.

|  |  |
| --- | --- |
| Company | comments |
| QC | Support the proposal. We think both configs are needed for the purpose of referring to a SSB index as well as for rate matching.In addition, we would like to clarify that same SCS, freq., and SFN should be assumed. |
| ZTE | Support FL’s proposal. We believe that center frequency, SCS and SFN offset of non-serving cell SSB should be provided with the following analyses.**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. |
| OPPO | We agree with QC on the clarification. |
| Huawei, HiSilicon | We don’t see the need of further discussion of other SSB information. |
| Futurewei | Should SSB index be supported? |
| InterDigital | Support FL proposal |
| Samsung | We are OK with the clarification on the SSB time-domain position information |
| Xiaomi | We agree with QC on the clarification. |
| Intel | Agree with the clarification |
| CATT | We are fine with the proposal. |
| DOCOMO | Support the proposal. |
| Lenovo, Motorola Mobility  | Support FL proposal and agree with QC’s clarification. |
| Nokia | Ok with the proposal.  |
| CMCC | Support the proposal. |
| LG | Same view with Huawei. |
| Apple | We think freq location needs to be clarified first |

Observation3 after Round0:

* Majority of companies agree with clarification on “SSB time domain position” for non-serving cell SSB consists of “halfFrameIndex” and “ssb-PositionsInBurst”

Proposal3 after Round0:

* 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)

Not support: LG

Please provide your comments whether above proposal is acceptable

|  |  |
| --- | --- |
| 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?  |
| 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. |

* 1. Item 4: Other RS

**Observation4:** There are few companies proposed to support non-serving cell NZP-CSI-RS for mobility, CSI as QCL source, while one company proposed not to support.

**Proposal4**: Discuss whether to support non-serving cell RS other than SSB for inter-cell MTRP operation

|  |  |
| --- | --- |
| Company | Comments |
| QC | Do not support. Motivation is not clear. The following is already concluded, and there is no need for further discussions on this:**Conclusion**Reuse Rel-15/16 QCL rule between the source and target RS/channel for non-serving cell RS/channel.  |
| ZTE | Support FL’s proposal. We think non-serving cell CSI-RS for mobility should be used as the QCL source in the light of the following reasons: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. |
| Ericsson | Do not support, agree with QC. Moreover, we don’t need to consider L1/L2 mobility measurements and procedures in multi-TRP agenda, let’s use MB agenda for this.  |
| OPPO | Do not support.  |
| Huawei, HiSilicon | Support FL proposal. CSI-RS for mobility has been supported for RRM purpose since R15, with performance requirements defined in R16, and supporting CSI-RS for mobility for inter-cell mTRP operation would help improving resource utilization.  |
| Futurewei | A clarification question: can the non-serving cell RS be QCLed to a non-serving cell SSB? |
| InterDigital | OK to discuss, but not here. It should be done under BM agenda. |
| Samsung | We do not see the need to support CSI-RS for mobility as an additional QCL source RS. It is sufficient to configure only the non-serving cell SSB as the QCL source RS. |
| Xiaomi | Not support. SSB is sufficient  |
| Intel | Not needed in our opinion. SSB should be sufficient |
| CATT | CSI-RS for mobility should at least be supported. |
| DOCOMO | Do not support the proposal. |
| Lenovo, Motorola Mobility  | Do not support. The following conclusion is enough for the TCI-state configuration for inter-cell multi-TRP.**Conclusion**Reuse Rel-15/16 QCL rule between the source and target RS/channel for non-serving cell RS/channel. |
| Nokia | Discussion should be ok. But SSB is enough.  |
| LG | Support. Since mobility CSI-RS can have narrower beams and more flexible configuration than SSB, it provides finer QCL sources for eighbour cell DL RS |
| Apple | This proposal reverts previous conclusion as mentioned by Lenovo |

Observation4 after Round0:

* Views are diverging, majority of companies do not support non-serving cell RS other than SSB for inter-cell MTRP operation.

Based on majority of companies, updated proposal4 is provided.

Updated proposal4

* 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

Not support: ZTE

Please provide your comments whether above proposal is acceptable

|  |  |
| --- | --- |
| 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. |

* 1. Item 5: TCI state association with CORESET

**Observation5:** there are two companies raised the issue on UE behaviour when CORESET configured with a TCI state is configured with a common search space.

**Proposal5:** 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

|  |  |
| --- | --- |
| Company | comments |
| QC | We are ok with this in principle. However, should this be applied to all CSS? For example, what is the motivation for this restriction for Type3-CSS? |
| ZTE | Share the same view with QC that the use case of Type3-PDCCH CSS should be clarified. |
| Ericsson | Support the proposal and good suggestion from QC and ZTE, some details needs to be clarified. We can perhaps add an FSS on the different Types, e.g .Type 3.  |
| OPPO | The same view as QC and ZTE. For Type3-PDCCH CSS, e.g group common TPC, it can be allowed to be transmitted from serving cell or non-serving cell.  |
| 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 in principle |
| InterDigital | Need further discussion. |
| Xiaomi | support in principle, need further discussion on Type 3 CSS. |
| Intel | Support in principle |
| CATT | Support in principle. |
| DOCOMO | Support in principle, and agree with QC/ZTE/OPPO/Xiaomi for further clarification. |
| Lenovo, Motorola Mobility  | Support in principle and support share similar view with QC and ZTE. We can take Type 3 CSS as FFS. |
| Nokia/NSB | Without knowing how the inter-cell multi-TRP operation yet, we do not think this restriction is needed.  |
| LG | Support in principle |
| Apple | Is it only for CORESET0? |

Observation5 after Round0:

* Majority of companies are fine with the principle

Proposal5 after Round0:

* 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

|  |  |
| --- | --- |
| 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 |

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

**Observation6:** Several companies proposed to support configuration of non-serving cell SSB as QCL source for UL SRS, PUSCH, PUCCH transmission, while few companies also proposed to support non-serving cell CSI-RS as PL-RS for UL transmission.

Based on the observation, following tentative proposal is made.

**Proposal6:** Support configuration of non-serving cell SSB as QCL source RS with existing QCL relation for UL SRS, PUCCH, and PUSCH transmission

* FFS other non-serving cell RS

|  |  |
| --- | --- |
| Company | comments |
| QC | Support the proposal. For multi-DCI, we need to have UL (PUCCH/PUSCH/SRS) to both TRPs.  |
| ZTE | Support FL’s proposal.  |
| Ericsson | Support the proposal in principle, but I wonder if we need to discuss this. In our view, when we have an SSB associated to a ns-cell PCI agreed, then Rel.16 behaviour for mTRP operation follows automatically. No need to discuss all the Rel.16 details again.  |
| OPPO | Support to add non-serving cell SSB into spatial relation information of PUCCH/SRS. However, for PUSCH, we are not sure whether it is needed based on Rel-16 signaling. The spatial relation of PUSCH comes from SRI/SRS/PUCCH but not DL signal in current specification. Whether we need to support UL-TCI in Rel-17 for this function? |
| Huawei, HiSilicon | Instead of QCL source RS, we assume Proposal 6 is talking about extending spatial relation in R16. We don’t think this proposal is needed/justified. According to the conclusion of reusing R15/R16 QCL relation, for PDCCH/PDSCH reception, the UE will be configured with CSI-RS for DL QCL tracking, and these CSI-RS will have SSB from non-serving cell as QCL source. NW can simply use these CSI-RS as source RS for spatial relation indication for PUCCH/PUCCH/SRS when needed.  |
| Futurewei | Support |
| InterDigital | Support the proposal in principle, however it should be discussed under BM agenda. |
| Xiaomi | Support the proposal |
| CATT | We are fine with the proposal. |
| DOCOMO | Support the proposal. |
| Lenovo, Motorola Mobility  | Support FL’s proposal.  |
| Nokia/NSB | Support |
| LG | It is out of scope of this agenda. It should be discussed under BM agenda. |
| Apple | This should be out of scope |

Observation6 after Round0:

* Majority of companies support proposal 6.

Proposal6 after Round0:

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

Support: QC, DOCOMO, ZTE, Xiaomi, Nokia

Not support: OPPO, LG

Please provide your comments whether above proposal is acceptable

|  |  |
| --- | --- |
| 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. |

* 1. Item 7: Rate matching

**Observation7:** several companies expressed their views on rate matching of PDSCH /PDCCH from serving cell (or non-serving cell) rate matched around non-serving cell (or serving cell) SSB, however there are few companies supporting and others against, slight majority of do not support.

Based on observation above, following tentative proposal is made

**Proposal7:** Discuss whether to support PDSCH /PDCCH from serving cell (or non-serving cell) rate matched around non-serving cell (or serving cell) SSB.

|  |  |
| --- | --- |
| Company | comments |
| QC | We think there is no need for the additional rate matching.In addition, in the previous agreement, for both PDSCH and PDCCH, the word “rate matching” is used. However, we do not have rate matching around PDCCH in existing spec. We suggest to clarify that for PDCCH, dropping is meant, and not rate matching. |
| ZTE | Support to discuss it and we think PDSCH/PDCCH and non-serving cell SSB form different cells should be rate matched in MTRP inter-cell operation to guarantee inter-cell transmissions’ performance. |
| Ericsson | Agree with QC, no need for additional rate matching. In our view, when we have an SSB associated to a ns-cell PCI agreed, then Rel.16 behaviour for mTRP operation follows automatically, including rate matching. No need to discuss all the Rel.16 details again. |
| OPPO | Agree with QC and Ericsson that no additional rate matching is needed. If rate-matching is needed, rate-matching pattern can be used. There will be performance loss if the rate-matching is mandatory. |
| Futurewei | Ok with further discussion |
| InterDigital | Same view as Ericsson |
| Samsung | We are ok to discuss additional rate matching for inter-cell operation |
|  CATT | For both cases, rate matching is needed to avoid performance loss. |
| DOCOMO | Do not support it. No need for additional rate matching. |
| Lenovo, Motorola Mobility  | Agree with QC, Ericsson and OPPO that no additional rate matching is needed. |
| Nokia/NSB | Agree with QC and E/// |
| LG | Same view with ZTE and CATT |
| Apple | We think rate matching is necessary. UE cannot perform RLM based on SSB and at the same time UE needs to receive PDSCH according to RAN4 spec, since UE needs to sweep Rx beams to receive SSB. |

Observation7 after Round0:

* Views are diverging, slight majority of companies expressed that no additional rate matching is needed.

Proposal7 after Round0

* 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

Not support: ZTE, LG

Please provide your comments whether above proposal is acceptable

|  |  |
| --- | --- |
| 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 |

* 1. Item 8: Others

**ZTE**

Support sequence generation of a non-serving cell TRS used as TCI source should be based on slot index of this non-serving cell.

**Xiaomi**

Group based beam reporting is slightly preferred for inter-cell beam pairing.

Inter-cell beam management by gNB can be supported.

Whether the PDCCH candidate or CCE from CORESETs associated with neighboring cell should be considered as same as that of serving cell or not when calculating the maximum number of monitored PDCCH candidates and the maximum number of non-overlapped CCE.

**Intel**

Consider associating the following with a TCI-State including SSB-Index from another PCID:

* TRS
* CORESETs
* DCI codepoint for TCI-State switching
* NZP-CSI-RS-ResourceSet with repetition set to ‘on’ (L1-RSRP)
* BFD resources (failureDetectionResources)
* CSI-RS for CSI measurement

**Qualcomm**

In the set of symbols indicated to a UE by non-serving cell *ssb-PositionsInBurst*,

* Option 1: The UE does not transmit any UL signal/channel.
* Option 2: The UE can only transmit UL signal/channel associated with the serving cell PCI.
* Further study the impact on the following Rel. 15/16 procedures based on a selected option from Option 1 or 2 above:
	+ Procedure 1: When SSB overlaps with UL channel/RS, UE does not transmit the UL channels/RS [38.213, Section 11.1].
	+ Procedure 2: UE does not expect the set of SSB symbols to indicated as uplink symbols either semi-statically or dynamically (by SFI) [38.213, Section 11.1 and Section 11.1.1].
	+ Procedure 3: SSB symbols are assumed to be invalid symbols in a nominal repetition for PUSCH repetition Type B [38.214, Section 6.1.2.1].
	+ Procedure 4: For determination of the $N\_{PUCCH}^{Repeat}$ slots in the case of PUCCH repetition, i.e., a slot is not counted toward the $N\_{PUCCH}^{Repeat}$ slots if the PUCCH resource in that slot overlaps with a SSB [38.213, Section 9.2.6].

**Futurewei**

For an inter-cell TRP, a signal/antenna port is non-co-located (NCLed) to the serving cell (i.e., the serving cell’s SSB) and is directly or indirectly QCLed to the non-serving cell’s SSB.

**Samsung**

For QCL source RS and QCL source RS type from non-serving cell

* For DL channels, large scale QCL properties are inferred from up to two RSes for QCL-TypeA and QCL-TypeD respectively.
* The QCL-TypeA source RS is TRS from non-serving cell, and QCL-TypeD source RS is non-serving cell SSB.

**Sony**

Non-serving cell information such as Cell ID or Physical Cell ID for RS shall be added in the CSI-ReportConfig.

QCL information among CSI-ResourceConfig in terms of beam sweeping property shall be included in the CSI-ReportConfig.

**LG**

Neighbor cell’s SSB can be configured as QCL type C/D source of TRS/CSI-RS to support inter-cell multi-TRP operations.

**Nokia**

For L1 SSB based beam measurements and reporting, enhance the *CSI-SSB-ResourceSet IE* to associate set of SSBs with a cell-specific identifier (PCI).

For non-serving cell CSI-RS measurements, configure the NZP-CSI-RS with a QCL source RS that is associated with a non-serving cell identifier.

**Ericsson**

The UE can assume that non-serving-cell use the same Point A as the serving-cell when receiving from the non-serving-cell. Hence, no specification impact is foreseen.

|  |  |
| --- | --- |
| Company | comments |
| QC | At least the case of overlap between non-serving SSBs and UL signals / channels should be clarified.  |
| ZTE | How to successfully generate the sequence of non-serving cell TRS should be studied. |
| Ericsson | The Point A issue needs to be clarified. (includes the TRS sequence and CSI-RS, DRMS sequence).  |
| Apple | We also think point A needs to be clarified. |

1. Reference

|  |  |  |
| --- | --- | --- |
| [**R1-2102335**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102335.zip) | Enhancements on inter-cell multi-TRP operations in Rel-17 | Huawei, HiSilicon |
| Proposal 1: Clarify that ‘PDSCH/PDCCH from non-serving cell (PCI)’ refer to PDSCH/PDCCH from the serving cell but has a SSB/CSI-RS from non-serving cell as (indirect) QCL source. Proposal 2: Support Option 1, i.e., explicitly indicate the PCI of a neighbour cell in the SSB configuration inside a TCI state.Proposal 3: Support using NZP-CSI-RS from a non-serving cell or CSI-RS for RRM associated with a non-serving cell as QCL source for multi-DCI based multi-TRP transmission. |
| [**R1-2102380**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102380.zip) | Enhancement on inter-cell multi-TRP operation | OPPO |
| Proposal 1: Non-serving cell information includes SSB configuration information (e.g. PCI) of one neighboring cell, which is configured separately from QCL information to reduce signaling overhead.Proposal 2: To associate non-serving cell information with a TCI state, support Option 2: introduce a flag to indicate whether a TCI state/QCL information is associated with non-serving cell information or serving cell.Proposal 3: The neighboring cell (PCI) indicated by non-serving cell information should be one of the cells (PCIs) measured and reported by UE based on MeasObject.Proposal 4: For a CSI-RS QCLed with neighboring cell SSB, the transmit power is calculated based on powerControlOffsetSS and the SSB transmission power in neighboring cell information.Proposal 5: The resource of DL signal from serving cell is not impacted by the SSB configured by neighboring cell information. |
| [**R1-2102434**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102434.zip) | Remaining Issues for M-TRP Inter-cell Operation | InterDigital, Inc. |
| Proposal 1: Support explicit signalling of the non-serving cell related information.Proposal 2: Support Option 1 or 2 where an explicit indication of association of TCI state /QCL information with a serving/non-serving cell is implemented through inclusion of PCID into TCI state/QCL information or introducing a flag, respectively. |
| [**R1-2102443**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102443.zip) | Discussion on enhancement multi-TRP inter-cell operation | Spreadtrum Communications |
| Proposal 1: Support to indicate/associate non-serving cell PCI in the TCI state.Proposal 2: For inter-cell multi-TRP operation, PDSCH/PDCCH from the serving cell should not be rate-matched around non-serving cell SSB.Proposal3: For inter-cell multi-TRP operation, PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is not rate matched around serving cell SSB. |
| [**R1-2102508**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102508.zip) | Further discussion on inter-cell MTRP operation | vivo |
| Proposal 1: Strive to down select one of the 5 options for indication/association of non-serving cell information with TCI states, send LS to RAN2 on RAN1 agreements on inter-cell MTRP operation.Proposal 2: Clarify UE behaviour when CORESETs with type 0/1/2 SS is configured/activated with TCI states associated with SSB of another PCI.Proposal 3: * + CSI-RS for mobility should be supported as the QCL source for channels/RS.
	+ CSI-RS for CSI, beam management and tracking should all be allowed to be associated with non-serving cell RS for L1 inter-cell measurement.
		- FFS whether specification enhancement is needed.

Proposal 4: For discussion purpose, define PDSCH/PDCCH/RS from non-serving cell (PCI) as following: * + A non-serving cell RS is one of the following (agreement till now):
		- SSBs associated with the non-serving cell information;
		- RS configured with TCI states associated with non-serving cell information;
		- RS configured with TCI state with QCL source RS as a non-serving cell RS (including all three different kinds);
	+ A PDCCH/PDSCH from non-serving cell is the PDCCH/PDSCH transmitted with TCI states with QCL source RS as a non-serving cell RS.

Proposal 5: PDSCH in non-serving cell is not rate matched around SSB from serving cell and PDSCH in serving cell is not rate matched around SSB from non-serving cell.Proposal 6: Spatial relation and power control related configurations should be enhanced for SRS, PUCCH, PUSCH transmission towards target cell. |
| [**R1-2102600**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102600.zip) | Discussion on inter-cell operation for multi-TRP/panel | CATT |
| Proposal-1: The necessity of frequency (i.e. ssb-Freq-r16 and absoluteFrequencySSB) and SCS (i.e. sbSubcarrierSpacing-r16) parameters depends on whether inter-frequency scenario is supported. SFN and half-frame index are further needed for inter-cell mTRP.Proposal-2: Introduce a new indicator to indicate the non-serving cell information that a TCI state/QCL information is associated with (Option5). The indicator could be configured in the activation MAC-CE.Proposal 3: PDSCH/PDCCH from serving cell is rate matched around non-serving cell SSB. PDSCH/PDCCH from non-serving cell is rate matched around serving cell SSB.  |
| [**R1-2102662**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102662.zip) | Discussion on Multi-TRP inter-cell operation | ZTE |
| **Proposal 1:** Other non-serving cell SSB information provided to UE should at least include center frequency, SCS, and SFN offset.**Proposal 2:** Support to introduce a new RRC IE linking with some TCI states. * At least MeasObjectId and PCI should be contained in the new IE.

**Proposal 3:** For the configuration TCI state/ QCL-info with non-serving cell SSB information, support Opt. 3 that all TCI states should be split into two groups which corresponding to serving cell and non-serving cell, respectively.* Each group of TCI states is associated with a CORESETPoolIndex value.

**Proposal 4:** Supported to use non-serving cell CSI-RS for mobility as the QCL source for MTRP inter-cell transmission.**Proposal 5:** Support non-serving cell SSB and CSI-RS for mobility can be configured as the PL-RS for uplink transmission.**Proposal 6:** Support sequence generation of a non-serving cell TRS used as TCI source should be based on slot index of this non-serving cell.**Proposal 7:** Support that PDSCH /PDCCH from serving cell is rate matched around non-serving cell SSB, and support that PDSCH/PDCCH from non-serving cell is rate matched around serving cell SSB. |
| [**R1-2102762**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102762.zip) | Inter-cell multi-TRP operation | FUTUREWEI |
| Proposal 1: For inter-cell multi-TRP enhancement, replace the term “non-serving cell” with “cooperating cell” or the like.Proposal 2: For an inter-cell TRP, a signal/antenna port is non-co-located (NCLed) to the serving cell (i.e., the serving cell’s SSB) and is directly or indirectly QCLed to the non-serving cell’s SSB.Proposal 3: Explicitly configure the non-serving cell PCI as physicalCellId, reusing Rel-16 mechanism as much as possible.Proposal 4: Explicitly configure the non-serving cell SSB index.Proposal 5: For inter-cell multi-TRP, generalize QCL types to include all existing QCL types, DL-UL spatial relation info, SRI relation, CSI-RS and SRS association, and PL RS relation.Proposal 6: Indicate/associate non-serving cell PCI via QCL/TCI state, which implicitly groups all RSs, channels, resources, and TCI states to the serving cell and the non-serving cell respectively. CORESET pool index is not necessary. |
| [**R1-2102840**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102840.zip) | Enhancements on Multi-TRP inter-cell operation | Lenovo, Motorola Mobility |
| Proposal 1: SSB index from a non-serving cell can be directly configured in QCL-info and SSB-InfoNcell-r16/SSB-Configuration-r16 are used to provide the non-serving cell’s information for the UE to obtain the correct SSB information.Proposal 2: The non-serving PCID configured in SSB-InfoNcell-r16/SSB-Configuration-r16 is associated with a neighboring cell configured in the MO.Proposal 3: The configured non-serving cell’s SSB index is within the SMTC configured for this cell.Proposal 4: Option 3 should be supported.Proposal 5: In inter-cell multi-DCI based multi-TRP scenario, CORESETPoolIndex=0 is associated with the serving PCID and CORESETPoolIndex=1 is associated with a non-serving PCID different from the serving PCID.Proposal 6: The UE assumes that TRS contained in the TCI state activated for PDCCH/PDSCH transmitted from TRP associated with a non-serving PCID is QCLed with a SSB index from this non-serving cell.Proposal 7: SSB from a non-serving cell can be configured as the spatial relation and PL-RS for PUCCH resources and SRS resources.Proposal 8: When CSI-RS resource is configured as the spatialRelationInfo and/or PL-RS for PUCCH and/or SRS resource targeting a TRP associated with a non-serving PCID, the UE assumes that the CSI-RS is QCLed with a SSB index from the non-serving cell. |
| [**R1-2102879**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102879.zip) | Enhancements on Multi-TRP inter-cell operation | CMCC |
| Proposal 1: A flag or a new indicator can be configured in /associated with a TCI state when the SSB from non-serving cell is used as the QCL reference RS. Proposal 2: A new RRC IE can be introduced to configure the non-serving cell information. |
| [**R1-2102961**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2102961.zip) | Enhancement on Inter-cell Multi-TRP operations | Xiaomi |
| Proposal 1: Prefer Option 2 or Option 5 to configure TCI state associated with non-serving cell. Proposal 2: Not support CSI-RS from non-serving cell as non-serving cell RS.Proposal 3: Group based beam reporting is slightly preferred for inter-cell beam pairing.Proposal 4: Inter-cell beam management by gNB can be supported.Proposal 5: Whether the PDCCH candidate or CCE from CORESETs associated with neighboring cell should be considered as same as that of serving cell or not when calculating the maximum number of monitored PDCCH candidates and the maximum number of non-overlapped CCE. |
| [**R1-2103016**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103016.zip) | Multi-TRP enhancements for inter-cell operation | Intel Corporation |
| Proposal-1: Multi-cell reception mode is supported by providing the following information explicitly to the UE* PCID (PhysCellId)
* SSB pattern (ssb-PositionsInBurst, ssb-periodicityServingCell)
* sub-carrier spacing (subcarrierSpacing)
* frequency (absoluteFrequencySSB)

Proposal-2: Consider associating the following with a TCI-State including SSB-Index from another PCID:* TRS
* CORESETs
* DCI codepoint for TCI-State switching
* NZP-CSI-RS-ResourceSet with repetition set to ‘on’ (L1-RSRP)
* BFD resources (failureDetectionResources)
* CSI-RS for CSI measurement
 |
| [**R1-2103090**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103090.zip) | Views on Rel-17 Inter-cell multi-TRP operation | Apple |
| Proposal 1: For inter-cell multi-TRP operation, support option 2/3/5 to define the association between TCI and non-serving cell information, where an indicator can be used to provide the linkage between non-serving cell information and a TCI* The TCI with the same indicator should be associated with the same CORESETPoolIndex

Proposal 2: Support to introduce a UE capability to report the following information* Whether PDSCH /PDCCH from serving cell (PCI) is rate matched around non-serving cell SSB
* Whether PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around serving cell SSB
 |
| [**R1-2103152**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103152.zip) | Enhancements on Multi-TRP inter-cell operation | Qualcomm Incorporated |
| Proposal 1: For non-serving cell SSB information * The SSBs of non-serving cell have the same center frequency and SCS as the SSBs of the serving cell, and are associated with the same SFN.
* The information related to “SSB time domain position” for non-serving cell SSB consists of
	+ halfFrameIndex
	+ ssb-PositionsInBurst

Proposal 2: When SSB is used as reference signal in *QCL-Info*, support Option 2: Introduce a flag to indicate whether the *SSB-Index* is associated with the serving cell or is associated with non-serving cell. RRC signalling details are up to RAN2 to decide. Proposal 3: UE does not expect channels associated with CORESETPoolIndex value 0 and 1 to have TCI states associated with non-serving cell and serving cell PCI, respectively. Proposal 4: When SSB is used as reference signal in *SRS-SpatialRelationInfo, PUCCH-SpatialRelationInfo, PUCCH-PathlossReferenceRS, PUSCH-PathlossReferenceRS,* and *pathlossReferenceRS* under *SRS-ResourceSet*, support introducing a flag to indicate whether the *SSB-Index* is associated with the serving cell or is associated with non-serving cell. RRC signalling details are up to RAN2 to decide. Proposal 5: For PDCCH clarify that: PDCCH candidates associated with non-serving cell PCI / CORESETPoolIndex value 1 are not monitored if they overlap with a non-serving cell SSB.* Serving cell SSBs do not impact PDSCH/PDCCH from non-serving cell PCI.
* Non-serving cell SSBs do not impact PDSCH/PDCCH from serving cell PCI.

Proposal 6: In the set of symbols indicated to a UE by non-serving cell *ssb-PositionsInBurst*,* Option 1: The UE does not transmit any UL signal/channel.
* Option 2: The UE can only transmit UL signal/channel associated with the serving cell PCI.
* Further study the impact on the following Rel. 15/16 procedures based on a selected option from Option 1 or 2 above:
	+ Procedure 1: When SSB overlaps with UL channel/RS, UE does not transmit the UL channels/RS [38.213, Section 11.1].
	+ Procedure 2: UE does not expect the set of SSB symbols to indicated as uplink symbols either semi-statically or dynamically (by SFI) [38.213, Section 11.1 and Section 11.1.1].
	+ Procedure 3: SSB symbols are assumed to be invalid symbols in a nominal repetition for PUSCH repetition Type B [38.214, Section 6.1.2.1].
	+ Procedure 4: For determination of the $N\_{PUCCH}^{Repeat}$ slots in the case of PUCCH repetition, i.e., a slot is not counted toward the $N\_{PUCCH}^{Repeat}$ slots if the PUCCH resource in that slot overlaps with a SSB [38.213, Section 9.2.6].
 |
| [**R1-2103223**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103223.zip) | Enhancements on Multi-TRP inter-cell operation | Samsung |
| **Proposal 1:** For non-serving cell PCI indication for inter-cell mTRP operation* Selecting between explicit and implicit methods of indicating the non-serving cell PCI in TCI state shall take into account signaling overhead, payload variation, and RAN2 impact.
* In terms of minimizing the signaling overhead, the implicit non-serving cell PCI indication in TCI state shall be supported.

**Proposal 2:** For QCL source RS and QCL source RS type from non-serving cell* For DL channels, large scale QCL properties are inferred from up to two RSes for QCL-TypeA and QCL-TypeD respectively.
* The QCL-TypeA source RS is TRS from non-serving cell, and QCL-TypeD source RS is non-serving cell SSB.
 |
| [**R1-2103289**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103289.zip) | Considerations on inter-cell operation | Sony |
| Proposal 1 Non-serving cell information such as Cell ID or Physical Cell ID for RS shall be added in the *CSI-ReportConfig*.Proposal 2 QCL information among CSI-ResourceConfig in terms of beam sweeping property shall be included in the *CSI-ReportConfig*. |
| [**R1-2103367**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103367.zip) | Enhancements to enable inter-cell multi-TRP operations | Nokia, Nokia Shanghai Bell |
| Proposal 1: To configure SSB as non-serving cell RS, indicate the associated cell (PCI) and SSB-index for the SSB in the *referenceSignal* parameter (Option 1).Proposal 2: To configure NZP-CSI-RS resource as non-serving cell RS, configure the RS with a QCL source RS that is associated with a non-serving cell.Proposal 3: For L1 SSB based beam measurements and reporting, enhance the *CSI-SSB-ResourceSet IE* to associate set of SSBs with a cell-specific identifier (PCI).Proposal 4 : For non-serving cell CSI-RS measurements, configure the NZP-CSI-RS with a QCL source RS that is associated with a non-serving cell identifier.Proposal 5: For inter-cell multi-DCI based multi-TRP support, the CORESETs of non-serving cell are pooled under the same CORESETPoolIndex. |
| [**R1-2103506**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103506.zip) | Enhancements on Multi-TRP inter-cell operation | LG Electronics |
| Proposal #1: Neighbor cell’s SSB can be configured as QCL type C/D source of TRS/CSI-RS to support inter-cell multi-TRP operations. Proposal #2: Consider mobility CSI-RS for QCL type C/D source of TRS/CSI-RS as well.Proposal #3: *MeasObjectId*, and PCID and SSB index in *MeasObjectNR* corresponding *MeasObjectId* should be associated with or configured as *referenceSignal* in *QCL-info* in *TCI-State.*Proposal #4: PDSCH /PDCCH from serving cell should be rate matched around non-serving cell SSB and PDSCH /PDCCH from non-serving cell should be rate matched around serving cell SSB. |
| [**R1-2103561**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103561.zip) | Discussion on inter-cell multi-TRP operations | NTT DOCOMO, INC. |
| Proposal 1:* + Define a separate IE for non-serving cell configuration for MTRP inter-cell operation.
	+ At least PhysCellId is included in the IE.
	+ A new indicator (e.g., re-index the non-serving cells) is needed in the IE to indicate each non-serving cell.

Proposal 2:* + Support to configure more than one non-serving cell’s configurations on a CC.
	+ Support to configure at least 3 non-serving cells on a CC with 2-bit new indicator.

Proposal 3:* + Support Option 5 for TCI state/QCL-info configuration, i.e., to configure a new indicator (e.g., re-index the non-serving cells) in TCI state/QCL-Info configuration to indicate the non-serving cell.
	+ Support to configure up to 1 non-serving cell from the re-indexing indexes to be associated with the TCI state/QCL-info configuration on a CC.

Proposal 4:* + Support configuration of non-serving cell SSB as QCL source RS with existing QCL relation for UL SRS, PUCCH, and PUSCH transmission.

Proposal 5:Do not support PDSCH /PDCCH from serving cell (or non-serving cell) rate matched around non-serving cell (or serving cell) SSB. |
| [**R1-2103715**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_104b-e/Docs/R1-2103715.zip) | On Multi-TRP inter-cell operation  | Ericsson |
| [Proposal 1 The UE can assume that non-serving-cell use the same Point A as the serving-cell when receiving from the non-serving-cell. Hence, no specification impact is foreseen.](#_Toc68618533)[Proposal 2 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](#_Toc68618535)[Proposal 3 Agree on Option 1: Indicate/associate non-serving cell PCI in the TCI state. FFS other non-serving cell information](#_Toc68618536)[Proposal 4 Send an LS to RAN2 with the agreements made in the inter-cell multi-TRP agenda item, so they can start their work on the signalling.](#_Toc68618537) |

**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.