**3GPP TSG RAN WG1 #106-e R1-210xxxx**

**e-Meeting, August 16th – 26th, 2021**

Source: moderator (vivo)

Title: Feature lead summary 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.

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

**Item 1-1**

The options below refers to the 5 options from RAN1#104-e.

**Option1 :** Huawei/HiSi, Spreadtrum, Ericsson, Nokia, Futurewei, Lenovo/MotM

**Option2 :** IDC, OPPO, CMCC, Apple, ZTE

**Option3 :** ZTE, Lenovo/MotM, Apple, Futurewei

**Option4 : Samsung**

**Option5 :** CATT, Apple, DOCOMO, Xiaomi, ZTE

**Observations :**

* From the proposals in the contributions, support for different options are almost equally split.
* There are few contributions proposing to introduce a new RRC IE to link TCI states with PCI differnt from serving cell PCI, or explicit signaling for the second cell PCI.
* There is one contribution proposing to agree on explicit or implicit indication/association of TCI states with PCI different from serving cell PCI
* There are few contributions proposing to send LS to RAN2 with the agreements made so far on necessary information for linking TCI states with PCI differnt from serving cell PCI

**Observation after initial round of comments:**

With the proposal 1-2 (which has been discussed extensively), option2 above can be merged with option5. According to comments from companies in this document below, current support for different options (excluding option2, companies supporting option2 please indicate which option do you prefer) as below.

ZTE, Apple support option3 and option5, Lenovo/MotM, Futurewei support Option1 and option 5. @ZTE, Apple, Lenovo/MotM, Futurewei is it ok for you to support one option only? In proposal 3-2, we are still discussion the association with CORESETPoolIndex. Hence, I propose to remove option3.

@Samsung, option4 can be categorized as implicit mechanism, is it ok for you to support option5 and remove option4?

**Option1 :** Huawei/HiSi, Spreadtrum, Ericsson, Nokia, Futurewei, Lenovo/MotM, MediaTek, LG(?)

**~~Option2 :~~** ~~IDC, OPPO, CMCC, Apple, ZTE~~

**~~Option3 :~~** ~~ZTE, Lenovo/MotM, Apple, Futurewei~~

**Option4 :** Samsung

**Option5 :** CATT, Apple, DOCOMO, Xiaomi, ZTE, vivo

In the offline email discussion options A and B were discussed and proposed to map the options 1~5 into them.

Option A - Explicit indication/association of PCI and [activated] TCI state

Option B – Implicit indication/association of PCI and [activated] TCI state

**Proposal 1-1:**

**Item 1-2**

Number of RRC configured PCI different from serving cell PCI

**Alt1:** the maximum number of RRC-configured PCIs different from the serving cell PCI per CC is equal to 1

Support: OPPO, Qualcomm, Intel, Apple

**Alt2:** the maximum number of RRC-configured PCIs different from the serving cell PCI per CC is greater than 1 with at most 1 additional PCI is activated

Support: Huawei/HiSi, ~~IDC (max 2)~~, Ericsson, Futurewei, DOCOMO (at least 3)

**Proposal 1-2:[offline consensus]**

* Max number of additional RRC-configured PCIs per CC is X
	+ Down-select one of the following alternatives:
		- Alt 1: The value of X is 3 or 7
			* Support UE reports the capability of maximum number of additional RRC-configured PCIs per CC
			* FFS: details of the UE capability, e.g. candidate value, separate or common value with regard to different SSB configurations
		- Alt 2:
			* The value of X is 3 or 7 if SSB time domain positions and periodicity are exactly the same among the PCIs and same as serving cell PCI
				+ Support UE reports the capability of maximum number of additional RRC-configured PCIs per CC (3 or 7)
			* Otherwise, the value of X is 1 per CC
	+ Only 1 additional PCI can be associated with the active TCI States

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| Company | comments |
| QC | Item 1-1: We prefer Option 2. Also, we prefer RAN1 select one option since we agreed before that we will down-select one option. If this is not possible, we would be ok to let RAN2 decide it (in which case, LS needs to describe RAN1’s intention rather than copying the 5 options).Issue 1-2: We support Alt1. As discussed offline, we can be a bit more flexible for this part if there is strong demand for larger number. In that case, the complexity associated with memory as well as rate matching patterns (SSB locations) need to be considered. For rate matching part, if all PCIs have the same exact SSB locations, the concern is alleviated. Hence, we suggest the following as a compromise:* Max number of additional RRC-configured PCIs is 1 if SSB time domain positions or periodicity is not exactly the same as serving cell PCI
* Max number of additional RRC-configured PCIs is X if SSB time domain positions and periodicity is exactly the same among the PCIs and same as serving cell PCI
	+ X= 3 or 7 (so that 2 or 3 bits would be enough to identify the PCI if RAN1/RAN2 decides to minimize the RRC overhead)
	+ Max supported X is UE capability (granularity can be discussed, e.g., UE capability can be whether more than 1 is supported (binary) or can directly indicate max value of X)
 |
| ZTE | On item 1-1, although our first preference is option 3, we can also be fine with option 2 and 5. As FL’s assessment in offline, to make progress in this meeting, maybe one LS will be sent to RAN2 for down-selection among the five options. However, as QC mentioned, it is better to clarify the intention in RAN1 firstly to help RAN2 design the proper signaling. From our perspective, the five options raised in RAN1 aim to decide **which of RRC, MAC CE or DCI should be used to select the non-serving cell TRP.** Based on that, the purpose of option 1 is to use DCI to dynamically select the non-serving cell TRP. The purpose of option 2/4/3/5 is to use RRC or MAC CE to statically/semi-statically select the the non-serving cell TRP. If the understanding above is correct, RAN1 can down-select among five options firstly according to the intention above, then let RAN2 design the signaling.On item 1-2, we prefer Alt. 2 for more scheduling flexibility.Regarding the maximum number of RRC-configured additional PCIs, if UE storage and rate matching should be concerned here, we think RAN1 can formulate SSB time domain should be same among several RRC-configured additional PCIs, because the main purpose of inter-cell MTRP is to enhance QCL/TCI-related indication. |
| Futurewei | On item 1-1, for Options 1~5, it would be useful to further clarify them since the terms ‘explicit’, ‘implicit’, ‘associate’, ‘indicate’, etc., could be interpreted differently by different companies. For example, what we support is the following for inter-cell M-TRP:* Cell 0
	+ PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
* Cell 1
	+ PCI1 --- RS1\_0 --- RS1\_1 --- RS1\_2 …

This may be interpreted as Option 1 or Option 3.We do not think the following with additional, explicit indexing/flags is necessary:* Cell 0
	+ [Index0/flag0:]  PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
* Cell 1
	+ Index1/flag1:  PCI1 --- RS1\_0 --- RS1\_1 --- RS1\_2 …

Could companies clarify/illustrate their supported options similar to something like above to best align the understanding?On item 1-2, we support Alt2 but we think the number should also be based on UE capability reporting.  |
| NTT DOCOMO | On item 1-1, we support Option5. If it is difficult to down select from the 5 options, we can also accept to agree on a more general proposal and leave signaling details to RAN2. The 5 options can be categorized into 2 general options below.* Option A - Explicit indication of PCI in the TCI state
	+ Examples: Option 1 with ‘indicate’
* Option B – Implicit association of PCI and TCI state
	+ Examples: Option 2-5, and Option 1 with ‘associate’
* Detailed signaling to be decided by RAN2

On item 1-2, we support Alt.2 with more than 1 different PCI to be RRC configured based on UE capability reporting. |
| Xiaomi | Item 1-1: Prefer Option 5. The association of spatial relation between a reference RS and the target SRS in *SRS-SpatialRelationInfoPos* as shown belowcan be a baseline for the configuration of TCI state considering non-serving.SRS-SpatialRelationInfoPos-r16 ::= CHOICE { servingRS-r16 SEQUENCE { servingCellId ServCellIndex OPTIONAL, -- Need S referenceSignal-r16 CHOICE { ssb-IndexServing-r16 SSB-Index, csi-RS-IndexServing-r16 NZP-CSI-RS-ResourceId, srs-SpatialRelation-r16 SEQUENCE { resourceSelection-r16 CHOICE { srs-ResourceId-r16 SRS-ResourceId, srs-PosResourceId-r16 SRS-PosResourceId-r16 }, uplinkBWP-r16 BWP-Id } } }, ssb-Ncell-r16 SSB-InfoNcell-r16, dl-PRS-r16 DL-PRS-Info-r16}For example, the *referenceSignal* in QCL-Info can be chosen between serving cell RS (servingRS) and SSB-InfoNcell, a new indicator which is similar to the *SSB-InfoNcell-r16* in *SRS-SpatialRelationInfoPos-r16*. Therefore, we prefer option 5.TCI-State ::= SEQUENCE { tci-StateId TCI-StateId, qcl-Type1 QCL-Info, qcl-Type2 QCL-Info OPTIONAL, -- Need R ...}QCL-Info ::= SEQUENCE { cell ServCellIndex OPTIONAL, -- Need R bwp-Id BWP-Id OPTIONAL, -- Cond CSI-RS-IndicatedreferenceSignal CHOICE { servingRS CHOICE { csi-rs NZP-CSI-RS-ResourceId, ssb SSB-Index } ssb-Ncell SSB-InfoNcell }, qcl-Type ENUMERATED {typeA, typeB, typeC, typeD}, ...}Of course, this configuration of TCI state above is just an example and other feasible methods will do. We are agree with QC that it is ok to let RAN2 decide it.Item 1-2: prefer Alt2. |
| OPPO | On item 1-1, we are fine to only send two options to RAN2 and leave the signaling design to RAN2. However, the information should include the conclusion of item 1-2, since the number of RRC configurable PCIs is very important for signaling design.On item 1-2, we prefer Alt.1, but we can compromise to Qualcomm’s proposal. Furthermore, we prefer X=3 as the maximal value. |
| LG | On item 1-1, Option 1 is a high level proposal without signaling details, including other option. so if consensus is not reached Option 1 is default. We prefer to leave detail signaling design such as Option 2-5 and focus on what neighboring cell information we need to support inter-cell MTRP.On item 1-2, there are different complexity and memory issue depending on whether SSB pattern and position is same or not. So, even though our preference is Alt 1, we are open for Alt 2 in case of same SSB pattern and position. |
| Samsung | We share the same understanding as DOCOMO about the categorization of the 5 options. From our understanding, Option 1 is about indicating PCI in TCI state, which is a very different mechanism from the other 4 options in various aspects. So we suggest the following:* Option A – Explicit indication of PCI in the TCI state
	+ Examples: Option 1
* Option B – Implicit association of PCI and TCI state
	+ Examples: Option 2-5

After the down-selection, the group can decide whether to send a LS to RAN2, and if so, what will be captured inside. |
| Spreadtrum | Item 1-1: Support option 1, it is clean. But if we still could not achieve consensus in this meeting, we are fine to leave it to RAN2.Item 1-2: Generally either is fine to us, but for Alt2, the maximum number of additional PCI should be up to UE capability. |
| MediaTek | Item 1-1: Support option 1Item 1-2: Support Alt 1 |
| IDC | Item 1-1: Our preference is Option 2. In general, we are OK with Samsung’s proposal, however without the examples. In our view, any solution that relies on an indication based on an IE, for example in TCI state, flag, group ID, etc., should belong to Option A. And Option B should only cover pure association-based indication that does not require any new IE.* Option A – Explicit indication of PCI in the TCI state
* Option B – Implicit association of PCI and TCI state

Item 1-2: Our preference is Alt 1. We don’t think configuration of more than one PCI would have much merits in practical scenarios. However, we would be OK, if it will be based on UE capability. |
| Huawei, HiSilicon | Item 1-1: We prefer Option 1. If it is difficult to conclude in RAN1, we are fine to leave it to RAN2. Item 1-2: We prefer Alt-2.  |
| Lenovo/MotM | Item 1-1: Support option 3.Item 1-2: Prefer Alt 1 |
| Nokia/NSB | Item 1.2: The latest update from Moderator seems to be ok for further discussion. We prefer Alt.1, * + - Alt 1: The value of X is 3 or 7
			* Support UE reports the capability of maximum number of additional RRC-configured PCIs per CC
			* FFS: details of the UE capability, e.g. candidate value, separate or common value with regard to different SSB configurations

Also, RAN1 only considers the enhancements to the TCI state to support inter-cell operation. Most likely configuring 1 PCI would be enough for most scenarios. However, there should be some level of flexibility allowed for the network. |

* 1. Item 2: Rate matching

**Item2-1**

Clarify previous agreement as below:

PDSCH that uses SSB associated with a physical cell ID as an indirect QCL reference is rate matched around SSB with the same PCI as the indirect QCL reference of the PDSCH.

* Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel

**Observation after initial round of comments:**

No need: Qualcomm, OPPO, Spreadtrum, MediaTek, Lenovo/MotM

**Proposal2-1:**

**Item2-2**

Clarify the following with respect to PDSCH rate matching / not monitoring PDCCH candidates:

* 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.

**Observation after initial round of comments:**

Support: Qualcomm, ZTE, Spreadtrum, MediaTek, Lenovo/MotM

Do not support:

**Proposal2-2:**

**Item2-3**

**Alt1:** PDSCH /PDCCH associated with serving cell PCI should be rate matched around non-serving cell SSB, and PDSCH/PDCCH associated with non-serving cell PCI should be rate matched around serving cell SSB as well.

Support: ZTE, CATT, Intel, Apple (with UE capability), LG,

**Alt2:** PDSCH/PDCCH from the serving cell should not be rate-matched around non-serving cell SSB, and PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is not rate matched around serving cell SSB.

Support: Spreadtrum, OPPO, DOCOMO, vivo

**Observation2-3:** support for 2 alternatives are almost equally split, further discussion on the alternatives is needed.

**Observation after initial round of comments:**

Alt1: LG

Alt2: Qualcomm, ZTE, DOCOMO, Xiaomi, OPPO, Spreadtrum, MediaTek, Lenovo/MotM, vivo

Given the majority of companies supporting alt2, hence following is proposed (text in red is revised part from original alt2 above)

**Proposal2-3:**

* PDSCH/PDCCH from the serving cell should not be rate-matched around SSB from cell with different PCI than serving cell PCI, and PDSCH/PDCCH from cell with different PCI than serving cell PCI associated with TCI state and/or QCL-info is not rate matched around serving cell SSB.

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| Company | comments |
| QC | Item 2-1: We do not understand the intention. This is already agreed, and the “indirect part” is just Rel.15/16 TCI framework. We already twice agreed with “reusing Rel-15/Rel-16 QCL rules”. Do we need to agree to this one more time?Item 2-2 / 2-3: These two are the same issue. Our preference is Item 2-2 or Alt2 in Item 2-3. |
| Apple | Item 2-3, we have a question for Alt2, without rate matching, does it mean UE can do SSB measurement and PDSCH decoding in the overlapped REs simultaneously, or we assume this case would not happen based on network scheduling?  |
| ZTE | On item 2-1, we are kinda confused to its purpose, more clarification need to be provided.On item 2-2 and 2-3, although our preference is Alt. 1 in item 2-2, we can be fine with item 2-2 and Alt. 2 in item 2-3. |
| NTT DOCOMO | On item 2-2 and 2-3, we prefer Alt.2. Otherwise, resource efficiency will decrease unnecessarily.Regarding Apple’s question, we think it may happen that UE will do SSB measurement and PDSCH decoding in the overlapped REs simultaneously, which is not a problem in mDCI based MTRP scenario. |
| Xiaomi | Item 2-3: Support Alt2. |
| OPPO | On item 2-1, we think this is natural understanding on the agreement based on Rel-15/16 QCL rules. We don’t need any further clarification.On item 2-3, we prefer Alt.2. Regarding Apple’s question, our understanding is that the non-serving cell SSB should be the SSB configured in *MeasObject*, which means that the UE will measure the SSB in SMTC window.  |
| LG | On item 2-3, we prefer Alt 1. In Alt 2, SSB measurement performance is degraded due to interference from PDSCH. |
| Spreadtrum | Item 2-1: not necessary. We have the agreement in RAN1#104e below. If the intention is to clarify the definition of PDSCH/PDCCH from non-serving cell, **#7-2** is for the same motivation.AgreementAgree 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

Item 2-2/2-3: Support item 2-2 or Alt2 in item 2-3. |
| MediaTek | Item 2-1: Not neededItem 2-2: SupportItem 2-3: Support Alt2 |
| IDC | Item 2-1: NeutralItem 2-2: NeutralItem 2-3: We may want to wait for a conclusion on 1-2. |
| Huawei, HiSilicon | Item 2-3: We think it is better to avoid saying “PDSCH/PDCCH from non-serving cell”, which may lead to more confusion.  |
| Lenovo/MotM | Item 2-1: Not neededItem 2-2: SupportItem 2-3: Prefer Alt 2. |
| Nokia/NSB | Item 2-1: not needed.Item 2-2: related to item 2-3 ?Item 2-3: Alt 2. |

* 1. Item 3: PCI association with CORESETPoolIndex

**Item 3-1**

Whether CORESETPoolIndex should be configured for inter-cell MTRP operation in Rel-17?

Yes: Qualcomm, Apple, ZTE, DOCOMO, Xiaomi, OPPO, LG, Samsung, Spreadtrum, MediaTek, Huawei/HiSi, Lenovo/MotM, vivo

No:

**Observation after initial round of comments:**

Clear majority of companies replied “Yes” to the above question. Hence following is proposed

**Proposal3-1:**

* CORESETPoolIndex should be configured for inter-cell MTRP operation in Rel-17

With majority of companies supporting proposal 3-1, alternative3 below can be removed. Alt1 is revised according to offline email discussion.

**Item3-2**

**Alt1:** one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH is associated with one CORESETPoolIndex, another PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH is associated with another CORESETPoolIndex

Support: ZTE, Lenovo/MotM, Spreadtrum, Samsung, OPPO, Qualcomm, CMCC, Apple, LG, DOCOMO, Xiaomi, Nokia, Futurewei, IDC, MediaTek

**Alt2:** one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with more than one CORESETPoolIndex

Support: Huawwei/HiSi, CATT, Futurewei

**~~Alt3:~~** ~~one PCI associated with TCI states for [PDSCH]/PDCCH via QCL relationship without association with CORESETPoolIndex~~

**Observation3-2:** Clear majority of companies support Alt1. Hence following is proposed:

**Proposal3-2:**

* One PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH is associated with one CORESETPoolIndex, another PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH is associated with another CORESETPoolIndex

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| Company | comments |
| QC | Issue 3-1: Yes.Issue 3-2: Alt1. Furthermore, the other direction is also needed as mentioned by Samsung:* One CORESETPoolIndex can be associated with only one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH

We would like to mention that any other alternative is out of scope based on the last RANP agreement:“1. RAN confirms that inter-cell mTRP in RAN1 work only considers multi-DCI and multi-PDSCH reception (per WI objective). Any scheme tailored for reception of a single PDCCH and/or a single PDSCH is not supported in Rel-17 mTRP.” |
| Apple | Issue 3-1: Yes |
| ZTE | On issue 3-1, our response is yes.On issue 3-2, we support Alt. 1. |
| Futurewei | For the 3 alternatives, again we want to use some examples to illustrate, and we emphasize the scenarios with both intra-cell and inter-cell M-TRPs.* R16 S-TRP (0 or 1 index/PCI)
	+ [Coresetpoolindex 0]  PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
* R16 intra-cell M-TRP (1 or 2 index/PCI)
	+ Cell 0
		- [Coresetpoolindex 0]  PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
		- Coresetpoolindex 1:  PCI0 --- RS1\_0 --- RS1\_1 --- RS1\_2 …
* R17 inter-cell M-TRP (0 or 1 or 2 index/PCI) (TRPs are differentiated via their PCIs, not by Coresetpoolindexes)
	+ Cell 0
		- [Coresetpoolindex 0]  PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
	+ Cell 1
		- [Coresetpoolindex 0]:  PCI1 --- RS1\_0 --- RS1\_1 --- RS1\_2 …
* R17 intra-cell + inter-cell M-TRP (1 or 2 index/PCI)
	+ Cell 0
		- [Coresetpoolindex 0]  PCI0 --- RS0\_0 --- RS0\_1 --- RS0\_2 …
		- Coresetpoolindex 1:  PCI0 --- RS1\_0 --- RS1\_1 --- RS1\_2 …
	+ Cell 1
		- [Coresetpoolindex 0]:  PCI1 --- RS2\_0 --- RS2\_1 --- RS2\_2 …
		- Coresetpoolindex 1:  PCI1 --- RS3\_0 --- RS3\_1 --- RS3\_2 …

To us, the above is the most natural extension of R16 framework (within each cell, it is exactly the same as R16). Could other companies also provide some examples like this so that we can compare the potential solutions (especially to see if they can also well cover intra-cell and intra+inter-cell scenarios)? |
| NTT DOCOMO | Item 3-1: Yes.Issue 3-2: Alt1. |
| Xiaomi | Item 3-1: YesFor multi-TRP operation in Rel15/16, the CORESETPoolIndex is used for informing the UE whether to receive multiple PDCCHs from multi-TRP. And for inter-cell multi-TRP, it is still needed.Item 3-2: Alt1.At present, the allowed values of CORESETPoolIndex are 0 and 1, which means that only two TRPs are support. For inter-cell multi-TRP in Rel17, we still consider two TRPs, one from serving cell and one from non-serving cell. Therefore, we support that one PCI can be associated with only one CORESETPoolIndex. |
| OPPO | Item 3-1: Yes. It is clear that the inter-cell M-TRP enhancement should be based on m-DCI in Rel-16, which is fully based on *CORESETPoolindex*.Item 3-2: Alt1. |
| LG | Item 3-1: Yes.Issue 3-2: Alt1. |
| Samsung | Item 3-1: YesAs pointed out in the offline email discussions, the current formulations of the alternatives are not clear. The following condition should be added,* One CORESETPoolIndex can be associated with only one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH
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| Spreadtrum | Item 3-1: YesItem 3-2: Alt1 |
| MediaTek | Item 3-1: YesItem 3-2: Alt1 |
| IDC | Item 3-1: NeutralItem 3-2: We can accept Alt1 |
| Huawei, HiSilicon | Item 3-1: YesItem 3-2: We think Alt-2 is more flexible and can support both intra-cell and inter-cell scenarios, as pointed out by FutureWei.  |
| Lenovo/MotM | Item 3-1: YesItem 3-2: Alt1 |
| Nokia/NSB | 3-1: yes, use of CORESETPoolIndex is needed at least for M-DCI based Multi-TRP. If CORESETPoolIndex is not configured, having two different PCIs on CORESETs can be associated to CORESETPoolIndex to follow multi-DCI based multi-TRP operation. 3-2: Start with supporting Alt 1. Ok to allow other alternatives. Alt.2 may allow multi-DCI operation via a different PCI than the serving PCI. Alt.3 may allow DPS operation.  |

* 1. Item 4: relation with CORESET

**Proposal4:**

[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 SSB having additional PCI (i.e. non-serving PCI)](#_Toc79134958)

**Observation after initial round of comments:**

* Majority of companies support without restricting Type3 CSS.
* 2 companies commented that further discussion is needed.
* 1 company commented that this proposal is not needed.

Further discussion is needed.

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| Company | comments |
| QC | Ok with Type0/0A/1/2 CSS. We think Type3 CSS does not need to have this restriction. |
| Apple | We do not think this is necessary. |
| ZTE | We share similar view with QC that the use case of Type3-PDCCH CSS should be discussed in particular. |
| Futurewei | Generally support, and QC’s comment makes sense. |
| NTT DOCOMO | Agree with QC’s comment. |
| Xiaomi | Not support this proposal. For inter-cell multi-TRP, in order to receive PDSCH/PDCCH from non-serving cell, some basic parameters of non-serving cell, like the slot format, are needed. And we still don’t know whether all these parameters are configured by serving cell. Or some of them are configured by non-serving cell via configuring a common search space to a CORESET configured with a TCI state associated additional PCI. We think that more discussions are needed about this item. |
| OPPO | Agree with QC. |
| LG | Agree with QC’s comment. |
| IDC | Need further discussion on this |
| Huawei, HiSilicon | We think it is unnecessary for a UE to be configured with a CSS associated with a CORESET configured with a TCI state, which is indirectly associated with an SSB having additional PCI (i.e. non-serving PCI). |
| Lenovo/MotM | Agree with QC. |
| Nokia/NSB | The restriction is not needed.  |

* 1. Item 5: Other non-serving cell information

**Proposal5:** Whether to support one or more of the following information from cell with different PCI for inter-cell MTRP operation

* Center frequency
* SCS
* SFN offset (for inter frequency operation)
* half-frame index
* ssb-PositionsInBurst
* ss-PBCH-BlockPower

**Observation after initial round of comments:**

* {Center frequency, SCS, SFN offset} are not needed: QC, Futurewei, DOCOMO, OPPO, LG, Spreadtrum, MediaTek, Lenovo/MotM, vivo
* for {Center frequency, SCS, SFN offset}, clarify that UE assumes all of them be the same for both cells: Apple, DOCOMO, IDC, Lenovo/MotM
* SFN offset is needed: ZTE
* SCS and SFN offset need further discussion: Xiaomi

Majority of companies expressed that last 3 bullets have been agreed in previous meeting and first 3 bullets are either not needed or clarify that the UE assumes them toe be same for both cell. Hence, following is proposed

**Updated propsoal5:**

* Clarify that the UE assumes Center frequency, SCS, SFN offset are same for both cells for inter-cell multi TRP operation

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| Company | comments |
| QC | Support the last 3 (• half-frame index, • ssb-PositionsInBurst, • ss-PBCH-BlockPower) + periodicity for clarification, which are already agreed in principle in our understanding:**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

For the first 3 items (center freq., SCS, SFN), we do not understand why they are needed. What is the use case? We are discussing mDCI based mTRP, which is defined in a given CC (intra-frequency).  |
| Apple | In our view, the last 3 have been agreed.For the first 3 items, we think one possible way is that UE should assume all of them be the same for both cells. |
| ZTE | Regarding center frequency and SCS, we can accept to limit both of the two parameter is set as the same as serving cell to be in line with the assumption that Rel-17 inter-cell MTRP is based on Rel-16 mDCI MTRP.Regarding SFN offset, note that the frame timing difference between serving cell and neighbor cell can be different **when CA operation, instead of inter-frequency operation, for Rel-16 mDCI MTRP**, and which is smaller than 5ms according to the description in TS 38.211 as shown in following table. Then, UE can report frame timing difference between serving cell and neighbor cell in an L3 measurement reporting according to current TS38.331. Hence it should support to configure SFN offset be different between serving cell and non-serving cell, and treat SFN offset as non-serving cell SSB information.

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| **TS 38.211, Subclause 6.3.3.2 Mapping to physical resource***<Omitted Part>*For handover purposes to a target cell in paired or unpaired spectrum where the target cell uses , the UE may assume the absolute value of the time difference between radio frame in the current cell and radio frame in the target cell is less than if the association pattern period in clause 8.1 of [5, TS 38.213] is not equal to 10 ms.*<Omitted Part>* |

Regarding half-frame index, ssb-PositionsInBurst and ss-PBCH-BlockPower, we support to include such information to keep alignment with the previous agreement as QC shown above. |
| Futurewei | Similar view as QC |
| NTT DOCOMO | Agree with QC/Apple’s comment. |
| Xiaomi | For the last 3, agree with QC and Apple, they have already been agreed. For the first 3 parameters, we think that whether these parameters are needed depends on the use case of inter-cell multi-TRP. If only intra-frequency is considered, center frequency is not needed. SCS and SFN offset are cell-specific, and whether these two information can be assumed to be the same for inter-cell multi-TRP need to be decided. |
| OPPO | The same view as QC and apple. |
| LG | First 3 items are not needed. |
| Samsung | We share the same understanding with QC and Apple that those time-domain parameters have been agreed. |
| Spreadtrum | Agree with QC |
| MediaTek | Same view as QC |
| IDC | Same comment as Apple |
| Huawei, HiSilicon | We still think there is no need to explicitly indicate non-serving cell information such as SSB time domain position, SSB transmission periodicity, and SSB transmission power. The UE could obtain SSB time domain position and SSB transmission periodicity from the configured Measurement Object directly, and the SSB transmission power is not needed for QCL tracking purpose. |
| Lenovo/MotM | Agree with QC/Apple. The first 3 items should be the same as that for the serving cell. |
| Nokia/NSB | Agree with the QC comment.  |

* 1. Item 6: UL signal/channels

**Proposal 2-6:**

* When SSB is used as reference signal in SRS-SpatialRelationInfo, PUCCH-SpatialRelationInfo, PUCCH-PathlossReferenceRS, PUSCH-PathlossReferenceRS, and pathlossReferenceRS under SRS-ResourceSet, the configuration indicates whether the SSB-Index is associated with the serving cell PCI or the other PCI.

**Observation after initial round of comments:**

* Support proposal 2-6: Qualcomm, ZTE, DOCOMO, Xiaomi, Lenovo/MotM
* Do not support proposal 2-6: Apple, OPPO, LG, MediaTek, Huawei/HiSi
* Clarification needed for SRS: Futurewei, IDC

Related discussion had had happened in previous meetings, and the situation similar in this meeting. Hence I would propose not to discuss in this meeting.

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| --- | --- |
| Company | comments |
| QC | Support. We think AI 8.1.1 does not address this issue. This is because the corresponding enhancement in 8.1.1 assume unified TCI (no spatial relation info) while inter-cell mTRP is based on Rel-15/16 TCI framework as clarified in the revised WID.Any company who believes that this is out-of-scope, has to explain why? The WID mentions the following, and part of multi-DCI based mTRP operation is related to sending the feedback for PDSCH (on PUCCH or PUSCH).1. Enhancement on the support for multi-TRP deployment, targeting both FR1 and FR2:
	1. Identify and specify QCL/TCI-related enhancements to enable inter-cell multi-TRP operations, assuming multi-DCI based multi-PDSCH reception based on Rel-15/16 TCI framework
 |
| Apple | Do not support. CSI-RS should be sufficient. In addition, we failed to see that this is within scope. |
| ZTE | We support FL’s proposal 2-6. |
| Futurewei | In general, we support UL and we think UL has not been discussed sufficiently.For this specific proposal, however, we have a question. For example, for the SRS configuration, it may already be clear from the RRC configuration IE design that whether the SRS is for the serving cell or the additional cell, and then the SSB-index does not need to additionally carry PCI association information. Please clarify. |
| NTT DOCOMO | Support FL proposal 2-6. Enhancement on UL is also important. |
| Xiaomi | Support proposal 2-6 |
| OPPO | We share similar view as Apple. |
| LG | Same view with Apple. In Rel-15/16, TCI and Spatial relation are separately defined and configured, and nothing related to spatial relation enhancement is described in WID.  |
| MediaTek | Don’t support. Same view as Apple. |
| IDC | Same comment as Futurewei |
| Huawei, HiSilicon | We share similar view as Apple.  |
| Lenovo/MotM | Support FL proposal. |
| Nokia | Support. |

* 1. Item 7: Others

**#7-1:** clarification on terms used in the context of inter-cell MTRP operation

* For inter-cell multi-TRP enhancement, adopt the terms “additional PCI”, “additional cell”, “additional SSB”, or according to RAN2 inputs.

**#7-2:** Clarification

* Clarify that ‘PDSCH/PDCCH from non-serving cell’ refer to PDSCH/PDCCH from the serving cell but has a SSB/CSI-RS from non-serving cell as indirect QCL source.
* Clarify that “PDSCH from non-serving cell (PCI)” are those PDCH/PDCCH that use SSB associated with a physical cell ID different from that of the serving cell as an indirect QCL reference.
	+ Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel

**#7-3:** CSI-RS from the cell with different PCI

* 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.
* The additional PCI is associated with the TCI state configured for CSI-RS in addition to PDSCH/PDCCH.

**#7-4:** sequence generation of TRS from cell with different PCI

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

**#7-5:** restriction on SSB from cell with different PCI

* The configured non-serving cell’s SSB is within the SMTC configured for this cell.

**#7-6:** assumption on Point A

* [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.](#_Toc79134957)

**#7-7:** Overlap with UL signals/channels

* How the non-serving cell SSBs should be treated with respect to the UL-related Procedures 1-4 below:
	+ 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 (indicated by *ssb-PositionsInBurst*) 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 slots in the case of PUCCH repetition, i.e., a slot is not counted toward the slots if the PUCCH resource in that slot overlaps with a SSB [38.213, Section 9.2.6].

**Observation after initial round of comments:**

Need discussion on #7-1: Futurewei, DOCOMO, Xiaomi, LG

Need discussion on #7-2: Futurewei, DOCOMO, Xiaomi, LG, Spreadtrum, Huawei/HiSi

Need discussion on #7-3: Apple, Futurewei, DOCOMO, OPPO, LG, Spreadtrum

Need discussion on #7-4:

Need discussion on #7-5: OPPO

Need discussion on #7-6: Apple, Futurewei, Spreadtrum

Need discussion on #7-7: Qualcomm, ZTE, DOCOMO

Based on the comments it is proposed to discuss items #7-2 and #7-3. Following tentative proposals are made.

**Proposal 7-2**

* Clarify that ‘PDSCH/PDCCH from non-serving cell’ refer to PDSCH/PDCCH from the serving cell but has a SSB/CSI-RS from non-serving cell as indirect QCL source.
* Clarify that “PDSCH from non-serving cell (PCI)” are those PDCH/PDCCH that use SSB associated with a physical cell ID different from that of the serving cell as an indirect QCL reference.
	+ Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel

**Proposal 7-3**

* 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.
* The additional PCI is associated with the TCI state configured for CSI-RS in addition to PDSCH/PDCCH.

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| --- | --- |
| Company | comments |
| QC | We added issue 7-7 above, which we explained in our contribution, and we think should be addressed. |
| Apple | We think 7-3 and 7-6 should be discussed, since both issues are about the measurement for the QCL enhancement. Other issues can be deprioritized. |
| ZTE | We would like to discuss issue 7-7 (which is related to/ similar as rate matching issues) firstly once time budget is enough in this meeting. |
| Futurewei | Support to discussion 7-1, 7-2, 7-3, 7-6. |
| NTT DOCOMO | Support to discuss 7-1, 7-2, 7-3, 7-7. |
| Xiaomi | #7-1: According to the LS Reply on TCI State Update for L1/L2-Centric Inter-Cell Mobility, RAN2 thinks that the Data transmission and reception in a "non-serving cell" seems contradictory with respect to serving cell definition. So, the ‘non-serving cell’ term could be replaced with something clearer. We can decide which term is appropriate, additional PCI, additional cell or additional SSB, and then send LS to RAN2.#7-2: It is beneficial to clarify what ‘PDSCH/PDCCH from non-serving cell’ exactly means. |
| OPPO | Support to discuss 7-3, 7-5. If 7-5 is agreed, we don’t need to discuss 7-7 at all. |
| LG | Support to discuss 7-1, 7-2, 7-3. Other issues can be deprioritized. |
| Spreadtrum | Support to discuss 7-2,7-3,7-6 |
| Huawei, HiSilicon | Support to discuss 7-2 first, which can help align the understanding across WGs. Others can be deprioritized.  |

1. Previous agreements

RAN1 #102-e:

**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.

RAN1#103-e:

**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.

RAN1#104-e:

 **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.

RAN1#104b-e:

**Agreement**

* For intercell MTRP operation, 1 additional PCI different from the serving cell PCI is supported per CC
	+ The additional PCI is the one associated with one or more TCI states that are activated for [CSI-RS for CSI]/PDSCH/PDCCH, per CC.
	+ Applicable at least for non-cross carrier QCL indication
		- FFS: Cross carrier scheduling QCL indication
* RAN1 to decide on the maximum number of PCIs different from the serving cell PCI per CC and/or across all CCs that can be RRC-configured for multi-DCI based inter-cell multi-TRP
* Above should be specified by reusing R15 QCL rules as concluded in RAN1#104-e

**Conclusion**

Configuration of CSI-RS for mobility as QCL source for intercell MTRP operation is not supported from Rel-17 specification point of view

**Agreement**

For intercell MTRP operation, downselect one or more of the following alternatives in RAN1#105-e

* Alt1: one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex
* Alt2: one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with more than one CORESETPoolIndex
* Alt3: one PCI associated with TCI states for [PDSCH]/PDCCH via QCL relationship without association with CORESETPoolIndex

Note: This agreement is not related to the down-selection of one of the 5 options from RAN1#104-e

Note: Above should be specified by reusing Rel-15/Rel-16 QCL rules as concluded in RAN1#104-e

1. Reference

|  |  |  |
| --- | --- | --- |
| R1-2106465 | Enhancements on inter-cell multi-TRP operation in Rel-17 | Huawei, HiSilicon |
| **Observation 1: For inter-cell multi-TRP operation, with the aid of existing information in MO, there is no need to explicitly indicate non-serving cell information such as SSB time domain position, SSB transmission periodicity, and SSB transmission power.****Proposal 1: Clarify that ‘PDSCH/PDCCH from non-serving cell’ refer to PDSCH/PDCCH from the serving cell but has a SSB/CSI-RS from non-serving cell as indirect QCL source.** **Proposal 2: The additional PCI that is different from the serving cell PCI can be indicated as part of TCI state configured for CSI-RS contained in TCI states activated for PDSCH/PDCCH.****Proposal 3: Support more than one PCIs which is different from the serving cell that can be RRC-configured for multi-DCI based inter-cell multi-TRP operation.****Proposal 4:** **Support Alt2, one PCI that is different from the serving cell and associated with activated TCI states for PDSCH/PDCCH can be associated with more than one CORESETPoolIndex.****Proposal 5: Support Option 1, i.e., explicitly indicating one PCI that is different from the serving cell along with the SSB index inside a TCI state.** |
| [**R1-2106543**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106543.zip) | Discussion on Multi-TRP inter-cell operation | ZTE |
| **Observation 1:** Non-serving cell SSB used as QCL source RS for inter-cell MTRP operation should be one of SSBs which aims to mobility measurement.**Proposal 1:** Other non-serving cell SSB information provided to UE should also include center frequency, SCS, and SFN offset, especially when inter-frequency operation.**Proposal 2:** Support to introduce a new RRC IE to link TCI states with non-serving cell SSB information.* At least MeasObjectId and PCI of the non-serving cell SSB should be included in the new IE.

**Proposal 3:** For inter-cell MTRP operation, one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex.(Alt. 1)**Proposal 4:** For the configuration of associating TCI state/ QCL-info with non-serving cell SSB information, support that all TCI states should be split into two groups which corresponding to serving cell and non-serving cell, respectively. (Option 3)* Each group of TCI states is associated with a CORESETPoolIndex value.

**Proposal 5:** Support to use non-serving cell SSB for mobility measurement as the PL-RS for uplink transmission.**Proposal 6:** 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 non-serving cell PDSCH/PDCCH is rate matched around a subset of non-serving cell SSBs of transmitted SSBs configured in ssb-PositionsInBurst. **Proposal 8:** PDSCH /PDCCH associated with serving cell PCI should be rate matched around non-serving cell SSB, and PDSCH/PDCCH associated with non-serving cell PCI should be rate matched around serving cell SSB as well.**Proposal 9:** Any UL channels/signals (no matter associated with serving cell PCI or non-serving cell PCI) should NOT be transmitted in the symbols of non-serving cell SSB. |
| [**R1-2106573**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106573.zip) | Further discussion on inter-cell MTRP operation | vivo |
| **Proposal1**: * **Discuss and agree on maximum number of PCIs that can be configured to the UE to support inter-cell multi TRP operation**
* **Discuss and agree on the options (5 options from RAN1#104-e) for associating TCI state with PCI different from serving cell PCI, send LS to RAN2 on the agreements**
* **Discuss and agree on the alternatives (3 alternatives from RAN1#104b-e) for associating TCI states with CORESETPoolIndex, outcome of the agreements can be captured in RAN1 specification**

**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: 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 4: Clarify that “PDSCH from non-serving cell (PCI)” are those PDCH/PDCCH that use SSB associated with a physical cell ID different from that of the serving cell as an indirect QCL reference.*** **Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel**

**Proposal 5: Update previous agreement on rate matching as following:*** **PDSCH that uses SSB associated with a physical cell ID as an indirect QCL reference is rate matched around SSB with the same PCI as the indirect QCL reference of the PDSCH.**
	+ **Note: When RS X is an indirect QCL reference of a target channel, there exists at least one other source signal on the QCL chain between RS X and the target channel**
 |
| R1-2106642 | On M-TRP Inter-cell Operation | InterDigital, Inc. |
| **Proposal 1:** The SSB related information (time domain position, transmission periodicity, transmission power) to be included in the measurement’s configuration object to support inter-cell multi-TRP UE operation.**Proposal 2:** Support explicit signalling for the second cell PCI measurements.**Proposal 3:** Support Option 2 where a flag is introduced to indicate whether a TCI state/QCL information is associated with non-serving cell information or serving cell**.****Proposal 4:** Agree on Alternative 2: one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with more than one CORESETPoolIndex. **Proposal 5:** For the maximum number of PCIs across the CCs agree on scaling the carrier aggregation’s maximum number of CCs limit, considering 2 PCIs per CCs inter-cell multi-TRP decision. |
| [**R1-2106668**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106668.zip) | Enhancements on Multi-TRP inter-cell operation | Lenovo, Motorola Mobility |
| **Proposal 1: SSB 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 that is configured in a CSI-ReportConfig** **containging RS resources associated with one or more non-serving cells.****Proposal 3: The configured non-serving cell’s SSB is within the SMTC configured for this cell.****Proposal 4: Option 3 should be supported.*** **Explicit or implicit grouping of TCI states associated with non-serving cell information corresponding to the serving cell and the non-serving cell respectively**

**Proposal 5: PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex.****Proposal 6: 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.****Proposal 7: SSB from a non-serving cell can be configured as the spatial relation and PL-RS for PUCCH resources and SRS resources.** |
| [**R1-2106687**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106687.zip) | Discussion on enhancements on Multi-TRP inter-cell operation | Spreadtrum Communications |
| **Observation 1: For multi-DCI based inter-cell multi-TRP transmission, the framework where different TRPs use different CORESETs in PDCCH-Config could be still used.****Proposal 1: one PCI associated with TCI state shall be associated with CORESETPoolIndex.****Proposal 2: Support to indicate/associate non-serving cell PCI in the TCI state.****Proposal 3: For inter-cell multi-TRP operation, PDSCH/PDCCH from the serving cell should not be rate-matched around non-serving cell SSB.****Proposal 4: 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.** |
| [**R1-2106867**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106867.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 inter-cell mTRP operation,* * *Support the association between CORESETPoolIndex values and PCIs.*
* *One CORESETPoolIndex shall be associated with only one PCI with active TCI state for PDCCH/PDSCH.*
 |
| R1-2106937 | Enhancements 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).** **Proposal-3: Considering the association between non-servng cell information and CORESETPoolIndex, one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with more than one CORESETPoolIndex (Alt-2) should be supported.****Proposal-4: 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.**  |
| [**R1-2107026**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107026.zip) | On Multi-TRP inter-cell operation  | Ericsson |
| [**Proposal 1 The additional PCI is associated with TCI states for PDSCH/PDCCH via QCL relationships and without association or relation with a CORESETPoolIndex, i.e. support Alt.3**](#_Toc79134955)[**Proposal 2 Any RRC configured TCI state that contains an SSB (following Rel.16 multi-DCI specifications) can optionally be configured with an additional PCI value. How to configure this is up to RAN2. No restriction is needed on how many different additional PCI values that can be RRC configured**](#_Toc79134956)[**Proposal 3 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.**](#_Toc79134957)[**Proposal 4 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 SSB having additional PCI (i.e. non-serving PCI)**](#_Toc79134958)[**Proposal 5 Agree on Option 1: Indicate/associate non-serving cell PCI in the TCI state. FFS other non-serving cell information**](#_Toc79134959)[**Proposal 6 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 RRC signalling.**](#_Toc79134960) |
| [**R1-2107080**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107080.zip) | Inter-cell multi-TRP operation | FUTUREWEI |
| **Proposal 1: For inter-cell multi-TRP enhancement, adopt the terms “additional PCI”, “additional cell”, “additional SSB”, or according to RAN2 inputs.****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 additional cell’s SSB.****Proposal 3: At most 1 additional PCI can be activated per carrier at a time, and at most n additional PCIs can be configured per carrier, FFS n.****Proposal 4: Explicitly configure the additional** **cell SSB index.****Proposal 5: (Implicit) Association/grouping of inter-cell M-TRP resources via QCL/TCI association to the serving PCI or additional PCI is sufficient. Explicit indexing with a unique ID (not the PCI) is not necessary or essential.****Proposal 6: 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 7: For the scenario of a mixture of intra-cell M-TRP and inter-cell M-TRP, intra-cell resources can be differentiated by CORESET pool indexes as in Rel-16, and inter-cell resources can be differentiated by association/grouping via QCL/TCI association to corresponding PCIs.****Proposal 8: If CORESET pool index is to be used for inter-cell M-TRP, more bits may be needed and the indexing shall be consistent with association of resources to a PCI via QCL/TCI states.****Proposal 9: Indicate/associate additional cell PCI via QCL/TCI state, which implicitly groups all RSs, channels, resources, and TCI states to the serving cell and the additional cell respectively.** **Proposal 10:** **A PCI may be associated with no, one, or more CORESET pool indexes depending on the scenarios:*** **For a PCI without intra-cell M-TRP resources, no CORESET pool index is assigned;**
* **For a PCI with intra-cell M-TRP resources, one or no (absent) CORESET pool index is assigned to each of the groups of intra-cell M-TRP resources.**

**Proposal 11:** **Indication of an additional PCI for same/cross-carrier scheduling is not needed.** |
| [**R1-2107205**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107205.zip) | Enhancement on inter-cell multi-TRP operation | OPPO |
| ***Proposal 1: One PCI different from the serving cell PCI can be configured by RRC per CC, which should be one of the PCIs measured and reported by UE based on MeasObject.******Proposal 2: The maximum number of PCIs different from the serving cell PCI across all CCs is up to UE capability.******Proposal 3: Non-serving cell information includes SSB configuration information of one neighboring cell, which is configured separately from QCL information to reduce signaling overhead.******Proposal 4: 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 5: Clarify that SSB time domain position for non-serving cell SSB consists of “halfFrameIndex” and “ssb-PositionsInBurst”.******Proposal 6: 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 7: When two PCIs are associated with activated TCI states for [PDSCH]/PDCCH, support Alt 1: one PCI associated with one or more activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex.*** ***Proposal 8: The resource of DL signal from serving cell is not impacted by the SSB configured by neighboring cell information.*** |
| [**R1-2107325**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107325.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: For a CC associated with two CORESETPoolIndex values, the maximum number of RRC-configured PCIs different from the serving cell PCI per CC is equal to 1.****Proposal 3: For intercell MTRP operation, support Alt1 for both PDCCH and PDSCH*** **Alt1: one PCI associated with one or more of activated TCI states for PDSCH/PDCCH can be associated with only one CORESETPoolIndex**

**Proposal 4: When SSB is used as reference signal in *SRS-SpatialRelationInfo, PUCCH-SpatialRelationInfo, PUCCH-PathlossReferenceRS, PUSCH-PathlossReferenceRS,* and *pathlossReferenceRS* under *SRS-ResourceSet*, the configuration indicates whether the *SSB-Index* is associated with the serving cell PCI or the other PCI.** * **RRC signalling details are up to RAN2 to decide.**

**Proposal 5: Clarify the following with respect to PDSCH rate matching / not monitoring PDCCH candidates:*** **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 slots in the case of PUCCH repetition, i.e., a slot is not counted toward the slots if the PUCCH resource in that slot overlaps with a SSB [38.213, Section 9.2.6].**
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| [**R1-2107392**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107392.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: For intercell MTRP operation, support Alt1:*** ***one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex.******Proposal 3: A new RRC IE can be introduced to configure the non-serving cell information.*** |
| R1-2107572 | Multi-TRP enhancements for inter-cell operation | Intel Corporation |
| ***Proposal-1: A single additional PCI per CC is sufficient when the target RS is CSI-RS for CSI.******Proposal-2: Associate a non-serving PCI with TCI states for PDSCH/PDCCH via QCL relationship without association with CORESETPoolIndex******Proposal-3: Support indication of ssb-PositionsInBurst and half-frame index associated with the non-serving cell to the UE******Proposal-4: UE performs PDSCH rate-matching based on the union of ssb-PositionsInBurst and half-frame index associated with the serving cell and the non-serving cell.******Proposal-5: Support indication of ss-PBCH-BlockPower associated with the non-serving cell to the UE******Proposal-6: Support configuration of SSB with non-serving PCID as QCL source RS for SRS, PUCCH, and PUSCH transmission*** ***Proposal-7: Association of non-serving PCID with TCI state can be left to RAN2. RAN1 can provide the following information to RAN2 – a single non-serving PCI associated to activated TCI states for CSI-RS for CSI/PDSCH/PDCCH, a single non-serving PCI associated to activated TCI states for PUCCH-spatialRelationInfo or SRS-spatialRelationInfo for PUSCH, source RS for non-serving cell PCI is SSB and target RS for non-serving cell PCI is CSI-RS, DMRS for PDCCH/PDSCH, PL-RS (PUCCH, PUSCH)***  |
| [**R1-2107720**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107720.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***

***Proposal 3: For PCI and CORESETPoolIndex association, support Alt 1, where one PCI associated with one or more of activated TCI states for PDSCH/PDCCH can be associated with only one CORESETPoolIndex.******Proposal 4: Only 1 additional PCI is supported for inter-cell mTRP.******Proposal 5: The additional PCI is associated with the TCI state configured for CSI-RS in addition to PDSCH/PDCCH.*** |
| [**R1-2107816**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107816.zip) | Enhancements on Multi-TRP inter-cell operation | LG Electronics |
| **Proposal #1: For intercell MTRP operation, different PCID associated with one or more of activated TCI states for PDSCH/PDCCH should be associated with different CORESETPoolIndex.****Proposal #2: *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 #3: 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.** |
| [**R1-2107840**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107840.zip) | Discussion on inter-cell multi-TRP operations | NTT DOCOMO, INC. |
| **Proposal 1:*** + ***Define a separate IE for cells with different PCI 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 cell with different PCI.***

**Proposal 2:*** + ***Support to configure more than one cell with different PCI on a CC.***
	+ ***Support to configure at least 3 cells with different PCI 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.***

**Proposal 4:*** + ***Support Alt1: one PCI associated with one or more of activated TCI states for PDSCH/PDCCH can be associated with only one CORESETPoolIndex.***

**Proposal 5:*** + ***Support configuration of SSBs from a cell with different PCI as QCL source RS with existing QCL relation for UL SRS, PUCCH, and PUSCH transmission.***

**Proposal 6:*** + ***Do not support PDSCH /PDCCH from serving cell (or cell with different PCI) rate matched around SSBs from the cell with different PCI (or serving cell).***
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| [**R1-2107895**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107895.zip) | QCL/TCI-related enhancements on Inter-cell Multi-TRP | Xiaomi |
| ***Proposal 1: We prefer that only SSB is allowed to be the source RS type for RS transmitted from the non-serving cell TRP.******Proposal 2: The non-serving cell SSB information should be configured explicitly like the SSB-Configuration-r16 in ssb-InfoNcell-r16.******Proposal 3: Prefer Option 5 to configure TCI state associated with non-serving cell.******Proposal 4: We support alt.1 that one PCI associated with one or more of activated TCI states for PDSCH/PDCCH can be associated with only one CORESETPoolIndex for inter-cell multi-TRP in Rel17.******Proposal 5: Which cell UE should report the beam measurement results to needs to be discussed for inter-cell multi-TRP:**** ***Option1: Beam measurement results of both non-serving cell and serving cell(s) should be reported to serving cell.***
* ***Option2: Beam measurement results should be reported to their corresponding cell***

***Note: Other feasible options are not excluded.*** |
| [**R1-2108029**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108029.zip) | Discussion on Multi-TRP inter-cell operation | ASUSTEK COMPUTER (SHANGHAI) |
| **Proposal 1: Confirm that** **TRP-specific BFD counter and timer in the MAC procedure is supported on both Serving Cell and non-Serving Cell in inter-Cell multi-TRP operation.** **Proposal 2: Confirm that** **BFRQ framework based on Rel.16 SCell BFR BFRQ is supported on both Serving Cell and non-Serving Cell in inter-Cell multi-TRP operation.** **Proposal 3: A dedicated PUCCH-SR resource in a cell group should be associated with a non-Serving Cell, where the UE performs inter-Cell multi-TRP operation on the non-Serving Cell and a Serving Cell in the cell group.**  |
| [**R1-2108054**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2108054.zip) | Enhancements to enable inter-cell multi-TRP operations | Nokia, Nokia Shanghai Bell |
| Observation 1: SSB is the main QCL source for beam management reference signals.Observation 2: Associating SSB with a cell-specific identifier enables configuration of non-serving cell RS within the beam management framework.Observation 3: To associate NZP-CSI-RS with a non-serving cell, a QCL source (e.g. SSB) associated with non-serving cell identifier can be used.Observation 4: The *referenceSignal* parameter is used for SRS-SpatialRelationInfo, PUSCH-PathlossReferenceRS-r16, PUSCH-PathlossReferenceRS, PUCCH-SpatialRelationInfo and PUCCH-PathlossReferenceRS-r16.Observation 5: SSB based measurements can be supported by BM framework by associating the SSBs with a cell-specific identifier.Observation 6: NZP-CSI-RS measurements can be supported by BM framework by configuring the SSB with a cell-specific identifier as a QCL source in the TCI State.Observation 7: Even without CORESETPoolIndex configured for CORESETs, the UE can determine the inter-cell mTRP configuration/PDCCH reception through the QCL source for the RS indicated by active TCI state for a CORESET.**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: To support inter-cell multi-DCI based multi-TRP operation, select Alt.1,*** **Alt1: one PCI associated with one or more of activated TCI states for [PDSCH]/PDCCH can be associated with only one CORESETPoolIndex.**
* **In order to associate PCI and CORESETPoolIndex, select one or both of the following,**
	+ **Option 1: Configure CORESETPoolIndex explicitly and only one PCI associated (in the activated TCI states) with one CORESETPoolIndex.**
	+ **Option 2: Use an association between PCI (in the activated TCI states) and CORESETPoolIndex (e.g. lowest PCI is CORESETPoolIndex = 0) such that the UE can assume Rel-16 defined multi-DCI multi-TRP operations.**
		- **Note: Alt.3 defined dynamic point selection can be supported when activated TCI states of CORESETs are associated with single PCI.**
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