**3GPP TSG RAN WG1 #108-e R1-220xxxx**

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

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, the contributions submitted in AI 8.1.2.2 are summarized.

1. 1. RRC related

Although RAN1 has sent LS to RAN2 on RRC leaving detailed design to RAN2, based on contributions following points are proposed, please indicate if you agree or disagree any of them.

Proposal 2.1: please indicate whether one or more of the followings are acceptable

#1: [The value maxNrofAddionalPCI-r17 is 7.](#_Toc95761913)

#2: [Change the field name ssb-ToMeasure to ssb-PositionInBurst in SSB-MTCAdditionalPCI-r17.](#_Toc95761914)

#3: Additional information for the cell with SSB associated with different PCI should include rate matching pattern, LTE-CRS rate matching pattern, and RNTI.

#4: The information related to “SSB time domain position” for SSB with PCI different from the serving cell consists of halfFrameIndex.

#5: [Add the SSB transmission offset and SSB transmission power to SSB-MTCAdditionalPCI-r17.](#_Toc95761912)

#6: SSB from a serving cell associated with additional PCI can be directly configured in QCL-info and SSB-InfoNcell-r16/SSB-Configuration-r16 are used for providing the correct SSB information.

#7: A new RRC IE can be introduced to configure the information for SSB associated with PCI different from the serving cell if the related information is not configured in MeasObject.

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| Company |  | Comments (if any) |
| xxx | #1: (Agree/Disagree)#2: (Agree/Disagree)#3: (Agree/Disagree)#4: (Agree/Disagree)#5: (Agree/Disagree)#6: (Agree/Disagree)#7: (Agree/Disagree) | #1 : #2 : #3 : #4 : #5 : #6 :#7 :  |
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* 1. Value ranges for X1, X2

Value ranges for X1 and X2 have been agreed in RAN1#106b-e with other values as FFS. One company proposed to extend the value ranges, hence following is proposed.

Proposal 2.2:

* + The maximum number of configured additional PCIs is X1 when time domain positions and periodicity of configured SSBs with additional PCIs are the same as time domain positions and periodicity of the serving cell SSBs, with candidate values {0, 1, 2, 3, 4, 5, 6, 7};
	+ The maximum number of configured additional PCIs is X2 when time domain positions and periodicity of configured SSBs with additional PCIs are different with time domain positions and periodicity of the serving cell SSBs, with candidate values {0, 1, 2, 3, 4, 5, 6, 7};

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* 1. Rate matching

Rate matching issues have been discussed for several meetings in past with one agreement in RAN1#104-e with 2 FFSs. Multiple companies discussed those FFSs and proposals are diverse. Based on proposals in contributions, following options are listed below, and proposed to down select in RAN1#108-e.

Proposal 2.3: down select one of the options in RAN1#108-e

Option1: Do not support additional rate matching behaviour for inter-cell multi-TRP operation.

Option2: PDSCH/PDCCH from serving cell is rate matched around SSB from serving cell associated with additional PCI. PDSCH/PDCCH from serving cell associated with additional PCI is rate matched around serving cell SSB.

Option3: PDSCH/PDCCH from the serving cell is not rate matched around SSB from serving cell associated with additional PCI. PDSCH/PDCCH from serving cell associated with additional PCI is not rate matched around serving cell SSB.

Option4: For each cell with additional PCI, LTE CRS pattern for rate matching can be configured.

Option5: PDSCH is rate matched around the SSB for L1-RSRP measurement in addition to those SSBs with same PCI.

Please provide your views/comments on the 5 options in table below.

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| Company | Comments  |
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* 1. QCL related

Two contributions discussed QCL related issues, #1 is more of clarification where as #2 has been discussed in previous meetings. Please indicate whether you agree/disagree with the issues and provide comments in the table, if any.

#1: If SSB collides with DL signals associated with the same PCI, gNB should ensure the DL signals and SSB are QCLed with QCL-TypeD.

#2: TP for 38.214:

If the UE is configured with [TCI-State]s with [tci-StateId\_r17], the reference RS may additionally be an SS/PBCH block associated with a PCI different from the PCI of the serving cell, or a CSI-RS QCLed with an SS/PBCH block associated with a PCI different from the PCI of the serving cell.

#3: for TS 38.214

-- unchanged part omitted--

*If the UE receives the DM-RS for PDSCH and an SS/PBCH block associated with the same PCI in the same OFDM symbol(s), then the UE may assume that the DM-RS and SS/PBCH block are quasi co-located with 'typeD', if 'typeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.*

--unchanged part omitted--

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| Company |  | Comments (if any) |
| xxx | #1: (Agree/Disagree)#2: (Agree/Disagree)#3: (Agree/Disagree) | #1 : #2 : #3 : |
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* 1. CSS to monitor

Several contributions proposed to exclude Type2 CSS in a CORESET from monitoring when the active TCI state is associated with a PCI different from serving cell PCI. Hence, following is proposed.

Proposal 2.5:

* UE is not required to monitor a Type2 CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.

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* 1. UL transmission

Whehter to support tranmission of UL channel/signal toward the serving cell associated with additional PCI has been discussed in past meetings without reaching consensus. Another issue of UL transmission in serving cell on the symbols where SSB from the serving cell associated with additional PCI is being transmitted was discussed, also in Rel-17 coverage enhancement agenda, in past RAN1 meetings. Two different issues are discussed in the contributions submitted in this meeting. Please indicate whether you agree/disagree with issue#1 and issue#2, and provide comments in the table, if any.

Issue#1 : the issue of configuring SSB associated with additional PCI as QCL source or spatial relation for UL signal/channel has been discussed in past several meeting. There are 3 contributions proposing followings.

1. Support UL transmission between UE and TRP associated with non-serving cell PCI.
	* Xiaomi
2. Enhancements related to spatial relation are needed to support UL transmission between UE and TRP associated with non-serving cell PCI.
	* Xiaomi
3. SSB from a non-serving cell can be configured as the spatial relation and PL-RS for PUCCH resources and SRS resources.
	* Lenovo, Motorola Mobility
4. Support to use non-serving cell SSB for mobility measurement as the PL-RS for uplink transmission.
	* ZTE

Issue#2 : the issue of UL signal/channel transmission in serving cell on symbols overlapping with SSB from the cell associated with additional PCI has been discussed in previous meetings, and an related issue of available slot determination was discussed in coverage enhancement agenda. Based on contributions submitted in this meeting, following options are listed for down selection in RAN1#108-e.

Option 1: UL signal transmission is not impacted by SSB from cell associated with additional PCI. UE is not expected to receive SSB from cell associated with additional PCI on UL symbol.

Option 2: UE does not transmit UL channel/RS overlapping with SS/PBCH blocks indicated in the union of ssb-PositionsInBurst for the serving cell and the configured ssb-PositionsInBurst associated with the active additional PCI.

Option 3: The UE does not transmit any UL signal/channel if

* + - The SSB is used as a measurement resource by the UE, or
		- The SSB is associated with the active PCI (associated with one or more active TCI states) and the UL signal/channel is associated with the same PCI
			* Association of UL signal/channel with a PCI is derived based on PL-RS for the UL signal/channel

Option 4: The UE can only transmit UL signal/channel associated with the serving cell PCI, and does not transmit UL signal/channel associated with the active additional PCI.

* + - Association of UL signal/channel with the serving cell PCI or the active additional PCI is derived based on PL-RS for the UL signal/channel.

Please provide your views/comments in the table below.

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| Company |  | Comments (if any) |
| Xxx | Issue#1: (Agree/Disagree)Issue#2: (Agree/Disagree) | Issue#1 : Issue#2 : Option1 :Option2 :Option3 :Option4 : |
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* 1. BFR for inter-cell MTRP

Proposal 2.7: Whether to Apply Rel-17 BFR enhancement for mTRP also for inter-cell mTRP

* For multi-DCI based MTRP inter-cell, if Rel-16 per-cell BFR is configured, SSB associated with additional PCI can be configured as NBI-RS.
* For multi-DCI based MTRP inter-cell, if Rel-17 per-TRP BFR is configured, SSB associated with additional PCI can be configured as NBI-RS in the NBI-RS set associated with corresponding CORESETPoolIndex.

Please provide your views/comments in the table below.

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| Company | Comments (if any) |
| Xxx |  |
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* 1. Text proposals

Based one contributions, following TPs are proposed for discussion/agreement.

TP#1: for TS 38.214

**5.1.4 PDSCH resource mapping**

<unchanged parts are omitted>

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MSGB-RNTI, P-RNTI or TC-RNTI, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* and if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted when the UE is not configured with [*NumberOfAdditionalPCI*]. When the UE is configured with [*NumberOfAdditionalPCI*], if the PDSCH resource allocation overlaps with PRBs containing a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *AdditionalPCIInfo* with same physical cell identity as the one associated with a RS having same quasi-collocation properties as the PDSCH, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.

A UE is not expected to handle the case where PDSCH DM-RS REs are overlapping, even partially, with any RE(s) not available for PDSCH*.*

For operation with shared spectrum channel access, SS/PBCH block transmission according to *ssb-PositionsInBurst* represents all of the candidate SS/PBCH blocks corresponding to SS/PBCH block indices provided by *ssb-PositionsInBurst* as described in Clause 4.1 of [6, TS 38.213].

<unchanged parts are omitted>

TP#2: for TS 38.214

5.1.5 Antenna ports quasi co-location

-----------------------------Unchanged part omitted--------------------------

For a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition,* the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):

- 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with the same CSI-RS resource, or

- 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or

- 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block, the reference RS may additionally be an SS/PBCH block having a PCI different from the PCI of the serving cell. UE can assume center frequency, SCS, SFN offset are the same for SS/PBCH block from the serving cell and SS/PBCH block having a PCI different from the serving cell.

------------------------------------------End of Text Proposal#1 for TS 38.214--------------------------------------

TP#3: for TS 38.214

5.1 UE procedure for receiving the physical downlink shared channel

 -----------------------------Unchanged part omitted--------------------------

If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time, only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex*. For a *ControlResourceSet* without *coresetPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *coresetPoolIndex* as 0. ~~When the UE is configured with [~~*~~NumberOfAdditionalPCI~~*~~],~~ *~~ControlResourceSets~~* ~~corresponding to different~~ *~~coresetPoolIndex~~* ~~values may be associated with different physical cell IDs via activated TCI states of the~~ *~~ControlResourceSets~~*~~, where~~ *~~ControlResourceSets~~* ~~corresponding to one~~ *~~coresetPoolIndex~~* ~~can be associated with one physical cell ID and~~ *~~ControlResourceSets~~* ~~corresponding to another~~ *~~coresetPoolIndex~~* ~~can be associated with another physical cell ID.~~ When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* the following operations are allowed:

-----------------------------Unchanged part omitted--------------------------

TP#4: for TS 38.214

5.1.5 Antenna ports quasi co-location

-----------------------------Unchanged part omitted--------------------------

If the UE is configured with [NumberOfAdditionalPCI] and with PDCCH-Config that contains two different values of coresetPoolIndex in ControlResourceSet, the UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field 'Transmission Configuration Indication' in one CC/DL BWP. When a set of TCI state IDs are activated for a CORESETPoolIndex, the activated TCI states corresponding to one CORESETPoolIndex can be associated with one physical cell ID and activated TCI states corresponding to another coresetPoolIndex can be associated with another or the same physical cell ID.

-----------------------------Unchanged part omitted--------------------------

Please provide your views/comments on the TP in table below.

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| Company |  | Comments  |
| Xxx | TP#1: (Agree/Disagree)TP#2: (Agree/Disagree)TP#3: (Agree/Disagree)TP#4: (Agree/Disagree) | TP#1 : (if agree, proposed wording, if any)TP#2 : (if agree, proposed wording, if any)TP#3 : (if agree, proposed wording, if any)TP#4 : (if agree, proposed wording, if any) |
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* 1. Others

Various issues are raised in the contributions, the issues listed below either have been discussed in previous meetings or single company proposals. Please indicate which ones do you agree or disagree in the table below.

#1: UE is not expected to track a SSB with additional PCI which is not associated with any activated TCI state unless the SSB is configured for L1 measurement.

#2: Add FG16-2a as prerequisite feature group for FG 23-4. Add FG 16-2a-0 to FG 2a-10 as optional prerequisite feature groups for FG 23-4.

#3: For downlink signals associated with a serving cell associated with additional PCI, if virtual cell ID is not configured, the default ID should be the additional PCI.

#4: At most one PCI is associated with the activated TCI states for PDSCH/PDCCH associated with one CORESETPoolIndex.

#5: Support inter-operation, e.g., switching, between intra-cell MTRP and inter-cell MTRP

* One PCI associated with activated TCI states can be associated with more than one CORESETPoolIndex and one CORESETPoolIndex can be associated with only one PCI associated with activated TCI states

#6: Support inter-cell multi-DCI based multi-TRP operation, for both cases of CORESETPoolIndex is configured and not configured

* When CORESETPoolIndex is configured, multi-DCI based multi-TRP operation is applied regardless that CORESETPoolIndex values are associated with the same PCI or different PCIs. i.e. inter-cell multi-DCI multi-TRP or intra-cell multi-DCI multi-TRP operations.
* When CORESETPoolIndex is not configured but CORESETs are associated with two different PCIs, multi-DCI based multi-TRP operation is applied assuming that as if CORESETPoolIndex would be configured and CORESETPoolIndex are associated to different PCI.

#7: During the intermediate state (during the switching) between serving cell and different PCI, the UE is not required to monitor scheduling from a CORESET with associated with different PCI if the TCI state is associated with different PCI than the latest activated TCI state under the same CORESETpoolindex

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| Company |  | Comments (if any) |
| xxx | #1: (Agree/Disagree)#2: (Agree/Disagree)#3: (Agree/Disagree)#4: (Agree/Disagree)#5: (Agree/Disagree)#6: (Agree/Disagree)#7: (Agree/Disagree) | #1 : #2 : #3 : #4 : #5 : #6 : #7 :  |
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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

RAN1#106-e

**Agreement**

Introduce a new RRC indicator/signalling (e.g., re-index the non-serving cell) to indicate the non-serving cell information that a TCI state/QCL information is associated with, where the new indicator/signaling is not the exact PCI value

* Detailed signalling design is up to RAN2

**Agreement**

Rel. 17 inter-cell MTRP, the maximum number of additional RRC -configured PCIs per CC is denoted X and can be reported as a UE capability

* For the report value of X, multiple candidate values including 1 is supported.
	+ FFS : Which values to support other than 1.
	+ Values larger than 7 are precluded
	+ RAN1 needs to agree on value(s) of X other than 1
* Down-select one of the following alternatives:
	+ Alt 1: A single value of X is reported as UE capability for any possible SSB time domain position and periodicity
	+ Alt 3: At least Two independent X values (X1, X2) are reported as a UE capability for at least two different assumptions on SSB time domain position and periodicity with respect to serving cell SSB
* The serving cell PCI is always associated with active TCI states, only 1 additional PCI can be associated with the active TCI States

**Agreement**

* For inter-cell mTRP , 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*
* FFS : The association between PCI and *CORESETPoolIndex* when switching between intra-cell mTRP and inter-cell mTRP

**Agreement**

For a CSI-RS QCLed with a neighboring cell SSB, the CSI-RS EPRE is calculated based on *powerControlOffsetSS* and the SSB transmission power in the neighboring cell information.

**Agreement**

LS to RAN2 on multi-TRP inter-cell is endorsed in R1-2108633.

RAN1#106b-e

**Agreement**

* Center frequency, SCS, SFN offset are assumed to be the same for SSBs from the serving cell and the configured  SSBs with PCI different from the serving cell for inter-cell multi TRP operation.
* The information related to “SSB time domain position” for  SSB with PCI different from the serving cell consists of [halfFrameIndex and] ssb-PositionsInBurst

**Agreement**

Support two independent X values (X1, X2) are reported as a UE capability for two different assumptions on additional SSB time domain position and periodicity with respect to serving cell SSB.

* X1 (Case 1)= The maximum number of configured additional PCIs when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI
* X2 (Case 2)= The maximum number of configured additional PCIs when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1
* Note: By definition, Case 1 and Case 2 cannot be enabled simultaneously
* Supported values for X1 and X2 include~~s~~ at least 0,1,2,3 and 7. FFS on other values
* This UE capability has FR1 and FR2 differentiation (FFS : Whether this UE capability is per UE or per band)

RAN1#107-e

**Agreement**

UE is not required to monitor a Type0/0A/1[/2] CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.

1. Reference

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| [**R1-2200931**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200931.zip) | Remaining issues on inter-cell multi-TRP operation in Rel-17 | Huawei, HiSilicon |
| Proposal 1: Support the following values for X1 and X2 on RRC-configured PCI(s) different from serving cell PCI* + The maximum number of configured additional PCIs is X1 when time domain positions and periodicity of configured SSBs with additional PCIs are the same as time domain positions and periodicity of the serving cell SSBs, with candidate values {0, 1, 2, 3, 4, 5, 6, 7};
	+ The maximum number of configured additional PCIs is X2 when time domain positions and periodicity of configured SSBs with additional PCIs are different with time domain positions and periodicity of the serving cell SSBs, with candidate values {0, 1, 2, 3, 4, 5, 6, 7};

Proposal 2: Do not support additional rate matching behaviour for inter-cell multi-TRP operation.  |
| [**R1-2200993**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200993.zip) | Inter-cell multi-TRP operation | FUTUREWEI |
| Proposal 1: Inter-cell CSI-RS should also be allowed to be the reference RS for SRS, and modify TS 38.214 to as “If the UE is configured with [TCI-State]s with [tci-StateId\_r17], the reference RS may additionally be an SS/PBCH block associated with a PCI different from the PCI of the serving cell, or a CSI-RS QCLed with an SS/PBCH block associated with a PCI different from the PCI of the serving cell.” |
| [**R1-2201080**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201080.zip) | Maintenance on inter-cell MTRP operation | vivo |
| **Proposal 1:** * It is proposed to discuss and conclude the UE behavior on PUSCH/PUCCH transmission in the serving cell on the symbols where SSB from TRP associated with different PCI than serving cell PCI is being transmitted in RAN1#108-e.

**Proposal 2:** * Support the TP in section 3 above.
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| [**R1-2201187**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201187.zip) | Remaining issues on multi-TRP inter-cell operation | ZTE |
| **Observation:** Collision handling between UL channels/signals and non-serving cell SSBs needs to be specified in Rel-17 feMIMO session.**Proposal 1:** In the set of symbols indicated to a UE by ssb-PositionsInBurst in SSB associated with the active additional PCI, down-select one option as follows in Rel-17:* 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 , and does not transmit UL signal/channel associated with the active additional PCI.
	+ Association of UL signal/channel with the serving cell PCI or the active additional PCI is derived based on PL-RS for the UL signal/channel.

The following Rel. 15/16 procedures are 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 PUCCHRepeat slots in the case of PUCCH repetition, i.e., a slot is not counted toward the N PUCCHRepeat slots if the PUCCH resource in that slot overlaps with a SSB [38.213, Section 9.2.6].

**Proposal 2:** Additional information for the cell with SSB associated with different PCI should include rate matching pattern,, LTE-CRS rate matching pattern, and RNTI.**Proposal 3:** Support to use non-serving cell SSB for mobility measurement as the PL-RS for uplink transmission. |
| [**R1-2201225**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201225.zip) | Enhancement on inter-cell multi-TRP operation | OPPO |
| ***Proposal 1: UE is not expected to track a SSB with additional PCI which is not associated with any activated TCI state unless the SSB is configured for L1 measurement.******Proposal 2: UL signal transmission is not impacted by neighboring cell SSB. UE is not expected to receive neighboring cell SSB in UL symbol.******Proposal 3: Apply the above TP for SSB and PDSCH associated with the same PCI and transmitted in the same symbol.****If the UE receives the DM-RS for PDSCH and an SS/PBCH block associated with the same PCI in the same OFDM symbol(s), then the UE may assume that the DM-RS and SS/PBCH block are quasi co-located with 'typeD', if 'typeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.* |
| [**R1-2201330**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201330.zip) | Discussion on remaining issues on inter-cell operation for multi-TRP/panel | CATT |
| Observation-1: MAC CE based switching between intra-cell and inter-cell mTRP has already been supported without additional spec impact.Proposal-1: 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.Proposal-2: UE is not required to monitor a Type2 CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI. |
| [**R1-2201428**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201428.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 in a CSI-ReportConfig.Proposal 3: SSB from a non-serving cell can be configured as the spatial relation and PL-RS for PUCCH resources and SRS resources. |
| [**R1-2201465**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201465.zip) | Remaining issues on inter-cell multi-TRP operation | NTT DOCOMO, INC. |
| Proposal 1* + The information related to “SSB time domain position” for SSB with PCI different from the serving cell consists of halfFrameIndex.

Proposal 2* + For each cell with additional PCI, LTE CRS pattern for rate matching can be configured.

Proposal 3* + At most one PCI is associated with the activated TCI states for PDSCH/PDCCH associated with one CORESETPoolIndex.

Proposal 4* + UE is not required to monitor a Type 2 CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.
	+ Adopt following TP for TS 38.213.

|  |
| --- |
| 10 UE procedure for receiving control information[…]If a UE is not provided TCI-State\_r17, the UE is not required to monitor PDCCH candidates for a Type0/0A/1/2-PDCCH CSS set when the active TCI state for a corresponding CORESET is not associated with physCellId in ServingCellConfigCommon. |

Proposal 5* + For multi-DCI based MTRP inter-cell, if Rel-16 per-cell BFR is configured, SSB associated with additional PCI can be configured as NBI-RS.
	+ For multi-DCI based MTRP inter-cell, if Rel-17 per-TRP BFR is configured, SSB associated with additional PCI can be configured as NBI-RS in the NBI-RS set associated with corresponding CORESETPoolIndex.
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| [**R1-2201536**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201536.zip) | Discussion on enhancements on multi-TRP inter-cell operation | Spreadtrum Communications |
| Proposal 1: For inter-cell multi-TRP operation, PDSCH/PDCCH from the serving cell should not be rate-matched around non-serving cell SSB.Proposal 2: 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.Proposal 3: The information related to “SSB time domain position” for  SSB with PCI different from the serving cell consists of halfFrameIndex.Proposal 4: Suggest to adopt the following text proposal#1 in 38.214.------------------------------------------Start of Text Proposal#1 for TS 38.214--------------------------------------5.1.5 Antenna ports quasi co-location-----------------------------Unchanged part omitted--------------------------For a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition,* the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):- 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with the same CSI-RS resource, or- 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or- 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block, the reference RS may additionally be an SS/PBCH block having a PCI different from the PCI of the serving cell. UE can assume center frequency, SCS, SFN offset are the same for SS/PBCH block from the serving cell and SS/PBCH block having a PCI different from the serving cell.------------------------------------------End of Text Proposal#1 for TS 38.214-------------------------------------- |
| [**R1-2201569**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201569.zip) | Enhancements on Multi-TRP inter-cell operation | LG Electronics |
| Proposal #1: 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.Proposal #2: halfFrameIndex for non-serving cell SSB is not needed for inter-cell MTRP operation.Proposal #3: UE is not required to monitor a Type 2 CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI. |
| [**R1-2201621**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201621.zip) | Finalizing Multi-TRP inter-cell operation | Ericsson |
| [Proposal 1 Add the SSB transmission offset and SSB transmission power to SSB-MTCAdditionalPCI-r17.](#_Toc95761912)[Proposal 2 The value maxNrofAddionalPCI-r17 is 7.](#_Toc95761913)[Proposal 3 Change the field name ssb-ToMeasure to ssb-PositionInBurst in SSB-MTCAdditionalPCI-r17.](#_Toc95761914)[Proposal 4 Add FG16-2a as prerequisite feature group for FG 23-4. Add FG 16-2a-0 to FG 2a-10 as optional prerequisite feature groups for FG 23-4.](#_Toc95761915) |
| [**R1-2201684**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201684.zip) | Maintenance of multi-TRP inter-cell operation | Intel Corporation |
| Proposal-1: Extend current UE behavior of not transmitting UL channel/RS overlapping with SS/PBCH block indicated in ssb-PositionsInBurst (for the serving cell) to SS/PBCH blocks indicated in the union of ssb-PositionsInBurst for the serving cell and the configured ssb-PositionsInBurst associated with the active additional PCI (option-1).Proposal-2: Remove the brackets from “UE is not required to monitor a Type0/0A/1[/2] CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI” |
| [**R1-2201760**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201760.zip) | Views on Rel-17 Inter-cell multi-TRP operation | Apple |
| Proposal 1: If SSB collides with DL signals associated with the same PCI, gNB should ensure the DL signals and SSB are QCLed with QCL-TypeD.Proposal 2: For downlink signals associated with a non-serving cell, if virtual cell ID is not configured, the default ID should be PCI for the non-serving cell. |
| [**R1-2201846**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201846.zip) | Remaining issues of enhancements on Multi-TRP inter-cell operation | CMCC |
| Proposal 1: Revise the agreement of RAN1#107-e meeting as follows.UE is not required to monitor a Type0/0A/1/2 CSS in a CORESET when the active TCI state is associated with a PCI different from serving cell PCI.Proposal 2: A new RRC IE can be introduced to configure the information for SSB associated with PCI different from the serving cell if the related information is not configured in MeasObject.Proposal 3: In the set of symbols indicated to a UE for SSBs with PCI different from the serving cell, the UE can only transmit UL signal/channel associated with the serving cell PCI. |
| [**R1-2201941**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201941.zip) | Maintenance on multi-TRP Inter-cell Operation | Xiaomi |
| Proposal 1: Adopt the following TP to TS 38.214 Clause 5.1.4============================ Unchanged part omitted ===========================**5.1.4 PDSCH resource mapping**When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted. When UE is configured with [NumberOfAdditionalPCI], the UE shall assume that the PRBs containing SS/PBCH block transmission resources configured in CSI-ResourceConfig with physical cell ID different from that of serving cell are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.============================ Unchanged part omitted ===========================Proposal 2: The following TP related to TS38.214 clause 5.1 is provided.**5.1 UE procedure for receiving the physical downlink shared channel** …If a UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the UE may expect to receive multiple PDCCHs scheduling fully/partially/non-overlapped PDSCHs in time and frequency domain. The UE may expect the reception of full/partially-overlapped PDSCHs in time, only when PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex*. For a *ControlResourceSet* without *coresetPoolIndex*, the UE may assume that the *ControlResourceSet* is assigned with *coresetPoolIndex* as 0. ~~When the UE is configured with [~~*~~NumberOfAdditionalPCI~~*~~],~~ *~~ControlResourceSets~~* ~~corresponding to different~~ *~~coresetPoolIndex~~* ~~values may be associated with different physical cell IDs via activated TCI states of the~~ *~~ControlResourceSets~~*~~, where~~ *~~ControlResourceSets~~* ~~corresponding to one~~ *~~coresetPoolIndex~~* ~~can be associated with one physical cell ID and~~ *~~ControlResourceSets~~* ~~corresponding to another~~ *~~coresetPoolIndex~~* ~~can be associated with another physical cell ID.~~ When the UE is scheduled with full/partially/non-overlapped PDSCHs in time and frequency domain, the full scheduling information for receiving a PDSCH is indicated and carried only by the corresponding PDCCH, the UE is expected to be scheduled with the same active BWP and the same SCS. When the UE is scheduled with full/partially-overlapped PDSCHs in time and frequency domain, the UE can be scheduled with at most two codewords simultaneously. When PDCCHs that schedule two PDSCHs are associated to different *ControlResourceSets* having different values of *coresetPoolIndex,* the following operations are allowed:============================ Unchanged part omitted ===========================Proposal 3: Adopt the following TP to TS 38.214 clause 5.1.5.**5.1.5 Antenna ports quasi co-location**…If the UE is configured with [NumberOfAdditionalPCI] and with PDCCH-Config that contains two different values of coresetPoolIndex in ControlResourceSet, the UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field 'Transmission Configuration Indication' in one CC/DL BWP. When a set of TCI state IDs are activated for a CORESETPoolIndex, the activated TCI states corresponding to one CORESETPoolIndex can be associated with one physical cell ID and activated TCI states corresponding to another coresetPoolIndex can be associated with another or the same physical cell ID.Proposal 4: Support UL transmission between UE and TRP associated with non-serving cell PCI.Proposal 5: Enhancements related to spatial relation are needed to support UL transmission between UE and TRP associated with non-serving cell PCI. |
| [**R1-2201998**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201998.zip) | Maintenance on Rel-17 Inter-cell Multi-TRP | Samsung |
| **Proposal 1:** *Support inter-operation, e.g., switching, between intra-cell MTRP and inter-cell MTRP** *One PCI associated with activated TCI states can be associated with more than one CORESETPoolIndex and one CORESETPoolIndex can be associated with only one PCI associated with activated TCI states*
 |
| [**R1-2202124**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202124.zip) | Remaining details of Multi-TRP inter-cell operation | Qualcomm Incorporated |
| Proposal 1: Adopt the following TP to capture the existing agreement:============TP for 38.214 Section 5.1.4 ====================================--Unchanged part omitted------------------------When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted. If PDSCH resource allocation overlaps with PRBs containing SS/PBCH block transmission resources according to *ssb-PositionsInBurst* in *AdditionalPCIInfo* with same physical cell identity as the one associated with a RS having same quasi-collocation properties as the PDSCH, the UE shall assume that the PRBs containing SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where SS/PBCH block is transmitted.A UE is not expected to handle the case where PDSCH DM-RS REs are overlapping, even partially, with any RE(s) not available for PDSCH*.*===============================================================Proposal 2: In the set of symbols indicated to a UE by *ssb-PositionsInBurst* in *AdditionalPCIInfo** Alt1 (more efficient): UE does not transmit UL signal/channel if
	+ The SSB is used as a measurement resource by the UE, or
	+ The SSB is associated with the active PCI (associated with one or more active TCI states) and the UL signal/channel is associated with the same PCI
		- Association of UL signal/channel with a PCI is derived based on PL-RS for the UL signal/channel
* Alt2 (simpler): UE does not transmit UL signal/channel irrespective of whether the SSB is associated with the active PCI or not and irrespective of association of the UL signal/channel with a PCI
* The following Rel. 15/16/17 procedures are based on a selected Alt from Alt 1 or Alt 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].
	+ Procedure 5: For available slot counting for PUSCH introduced in Rel-17 coverage enhancement agenda item [38.214, Section 6.1.2.1].
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| [**R1-2202318**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202318.zip) | Maintenance of enhancements enabling inter-cell multi-TRP operations | Nokia, Nokia Shanghai Bell |
| **Observation 1:** MAC CE based switching is already supported**Proposal 1:** Support inter-cell multi-DCI based multi-TRP operation, for both cases of CORESETPoolIndex is configured and not configured.* When CORESETPoolIndex is configured, multi-DCI based multi-TRP operation is applied regardless that CORESETPoolIndex values are associated with the same PCI or different PCIs. i.e. inter-cell multi-DCI multi-TRP or intra-cell multi-DCI multi-TRP operations.
* When CORESETPoolIndex is not configured but CORESETs are associated with two different PCIs, multi-DCI based multi-TRP operation is applied assuming that as if CORESETPoolIndex would be configured and CORESETPoolIndex are associated to different PCI.

**Proposal 2:** Don’t support additional rate matching behaviour for inter-cell multi-TRP operation.**Proposal 3:** During the intermediate state (during the switching) between serving cell and different PCI, the UE is not required to monitor scheduling from a CORESET with associated with different PCI if the TCI state is associated with different PCI than the latest activated TCI state under the same CORESETpoolindex.**Proposal 4:** Apply Rel-17 BFR enhancement for mTRP also for inter-cell mTRP. |