3GPP TSG RAN WG1#94 **R1-1809758**
Gothenburg, Sweden, August 20th – 24th, 2018

Agenda item: **7.1.2.4**

Source: **Nokia, Nokia Shanghai Bell**

Title: **Feature lead summary on QCL**

Document for: **Discussion**

1 Introduction

In RAN1#94 meeting a total of 7 contributions [2-9], have been submitted on the QCL agenda item. Most of the documents contain text proposals, summarized in the following sections.

2 Text proposals for 38.214

Issue 2.1: Ericsson (R1-1809198), Qualcomm (R1-1809424)

---- Unchanged parts omitted, ***section 5.1.5 of 38.214****----*

For a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without the higher layer parameter *repetition*, the UE shall expect that a *TCI-State* indicates one of the following quasi co-location type(s):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with an SS/PBCH block , or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or
- 'QCL-TypeB' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* when 'QCL-TypeD' is not applicable.

---- Unchanged parts omitted, ***section 5.1.5 of 38.214****----*

Companies views:

Company	Comment
Ericsson	We observe that since the CSI-RS (CSI) is used to predict the quality of the PDSCH, it is very natural that the UE uses the same QCL assumption for the CSI-RS (CSI) and the PDSCH DMRS, and this proposal enables common QCL signalling to be consistent with this observation. Clearly, signalling different QCL assumptions for these two reference signals would imply that the large-scale properties of the corresponding two channels are different, which is counterintuitive.
Qualcomm	We agree. It looks to us that this basic association was missed by mistake and it should be added.
Samsung	Support

Issue 2.2: BM topic TP in Section 5.1.5 of 38.214 for the determination of QCL assumption before RRC configuration. (Huawei, R1-1808144)

< Start of the text proposal >

5.1.5 Antenna ports quasi co-location

< Unchanged parts are omitted >

For both the cases when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *Threshold-Sched-Offset*, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE. If none of configured TCI states contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH.

< End of the text proposal >

Companies views:

Company	Comment
Huawei	The default QCL assumption of lowest CORESET-ID when scheduling offset is smaller than threshold, is used after RRC configuration. In 38.214, the description may be also applied for the case before RRC configuration. For signal such as RMSI reception, the QCL parameters are derived from corresponding to the scheduling PDCCH and associated SSB. To avoid ambiguity, the description should be more precise.
Qualcomm	After RACH procedure and before RRC configuration, the beams identified during RACH procedure serve as default. These are the beam of SSB identified by the UE for DL. Either way, this looks a BM topic and it should be discussed in that agenda.
Samsung	Agree to Qualcomm
Ericsson	Agree. No need to discuss in BM agenda AI.

Issue 2.3: ZTE (R1-1808197)

For a CSI-RS resource in a *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):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or
- 'QCL-TypeC' with an SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block.
- 'QCL-TypeA' with an SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block.

Companies views:

Company	Comment
ZTE	One CSI-RS resource for BM and one SS/PBCH resource block can be configured as being quasi co-located with respect to 'QCL-Type A' and 'QCL-TypeD' To Qualcomm's comments, our intention is actually to make spec. aligned between different sections. We are OK for either above TP or agreeing with following change 5.2.1.4.3 L1-RSRP Reporting For L1-RSRP computation - the UE may be configured with CSI-RS resources, SS/PBCH Block resources or both CSI-RS and SS/PBCH block resources, when resource-wise quasi co-located with 'QCL-Type ~~A~~ C' and 'QCL-TypeD'.
Qualcomm	We need to discuss further to understand why QCL-TypeC is not enough for RSRP reporting, and QCL-TypeA is needed. Also, getting Type-A from SSB (which is only 20 PRBs), may not be the best choice, it is one of the reasons why TRS is introduced in the first place.

3 Other proposals

Issue 3.1: Signalling Reduction for Beam Indication (Nokia):

Proposal 1: ***Support determining spatial QCL source for e.g. periodic CSI-RS for CSI acquisition, periodic CSI for RLM, PUCCH and periodic SRS for codebook/non-codebook from the activated TCI state of the lowest CORESET-ID in the latest slot when TCI state (downlink) or spatial relation info (uplink) is not explicitly configured for the resource.***

Companies views:

Company	Comment
Nokia	One typical operating mode of NR cell is that the same downlink RS acts as source RS to determine both downlink TX beam and uplink TX for the UE for PDCCH, PDSCH, CSI-RS for CSI acquisition, CSI-RS for RLM, PUCCH and SRS for codebook/non-codebook transmission. Signalling overhead by separate configuration and activation signalling can be avoided if the spatial QCL assumption of a signal/ channel can be implicitly derived from another signal/ channel. That is more generally what is defined for the PDSCH when TCI is not present in DCI In addition, another concern is the beam management performance. Based on UE feature list (R1-1807891), both periodic and aperiodic beam reporting are mandatory (at least in FR2) while semi-persistent beam reporting is optional. However, aperiodic beam reporting is on PUSCH and creates more overhead and is less spectrum efficient than using PUCCH. The use of periodic beam reporting on PUCCH is attractive but the use of periodic CSI-RSs is subject to slow and heavy higher layer signaling related to beam switching. Thus, it's considered important to introduce means for dynamic beam switching also for periodic RSs. Since dynamic beam indication (MAC level) is supported for the PDCCH, activated TCI state of PDCCH could be used more generally as TCI state or spatial relation info for other signals and channels. This could be implemented so that when TCI state for downlink signal/channel (e.g. CSI-RS for CSI and RLM) or spatial relation info for uplink signal/channel (PUCCH, SRS for codebook/non-codebook) is not explicitly configured the

	UE can determine the spatial QCL source from the activated TCI state of the lowest CORESET-ID in the latest slot.
Qualcomm	TCI states shall always have QCL-typeD for FR2, i.e. when typeD is applicable.
Samsung	Support
Ericsson	Interesting proposal, but so far RAN1 has not discussed deriving QCL assumptions from a CORESET for anything but PDSCH.

Issue 3.2: QCL relation chain rule (Qualcomm, R1-1809424):

Proposal 15: If the QCL-type D of a first signal is changed and the first signal serves as QCL-type D source of a second signal, the QCL-type D of the second signal should also be changed accordingly.

Companies views:

Company	Comment
ZTE	It is obvious.
Samsung	Support
Ericsson	Unclear what this means. The QCL relations are conveyed via signaling and are updated individually. Is the proposal to enforce a sequence of NW signaling?

Issue 3.3: cross- CC scheduling (ZTE, R1-1808197):

Proposal2 : *When PDSCH and its scheduling PDCCH are in the different CCs,*

- *if TCI field is not present in DCI, UE obtains the QCL assumptions other than QCL-TypeD from the first one of M TCI-States configured for the active BWP in which the PDSCH is scheduled.*
- *if TCI field is present in DCI and the time offset between the reception of the DL DCI and the corresponding PDSCH is smaller than a threshold Threshold-Sched-Offset, UE obtains the QCL assumptions other than QCL-TypeD from the indicated TCI state in DCI for the PDSCH.*

Companies views:

Company	Comment
Qualcomm	This is again a BM topic and in general it should be discussed there, or it should be discussed in the BWP Agenda item (where this is captured in the summary there). For the sake of technical discussion, our position is that all QCL relations should come from the scheduled CC, e.g., if FR1 schedules FR2, all QCL parameters should come from FR2; we do not see any good reason to take Type A from FR1 and Type D from FR2; these are 2 different CCs, in different frequencies, the channels are different, and therefore taking one QCL type from FR1 and apply it to FR2 does not seem to make sense. The simplest solution (at this late stage of this release) would be to always enforce TCI field in DCI in this case with a schedule offset be no lower than the threshold (a minimum k0 threshold related to cross-carrier/BWP). Then, there is no problem. So our proposal is: *When PDSCH and its scheduling PDCCH are in the different CCs, the UE does not expect the TCI field to not be present in the DCI and that the time offset between the reception of the DL DCI and the corresponding PDSCH to be smaller than the threshold TrehsholSched-Offset.*

Ericsson	BM topic. A solution is needed.

Issue 3.4: assumptions for QCL acquisition When the time offset between the reception of the DL DCI and the corresponding PDSCH is smaller than a threshold (ZTE, R1-1808197):

Proposal 3: *When the time offset between the reception of the DL DCI and the corresponding PDSCH is smaller than a threshold Threshold-Sched-Offset, UE obtains QCL parameter from the CORESET with the lowest CORESET-ID which are associated with at least one search space set monitored by UE in the latest slot in the case that the PDSCH and the CORESET are in the same serving cell.*

Companies views:

Company	Comment

Issue 3.5: preclude the possibility of configuring aperiodic signal as the QCL source for PDCCH (VIVO, R1-1808222):

Proposal 7:

- *For PDCCH, if a TCI-State is configured with a reference to an RS associated with 'QCL-TypeD', that RS can be an SSB or periodic CSI-RS.*

Companies views:

Company	Comment
Qualcomm	We need further discussion, because we are under the impression that the aperiodic CSIRS cannot be used as a source for PDCCH.
ZTE	Seems OK
Samsung	No need to update the specification
Ericsson	No need to update the specification. This is not precluded by the spec, so it's allowed.

Issue 3.6: QCL assumption across CSI-RS resources (Intel, R1-1808670):

Proposal 7:

- *Specify antenna port relation between CSI-RS resources (with repetition "on" or "off") instead of current description based on Tx spatial filtering at gNB side*
    - *Same antenna port or spatial QCL should be considered*

Companies views:

Company	Comment
Qualcomm	This was discussed before several times, and we have a preference to keep the specification as is.
ZTE	Support, and we prefer the same antenna port
Samsung	No need to update the specification
Ericsson	We would prefer to clarify the specification, but the issue has been discussed several times in RAN1 already.

Issue 3.7: QCL assumption for the same CSI-RS resource over time (Intel, R1-1808670):

Proposal 8:

- *Clarify that UE may assume that all CSI-RS resource transmission occasions with the same CSI-RS resource configuration identity for a given CC and BWP is quasi co-located with respect to Doppler spread, Doppler shift, average gain, average delay, and spatial Rx parameters*

Companies views:

Company	Comment
ZTE	Not support. E.g. for aperiodic, different transmission occasions have no such relationship.
Ericsson	The signalled QCL relations apply. The UE cannot make any assumptions on top of that.

Issue 3.8: Lack of "average gain" parameter in QCL types (Intel, R1-1808670):

Proposal 9:

- *Amend QCL type A and QCL type D definitions to include the "average gain" parameter*
    - *If TCI state include both QCL Type A and Type D simultaneously prioritize" average gain obtained from the reference signal associated with QCL type D*

Companies views:

Company	Comment
Qualcomm	We understand the motivation and the clarification: to use one RS to drive the AGC / Channel estimation block of PDxCH DMRS (e.g., TRS -> PDxCH DMRS). We are generally supportive. A quick technical note is that, even if the "average gain" is added in the above definitions, the UE also needs to know the EPRE ratio between the RS and the PDxCH DMRS. This is already RRC-configured for PDSCH, but for PDCCH DMRS, it seems it is still being debated. Our point is that even if the "average gain" is added (which makes sense to add), for PDxCH DMRS the UE also requires the knowledge EPRE ratio of TRS to PDCCH DMRS, otherwise knowing that the "average gain" is the same it does not help.

ZTE	Not support. RSs with different powers have different average gain, e.g. PTRS and associated DMRS.
Ericsson	Disagree. This would prohibit dynamic beamforming.

Issue 3.9: Optional configuration of QCL-type D for BM CSI-RS (Intel, R1-1808670):

Proposal 10:

- *Clarify the meaning of "when applicable "for QCL-type D wrt to optional and mandatory configuration in FR2 for different types of RS*
  - *For beam management CSI-RS, QCL-Type D configuration is optional in FR2*
  - *For other CSI-RS, QCL-Type D configuration is mandatory in FR2*

Companies views:

Company	Comment
Qualcomm	We are under a different understanding of 38.214 section 5.1.5. "When applicable" is the same meaning for all resources. If Type-D is not configured for FR2 in CSIRS for BM, how will the UE know which beam is used?
ZTE	It is up to gNB implementation. Even for FR2, if UE only has one receive beams, it is possible that gNB does not configure QCL-type D.

Issue 3.12: TCI configurations for DM-RS of PDCCH (Qualcomm, R1-1809424):

Proposal 17: Update previous agreement on QCL relations for DMRS of PDCCH as follows:

For the DM-RS of PDCCH, the UE should only expect the following three configurations of the higher layer parameter *TCI-State* while the fourth configuration is valid as default, before TRS is configured:

Valid TCI state Configuration	**DL RS 1**	***qcl-Type1***	**DL RS 2 (if configured)**	***qcl-Type2* (if configured)**
1	TRS	QCL-TypeA	TRS	QCL-TypeD
2	TRS	QCL-TypeA	CSI-RS (BM)	QCL-TypeD
3**	CSI-RS (CSI)	QCL-TypeA	CSI-RS (CSI)	QCL-TypeD
4*	SS/PBCH Block*	QCL-TypeA	SS/PBCH Block*	QCL-TypeD

* Before TRS configured. Note: this is not a TCI state, rather a valid QCL assumption

~~**Note: Only when QCL type-D is not applicable~~

Companies views:

Company	Comment
Qualcomm	Support
ZTE	Fine
Ericsson	Support

Issue 3.12: SP CSI-RS as a source of QCL Typd-D for periodic TRS:

Proposal 18: Support a configuration of SP-CSI-RS as a souce of QCL Type-D for periodic TRS

For PDCCH and PDSCH, SP CSI-RS can be configured as a source of QCL Type-D and enables dynamic beam indication via MAC CE. However, P CSI-RS should be configured for periodic TRS and limits dynamic beam change operation.

- *repetition* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and defines whether a repetition in conjunction with spatial domain transmission filter is on/off at gNB-side as described in Subclause 5.1.6.1.2. and can be configured only when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is set to 'cri-RSRP' or 'none'.
- *qcl-InfoPeriodicCSI-RS* contains a reference to a *TCI-State* indicating QCL source RS(s). If the *TCI-State* is configured with a reference to an RS with 'QCL-TypeD' association, that RS may be an SS/PBCH block located in the same or different CC/DL BWP or a CSI-RS resource configured as periodic or semi-persistent located in the same or different CC/DL BWP.
- *trs-Info* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and for which the UE can assume that the antenna port with the same port index of the configured NZP CSI-RS resources in the *NZP-CSI-RS-ResourceSet* is the same as described in Subclause 5.1.6.1.1 and can be configured only when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is unconfigured or set to 'none'.

Companies views:

Company	Comment

References

[1] 3GPP, RAN1#92, Chairman's Notes
[2] R1-1805836 Remaining issues on QCL ZTE
[3] R1-1808144 Remaining issues on reference signals and QCL Huawei, HiSilicon
[4] R1-1808197 Maintenance for Reference signals and QCL ZTE
[5] R1-1808222 Remaining issues on reference signals and QCL vivo
[6] R1-1808670 Corrections to reference signals and QCL Intel Corporation
[7] R1-1809198 Maintenance for RS and QCL Ericsson
[8] R1-1809424 Maintenance for RS Qualcomm Incorporated

Appendix – Proposals

Proposals from different companies related to this topic are listed in the following:

Huawei, HiSilicon (R1-1808144)

Text proposal #17 on QCL in 38.214 version 15.2.0

The default QCL assumption of lowest CORESET-ID when scheduling offset is smaller than threshold, is used after RRC configuration. In 38.214, the description may be also applied for the case before RRC configuration. For signal such as RMSI reception, the QCL parameters are derived from corresponding to the scheduling PDCCH and associated SSB. To avoid ambiguity, the description should be more precise.

< Start of the text proposal >

5.1.5 Antenna ports quasi co-location

< Unchanged parts are omitted >

For both the cases when *tci-PresentInDCI* is set to 'enabled' and *tci-PresentInDCI* is not configured in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *Threshold-Sched-Offset*, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the lowest *CORESET-ID* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are configured for the UE. If none of configured TCI states contains 'QCL-TypeD', the UE shall obtain the other QCL assumptions from the indicated TCI states for its scheduled PDSCH irrespective of the time offset between the reception of the DL DCI and the corresponding PDSCH.

< End of the text proposal >

ZTE, Sanechips (R1-1808197)

Proposal2 : *When PDSCH and its scheduling PDCCH are in the different CCs,*

- *if TCI field is not present in DCI, UE obtains the QCL assumptions other than QCL-TypeD from the first one of M TCI-States configured for the active BWP in which the PDSCH is scheduled.*
- *if TCI field is present in DCI and the time offset between the reception of the DL DCI and the corresponding PDSCH is smaller than a threshold Threshold-Sched-Offset, UE obtains the QCL assumptions other than QCL-TypeD from the indicated TCI state in DCI for the PDSCH.*

Proposal 3: *When the time offset between the reception of the DL DCI and the corresponding PDSCH is smaller than a threshold Threshold-Sched-Offset, UE obtains QCL parameter from the CORESET with the lowest CORESET-ID which are associated with at least one search space set monitored by UE in the latest slot in the case that the PDSCH and the CORESET are in the same serving cell.*

Proposal-4: *One CSI-RS resource for BM and one SS/PBCH resource block can be configured as being quasi co-located with respect to 'QCL-Type A' and 'QCL-TypeD'.*

TP5 for section 5.1.5 in 38.214

For a CSI-RS resource in a *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):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or
- 'QCL-TypeC' with an SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block.
- 'QCL-TypeA' with an SS/PBCH block and, when applicable, 'QCL-TypeD' with the same SS/PBCH block.

VIVO (R1-1808222)

Proposal 7:

- *For PDCCH, if a TCI-State is configured with a reference to an RS associated with 'QCL-TypeD', that RS can be an SSB or periodic CSI-RS.*

Intel (R1-1808670)

QCL assumption across CSI-RS resources

Proposal 7:

- *Specify antenna port relation between CSI-RS resources (with repetition "on" or "off") instead of current description based on Tx spatial filtering at gNB side*
    - *Same antenna port or spatial QCL should be considered*

QCL assumption for the same CSI-RS resource over time

Proposal 8:

- *Clarify that UE may assume that all CSI-RS resource transmission occasions with the same CSI-RS resource configuration identity for a given CC and BWP is quasi co-located with respect to Doppler spread, Doppler shift, average gain, average delay, and spatial Rx parameters*

Lack of "average gain" parameter in QCL types

Proposal 9:

- *Amend QCL type A and QCL type D definitions to include the "average gain" parameter*
    - *If TCI state include both QCL Type A and Type D simultaneously prioritize" average gain obtained from the reference signal associated with QCL type D*

Optional configuration of QCL-type D for BM CSI-RS

Proposal 10:

- *Clarify the meaning of "when applicable "for QCL-type D wrt to optional and mandatory configuration in FR2 for different types of RS*
    - *For beam management CSI-RS, QCL-Type D configuration is optional in FR2*
    - *For other CSI-RS, QCL-Type D configuration is mandatory in FR2*

Ericsson (R1-1809198)

Observation 1 ***A QCL-TypeD link is missing between TRS and CSI-RS (CSI)***

Proposal 4: **The following QCL signalling is supported: QCL-TypeA + QCL-TypeD for TRS → CSI-RS (CSI)**

>>> Text Proposal for 38.214 Section 5.1.5 >>>

For a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without the higher layer parameter *repetition*, the UE shall expect that a *TCI-State* indicates one of the following quasi co-location type(s):

- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with the same CSI-RS resource, or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with an SS/PBCH block , or
- 'QCL-TypeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'QCL-TypeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or

- 'QCL-TypeB' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* when 'QCL-TypeD' is not applicable.

>>> End Text Proposal >>>

Qualcomm (R1-1809424)

6.1 QCL relation chain rule

Proposal 15: If the QCL-type D of a first signal is changed and the first signal serves as QCL-type D source of a second signal, the QCL-type D of the second signal should also be changed accordingly.

6.2 TCI configurations for CSI-RS for CSI

Proposal 16: Update previous agreement on QCL relations for CSI-RS for CSI as follows:

If a CSI-RS resource is in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without *repetition*, the UE should only expect the following three possible configurations of the higher layer parameter *TCI-State*:

Valid TCI state Configuration	**DL RS 1**	***qcl-Type1***	**DL RS 2 (if configured)**	***qcl-Type2* (if configured)**
1**	TRS	QCL-TypeA	SS/PBCH Block	QCL-TypeD
2**	TRS	QCL-TypeA	CSI-RS (BM)	QCL-TypeD
3**	TRS	QCL-TypeA	TRS	QCL-TypeD
4*	TRS	QCL-TypeB		

* If QCL type-D is not applicable

** If QCL type-D is applicable, DL RS2 and QCL type-2 shall be configured for the UE

6.3 TCI configurations for DM-RS of PDCCH

Furthermore, we note that there is an unusual asymmetry for the DMRS of PDCCH and PDSCH, in the following configuration. Based on current agreement, configuration 3 is only supported effectively for FR1, while in FR2 (when QCL Type D is applicable), PDCCH cannot be configured with this QCL configuration, which also makes it useless for PDSCH since in the typical scenario these two RS will be configured with the same source.

Agreement

Note: For all the tables below, if a row has the same RS type, same RS ID should be assumed.

…

For the DM-RS of PDCCH, the UE should only expect the following three configurations of the higher layer parameter *TCI-State* while the fourth configuration is valid as default, before TRS is configured:

Valid TCI state Configuration	**DL RS 1**	***qcl-Type1***	**DL RS 2 (if configured)**	***qcl-Type2* (if configured)**
1	TRS	QCL-TypeA	TRS	QCL-TypeD
2	TRS	QCL-TypeA	CSI-RS (BM)	QCL-TypeD
3**	CSI-RS (CSI)	QCL-TypeA		
4*	SS/PBCH Block*	QCL-TypeA	SS/PBCH Block*	QCL-TypeD

* Before TRS configured. Note: this is not a TCI state, rather a valid QCL assumption
**Note: Only when QCL type-D is not applicable

For the DM-RS of PDSCH, the UE should only expect the three following configurations of the higher layer parameter *TCI-State* while the fourth is valid by default, before TRS is configured:

Valid TCI state Configuration	**DL RS 1**	***qcl-Type1***	**DL RS 2 (if configured)**	***qcl-Type2* (if configured)**
1	TRS	QCL-TypeA	TRS	QCL-TypeD

2	TRS	QCL-TypeA	CSI-RS (BM)	QCL-TypeD
3**	CSI-RS (CSI)	QCL-TypeA	CSI-RS (CSI)	QCL-TypeD
4*	SS/PBCH Block*	QCL-TypeA	SS/PBCH Block*	QCL-TypeD

* Before TRS configured. Note: this is not a TCI state, rather a valid QCL assumption
** Note: QCL parameters may not be derived directly from CSI-RS (CSI)

Proposal 17: Update previous agreement on QCL relations for DMRS of PDCCH as follows:

For the DM-RS of PDCCH, the UE should only expect the following three configurations of the higher layer parameter *TCI-State* while the fourth configuration is valid as default, before TRS is configured:

Valid TCI state Configuration	**DL RS 1**	***qcl-Type1***	**DL RS 2 (if configured)**	***qcl-Type2* (if configured)**
1	TRS	QCL-TypeA	TRS	QCL-TypeD
2	TRS	QCL-TypeA	CSI-RS (BM)	QCL-TypeD
3**	CSI-RS (CSI)	QCL-TypeA	CSI-RS (CSI)	QCL-TypeD
4*	SS/PBCH Block*	QCL-TypeA	SS/PBCH Block*	QCL-TypeD

* Before TRS configured. Note: this is not a TCI state, rather a valid QCL assumption
~~**Note: Only when QCL-type-D is not applicable~~