**3GPP TSG-RAN WG1 Meeting #114 *R1-230xxxx***

**Toulouse, France, August 21 – 25, 2023**

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| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
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|  | **38.214** | **CR** | **-** | **Rev** | **-** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of specification support for network energy saving | | | | | | |
|  |  | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | |
| ***Source to TSG:*** |  | | | | | | |
|  |  | | | | | | |
| ***Work item code:*** | Netw\_Energy\_NR | | |  | ***Date:*** | | 2023-09-08 |
|  |  | |  | |  | |  |
| ***Category:*** | **B** |  | | | ***Release:*** | | Rel-18 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
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| ***Reason for change:*** | | Introduction of specification support for Network energy saving. | | | | | |
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| ***Summary of change:*** | | Introduction of specification support for Network energy saving. | | | | | |
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| ***Consequences if not approved:*** | Specification does not support network energy saving. | | | |
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| ***Clauses affected:*** | 5.1.6.1, 5.2.1, 5.2.1.1, 5.2.1.4.1, 5.2.1.4.2, 5.2.1.5.1, 5.2.1.5.2, 5.2.1.6, 5.2.2.3.1, 5.2.2.5, 5.2.3, 5.2.4, 6.2.1 | | | |
|  |  | | | |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  | Other core specifications | ... |
| ***affected:*** |  | **X** | Test specifications | ... |
| ***(show related CRs)*** |  | **X** | O&M Specifications | ... |
|  |  | | | |
| ***Other comments:*** |  | | | |
|  |  | | | |
| ***This CR's revision history:*** |  | | | |

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5.1.6 UE procedure for receiving reference signals

5.1.6.1 CSI-RS reception procedure

The CSI-RS defined in Clause 7.4.1.5 of [4, TS 38.211], may be used for time/frequency tracking, CSI computation, L1-RSRP computation, L1-SINR computation, mobility, and tracking during fast SCell activation.

For a CSI-RS resource associated with a *NZP-CSI-RS-ResourceSet* with the higher layer parameter *repetition* set to 'on', the UE shall not expect to be configured with CSI-RS over the symbols during which the UE is also configured to monitor the CORESET, while for other *NZP-CSI-RS-ResourceSet* configurations, if the UE is configured with a CSI-RS resource and a search space set associated with a CORESET in the same OFDM symbol(s), the UE may assume that the CSI-RS and a PDCCH DM-RS transmitted in all the search space sets associated with CORESET are quasi co-located with 'typeD', if 'typeD' is applicable. If the CORESET is activated with two TCI states, UE may assume that the first TCI state of the CORESET as the default QCL assumption for the CSI-RS. This also applies to the case when CSI-RS and the CORESET are in different intra-band component carriers, if 'typeD' is applicable. Furthermore, the UE shall not expect to be configured with the CSI-RS in PRBs that overlap those of the CORESET in the OFDM symbols occupied by the search space set(s).

The UE is not expected to receive CSI-RS and *SIB1* message in the overlapping PRBs in the OFDM symbols where *SIB1* is transmitted.

If the UE is configured with DRX,

- if the UE is configured to monitor DCI format 2\_6 and configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP' and 'ssb-Index-RSRP' when *drx-onDurationTimer* in *DRX-Config* is not started, the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;

- if the UE is configured to monitor DCI format 2\_6 and configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to cri-RSRP when *drx-onDurationTimer* in *DRX-Config* is not started, the most recent CSI measurement occasion occurs in DRX active time or during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside DRX active time for CSI to be reported;

- otherwise, the most recent CSI measurement occasion occurs in DRX active time for CSI to be reported.

During non-active periods of cell DTX, the UE configured with cell DTX is not expected to receive the periodic CSI-RS and semi-persistent CSI-RS configured in CSI report configuration in CSI-*ReportConfig* ~~for CSI reporting~~ associated with the higher layer parameter *reportQuantity* comprising at least ‘RI’.

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5.2 UE procedure for reporting channel state information (CSI)

5.2.1 Channel state information framework

The procedures on aperiodic CSI reporting described in this clause assume that the CSI reporting is triggered by DCI format 0\_1, but they equally apply to CSI reporting triggered by DCI format 0\_2, by applying the higher layer parameter *reportTriggerSizeDCI-0-2* instead of *reportTriggerSize*.

The time and frequency resources that can be used by the UE to report CSI are controlled by the gNB. CSI may consist of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), CSI-RS resource indicator (CRI), SS/PBCH Block Resource indicator (SSBRI), layer indicator (LI), rank indicator (RI), L1-RSRP, L1-SINR or CapabilityIndex.

For CQI, PMI, CRI, SSBRI, LI, RI, L1-RSRP, L1-SINR, CapabilityIndex a UE is configured by higher layers with N≥1 *CSI-ReportConfig* Reporting Settings, M≥1 *CSI-ResourceConfig* Resource Settings, and one or two list(s) of trigger states (given by the higher layer parameters *CSI-AperiodicTriggerStateList* and *CSI-SemiPersistentOnPUSCH-TriggerStateList*). Each trigger state in *CSI-AperiodicTriggerStateList* contains a list of associated *CSI-ReportConfigs* indicating the Resource Set IDs for channel and optionally for interference and a trigger state additionally contains one or more [*csi-ReportSubConfigID*] if the associated *CSI-ReportConfig* configured with a list of sub-configurations, as described in Clause 5.2.1.1. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig*, and a trigger state additionally contain one or more [csi-ReportSubConfigID] if the associated CSI-ReportConfig is configured with a list of sub-configurations, as described in Clause 5.2.1.1.

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#### 5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *BWP-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band: codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, L1-SINR, CRI, and SSBRI (SSB Resource Indicator) and CapabilityIndex.

The time domain behavior of the *CSI-ReportConfig* is indicated by the higher layer parameter *reportConfigType* and can be set to 'aperiodic', 'semiPersistentOnPUCCH', 'semiPersistentOnPUSCH', or 'periodic'. For 'periodic' and 'semiPersistentOnPUCCH'/'semiPersistentOnPUSCH' CSI reporting, the configured periodicity and slot offset applies in the numerology of the UL BWP in which the CSI report is configured to be transmitted on. The higher layer parameter *reportQuantity* indicates the CSI-related, L1-RSRP-related, L1-SINR-related or CapabilityIndex-related quantities to report. The *reportFreqConfiguration* indicates the reporting granularity in the frequency domain, including the CSI reporting band and if PMI/CQI reporting is wideband or sub-band. The *timeRestrictionForChannelMeasurements* parameter in *CSI-ReportConfig* can be configured to enable time domain restriction for channel measurements and *timeRestrictionForInterferenceMeasurements* can be configured to enable time domain restriction for interference measurements. The *CSI-ReportConfig* can also contain *CodebookConfig*, which contains configuration parameters for Type-I, Type II, Enhanced Type II CSI, or Further Enhanced Type II Port Selection including codebook subset restriction when applicable, and configurations of group-based reporting. A UE is not expected to be configured with a CSI report setting associated with a dormant DL BWP if the *reportConfigType* is set to ‘aperiodic’. A *CSI-ReportConfig* can contain a list of sub-configurations, provided by the higher layer parameter [*csi-ReportSubConfigList],* where each sub-configuration is identified by [*csi-ReportSubConfigID*] and corresponds to a list of one or more CSI-RS resources or corresponds to a CSI-RS antenna port subset, and/or corresponds to a power offset for PDSCH relative to CSI-RS. A UE is not expected to be configured with a *CSI-ReportConfig* that contains a mix of sub-configuration(s) each corresponding to a list of one or more CSI-RS resources and some other sub-configuration(s) each corresponding to CSI-RS antenna port subset.

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##### 5.2.1.4.1 Resource Setting configuration

For aperiodic CSI, each trigger state configured using the higher layer parameter *CSI-AperiodicTriggerState* is associated with one or multiple *CSI-ReportConfig* where the *CSI-ReportConfig* not configured with *groupBasedBeamReporting-r17* is linked to periodic, or semi-persistent, or aperiodic resource setting(s):

- When one Resource Setting is configured, the Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement for L1-RSRP or for channel and interference measurement for L1-SINR computation.

- When two Resource Settings are configured, the first one Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement and the second one (given by either higher layer parameter *csi-IM-ResourcesForInterference* or higher layer parameter *nzp-CSI-RS-ResourcesForInterference*) is for interference measurement performed on CSI-IM or on NZP CSI-RS.

- When three Resource Settings are configured, the first Resource Setting (higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement, the second one (given by higher layer parameter *csi-IM-ResourcesForInterference*) is for CSI-IM based interference measurement and the third one (given by higher layer parameter *nzp-CSI-RS-ResourcesForInterference*) is for NZP CSI-RS based interference measurement.

For aperiodic CSI, and for periodic and semi-persistent CSI resource settings, each trigger state configured using the higher layer parameter *CSI-AperiodicTriggerState* is associated with one or multiple *CSI-ReportConfig* where the *CSI-ReportConfig* configured with *groupBasedBeamReporting-r17* is linked to periodic or semi-persistent, setting(s):

- When one Resource Setting is configured, the Resource setting is given by *resourcesForChannelMeasurement* for L1-RSRP measurement. In such a case, the number of configured CSI Resource Sets in the Resource Setting is S=2

For aperiodic CSI, and for aperiodic CSI resource settings, each trigger state configured using the higher layer parameter *CSI-AperiodicTriggerState* is associated with one or multiple *CSI-ReportConfig* where the *CSI-ReportConfig* configured with *groupBasedBeamReporting-r17* is associated with *resourcesForChannel* and *resourcesForChannel2*, which correspond to first and second resource sets, respectively, for L1-RSRP measurement.

For semi-persistent or periodic CSI, each *CSI-ReportConfig* is linked to periodic or semi-persistent Resource Setting(s):

- When one Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is configured, the Resource Setting is for channel measurement for L1-RSRP or for channel and interference measurement for L1-SINR computation.

- When two Resource Settings are configured, the first Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement and the second Resource Setting (given by higher layer parameter *csi-IM-ResourcesForInterference*) is used for interference measurement performed on CSI-IM. For L1-SINR computation, the second Resource Setting (given by higher layer parameter *csi-IM-ResourcesForInterference* or higher layer parameter *nzp-CSI-RS-ResourceForInterference*) is used for interference measurement performed on CSI-IM or on NZP CSI-RS.

A UE is not expected to be configured with more than one CSI-RS resource in resource set for channel measurement for a *CSI-ReportConfig* with the higher layer parameter *codebookType* set to 'typeII', 'typeII-PortSelection', 'typeII-r16', 'typeII-PortSelection-r16', or 'typeII-PortSelection-r17'. A UE is not expected to be configured with more than 64 NZP CSI-RS resources and/or SS/PBCH block resources in resource setting for channel measurement for a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'none', 'cri-RI-CQI', 'cri-RSRP', 'ssb-Index-RSRP', 'cri-SINR' or 'ssb-Index-SINR', 'cri-RSRP- Index', 'ssb-Index-RSRP- Index', 'cri-SINR- Index' or 'ssb-Index-SINR- Index'. If interference measurement is performed on CSI-IM, each CSI-RS resource for channel measurement is resource-wise associated with a CSI-IM resource by the ordering of the CSI-RS resource and CSI-IM resource in the corresponding resource sets. The number of CSI-RS resources for channel measurement equals to the number of CSI-IM resources.

An NZP CSI-RS Resource Set for channel measurement with resources can be configured with two Resource Groups, with resources in Group 1 and resources in Group 2, such that , and with Resource Pairs. Each Resource Pair consists of one resource from Group 1 and one resource from Group 2. The same resource can be associated with two Resource Pairs in frequency range 1 but not in frequency range 2.

A subset of resources, where a subset contains one or more resources, of a NZP CSI-RS Resource Set for channel measurement corresponds to a sub-configuration contained in a *CSI-ReportConfig* if each of the sub-configuration(s) contains a list of one or more NZP CSI-RS resources*,* or all the resources of a NZP CSI-RS Resource Set for channel measurement correspond to each of the sub-configuration(s) contained in a *CSI-ReportConfig* if each of the sub-configurations does not contain a list of NZP CSI-RS resources, as described in Clause 5.2.1.4.2.

Except for L1-SINR, if interference measurement is performed on NZP CSI-RS, a UE does not expect to be configured with more than one NZP CSI-RS resource in the associated resource set within the resource setting for channel measurement. Except for L1-SINR, the UE configured with the higher layer parameter *nzp-CSI-RS-ResourcesForInterference* may expect no more than 18 NZP CSI-RS ports configured in a NZP CSI-RS resource set.

For CSI measurement(s) other than L1-SINR, a UE assumes:

- each NZP CSI-RS port configured for interference measurement corresponds to an interference transmission layer.

- all interference transmission layers on NZP CSI-RS ports for interference measurement take into account the associated EPRE ratios configured in 5.2.2.3.1;

- other interference signal on REs of NZP CSI-RS resource for channel measurement, NZP CSI-RS resource for interference measurement, or CSI-IM resource for interference measurement.

For L1-SINR measurement with dedicated interference measurement resources, a UE assumes:

- the total received power on dedicated NZP CSI-RS resource for interference measurement or dedicated CSI-IM resource for interference measurement corresponds to interference and noise.

##### 5.2.1.4.2 Report Quantity Configurations

A UE may be configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to either 'none', 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI', 'cri-RSRP', 'cri-SINR', 'ssb-Index-RSRP', 'ssb-Index-SINR', 'cri-RI-LI-PMI-CQI', 'cri-RSRP- Index', 'ssb-Index-RSRP- Index', 'cri-SINR- Index' or 'ssb-Index-SINR- Index'.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'none', then the UE shall not report any quantity for the *CSI-ReportConfig*.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI', the UE shall report a preferred precoder matrix for the entire reporting band, or a preferred precoder matrix per subband, according to Clause 5.2.2.2.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-i1',

- the UE expects, for that *CSI-ReportConfig,* to be configured with higher layer parameter *codebookType* set to 'typeI-SinglePanel' and *pmi-FormatIndicator* set to 'widebandPMI'and,

- the UE shall report a PMI consisting of a single wideband indication ( in Clause 5.2.2.2.1) for the entire CSI reporting band.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-i1-CQI',

- the UE expects, for that *CSI-ReportConfig,* to be configured with higher layer parameter *codebookType* set to 'typeI-SinglePanel' and *pmi-FormatIndicator* set to 'widebandPMI'and,

- the UE shall report a PMI consisting of a single wideband indication ( in Clause 5.2.2.2.1) for the entire CSI reporting band. The CQI is calculated conditioned on the reported assuming PDSCH transmission with  precoders (corresponding to the same but different  in Clause 5.2.2.2.1), where the UE assumes that one precoder is randomly selected from the set of  precoders for each PRG on PDSCH, where the PRG size for CQI calculation is configured by the higher layer parameter *pdsch-BundleSizeForCSI*.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-CQI',

- if the UE is configured with higher layer parameter *non-PMI-PortIndication* contained in a *CSI-ReportConfig,* *r* ports are indicated in the order of layer ordering for rank *r* and each CSI-RS resource in the CSI resource setting is linked to the *CSI-ReportConfig* based on the order of the associated *NZP-CSI-RS-ResourceId* in the linked CSI resource setting for channel measurement given by higher layer parameter *resourcesForChannelMeasurement*. The configured higher layer parameter *non-PMI-PortIndication* contains a sequence  of port indices, where  are the CSI-RS port indices associated with rank ν and  where is the number of ports in the CSI-RS resource. The UE shall only report RI corresponding to the configured fields of *PortIndexFor8Ranks*.

- if the UE is not configured with higher layer parameter *non-PMI-PortIndication,* the UE assumes, for each CSI-RS resource in the CSI resource setting linked to the *CSI-ReportConfig*, that the CSI-RS port indices  are associated with ranks  where  is the number of ports in the CSI-RS resource.

- When calculating the CQI for a rank, the UE shall use the ports indicated for that rank for the selected CSI-RS resource. The precoder for the indicated ports shall be assumed to be the identity matrix scaled by .

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index' or 'ssb-Index-RSRP- Index',

- if the UE is configured with the higher layer parameter *groupBasedBeamReporting* set to 'disabled', the UE is not required to update measurements for more than 64 CSI-RS and/or SSB resources, and the UE shall report in a single report *nrofReportedRS* (higher layer configured) different CRI or SSBRI for each report setting.

- if the UE is configured with the higher layer parameter *groupBasedBeamReporting* set to 'enabled', the UE is not required to update measurements for more than 64 CSI-RS and/or SSB resources, and the UE shall report in a single reporting instance two different CRI or SSBRI for each report setting, where CSI-RS and/or SSB resources can be received simultaneously by the UE either with a single spatial domain receive filter, or with multiple simultaneous spatial domain receive filters.

- if the UE is configured with the higher layer parameter *groupBasedBeamReporting-r17*, the UE is not required to update measurements for more than 64 CSI-RS and/or SSB resources, and the UE shall report in a single reporting instance *nrofReportedGroups,* if configured, group(s) of two CRIs or SSBRIs selecting one CSI-RS or SSB from each of the two CSI Resource Sets for the report setting, where CSI-RS and/or SSB resources of each group can be received simultaneously by the UE.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-SINR', 'ssb-Index-SINR', 'cri-SINR- Index' or 'ssb-Index-SINR- Index',

- if the UE is configured with the higher layer parameter *groupBasedBeamReporting* set to 'disabled', the UE shall report in a single report *nrofReportedRS* (higher layer configured) different CRI or SSBRI for each report setting.

- if the UE is configured with the higher layer parameter *groupBasedBeamReporting* set to 'enabled', the UE shall report in a single reporting instance two different CRI or SSBRI for each report setting, where CSI-RS and/or SSB resources can be received simultaneously by the UE.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RSRP', 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI', 'cri-RI-LI-PMI-CQI', 'cri-SINR', or 'cri-SINR- Index ', and resources are configured in the corresponding resource set for channel measurement, then the UE shall derive the CSI parameters other than CRI conditioned on the reported CRI, where CRI *k* (*k* ≥ 0) corresponds to the configured (*k*+1)-th entry of associated *nzp-CSI-RS-Resources* in the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement, and (*k*+1)-th entry of associated *csi-IM-Resource* in the corresponding *csi-IM-ResourceSet* (if configured) or (*k*+1)-th entry of associated *nzp-CSI-RS-Resources* in the corresponding *NZP-CSI-RS-ResourceSet* (if configured for *CSI-ReportConfig* with *reportQuantity* set to 'cri-SINR' or 'cri-SINR- Index ') for interference measurement. If CSI-RS resources are configured, each resource shall contain at most 16 CSI-RS ports. If CSI-RS resources are configured, each resource shall contain at most 8 CSI-RS ports.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI' and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is configured with resources, two Resource Groups with resources in Group 1, resources in Group 2, , and Resource Pairs:

- each resource can contain, subject to UE capability, at most 32 CSI-RS ports. For two Resource Groups with resources (i=1,2), if , the resource in NZP-CSI-RS-ResourceSet shall contain at most 32 CSI-RS ports; if , each resource in NZP-CSI-RS-ResourceSet shall contain at most 16 CSI-RS ports; if , each resource in NZP-CSI-RS-ResourceSet shall contain at most 8 CSI-RS ports.

- each of the Resource Pairs is associated to a CRI value.

- The *CSI-ReportConfig* may be configured with higher layer parameter *sharedCMR*. and are the numbers of resources associated to a CRI value, other than the *N* CRIs defined above, in Group 1 and Group 2, respectively, with , such that the total number of CRI values configured for the *CSI-ReportConfig* is .

- If the higher layer parameter *csi-ReportMode* is set to 'Mode1' and the higher layer parameter *numberOfSingleTRP-CSI-Mode1* is set to , ; otherwise,

- if the higher layer parameter *csi-ReportMode* is set to 'Mode1' and the higher layer parameter *numberOfSingleTRP-CSI-Mode1* is set to , or if *csi-ReportMode* is set to 'Mode2',

- if *sharedCMR* is configured: and ; otherwise

- if *sharedCMR* is not configured, only the resources in Group 1 and Group 2 that are not referred to in any Resource Pair are associated to *M* CRI values other than the *N* CRIs defined above.

- If interference measurement is performed on CSI-IM, resources are configured in the corresponding *csi-IM-ResourceSet*. The resources for channel measurement defined above are resource-wise associated with the first CSI-IM resources by the ordering of the CSI-RS resources and CSI-IM resources in the corresponding Resource Set. The Resource Pairs for channel measurement are associated to the last CSI-IM resources by the ordering of the CSI-RS Resource Pairs and CSI-IM resources in the CSI-IM Resource Set. The UE may assume that the two CSI-RS resources for channel measurement in a Resource Pair and the associated CSI-IM resource for interference measurement are resource-wise QCLed with respect to 'typeD'.

- The UE is not expected to be configured with NZP CSI-RS for interference measurement other than the NZP CSI-RS resources for channel measurement configured in the Resource Pairs.

- The UE expects, for that *CSI-ReportConfig,* to be configured with higher layer parameter *codebookType* set to 'typeI-SinglePanel', and

- The UE shall derive the CSI parameters other than CRI(s) conditioned on the reported CRI(s), as follows:

- If the higher layer parameter *csi-ReportMode* is set to 'Mode1' and the higher layer parameter *numberOfSingleTRP-CSI-Mode1* is set to , CRI(s) are reported:

- one CRI corresponds to the configured -th entry of the associated Resource Pairs in the corresponding CSI-RS Resource Set for channel measurement, and -th entry of the corresponding CSI-IM Resource Set, if configured. The UE shall report two RIs, two PMIs, two LIs (if configured), associated to the resource in Group 1 and the resource in Group 2, respectively, of the -th Resource Pair, and one CQI; and

- if , one CRI () corresponds to the configured -th entry of the associated resources in the corresponding CSI-RS Resource Set for channel measurement, and -th entry of the corresponding CSI-IM Resource Set, if configured. The UE shall report one RI, one PMI, one LI (if configured) and one or two CQIs conditioned on CRI ; or

- if , one CRI corresponds to the configured -th entry of the associated resources in Group 1 of the corresponding CSI-RS Resource Set for channel measurement, and -th entry of the associated resources in the corresponding CSI-IM Resource Set, if configured, and one CRI corresponds to the configured -th entry of the associated resources in Group 2 of the corresponding CSI-RS Resource Set for channel measurement, and -th entry of the corresponding CSI-IM Resource Set, if configured. The UE shall report one RI, one PMI, one LI (if configured) and one or two CQIs conditioned on CRI and one RI, one PMI, one LI (if configured) and one or two CQIs conditioned on CRI .

- If the higher layer parameter *csi-ReportMode* is set to 'Mode2', one CRI is reported, which corresponds to the -th entry of the resources or Resource Pairs in the corresponding CSI-RS Resource Set for channel measurement, and -th entry of the associated resources in the corresponding CSI-IM Resource Set, if configured. The first codepoints of the CRI correspond to resources associated to Group 1 and Group 2. The last codepoints of the CRI correspond to the configured Resource Pairs. The UE shall report one RI, one PMI, one LI, if configured, and one or two CQIs conditioned on CRI if ; or two RIs, two PMIs, two LIs, if configured, associated to the resource in Group 1 and the resource in Group 2, respectively, of the -th Resource Pair, and one CQI, otherwise.

- For a reported CRI corresponding to an entry of the Resource Pairs configured in the corresponding CSI-RS Resource Set for channel measurement:

- the UE shall not report a total number of layers larger than four.

- the two RIs are reported with a joint RI index corresponding to one of the four rank combinations: .

- The *CodebookConfig* in *CSI-ReportConfig* can be configured with two RI restriction parameters. One parameter applies to a reported RI when conditioned on a CRI corresponding to an entry of the CSI-RS resources defined above. Another parameter applies to a reported joint RI index when conditioned on a CRI corresponding to an entry of the Resource Pairs and indicates one or more of the four rank combinations that are allowed to correspond to the reported PMIs and RIs.

- The *CodebookConfig* in *CSI-ReportConfig* can be configured with two Codebook Subset Restrictions. The first restriction applies to a reported PMI associated to a CSI-RS resource in Group 1. The second restriction applies to a reported PMI associated to a CSI-RS resource in Group 2.

If the UE is configured with a *CSI-ReportConfig* that contains a list of sub-configurations, provided by the higher layer parameter [*csi-ReportSubConfigList]*:

- the UE expects to be configured with the higher layer parameter *codebookType* set to 'typeI-SinglePanel' or 'typeI-MultiPanel'. If the UE indicates a capability for supporting mixed codebook combination in a slot with [ABC], each sub-configuration can be configured with the higher layer parameter *codebookType* set to 'typeI-SinglePanel' or 'typeI-MultiPanel'. - Each sub-configuration can be configured with an antenna port subset using the higher layer bitmap parameter [*port-subsetIndicator*] which contains the bit sequence , where is the MSB and is the LSB, bit corresponds to antenna port , and is the number of ports *nrofPorts* configured for the CSI-RS resources(s) within the *NZP-CSI-RS-ResourceSet* contained in the *CSI-ResourceConfig* for channel measurement that corresponds to the *CSI-ReportConfig*. A bit value 0 in [*port-subsetIndicator*] indicates that the corresponding antenna port is disabled for the sub-configuration, whereas bit value 1 indicates that the antenna port is enabled and belongs to the antenna port subset for the sub-configuration.

- If a sub-configuration is configured with an antenna port subset, then the sub-configuration can be configured with a [RI restriction parameter] and, if the number of antenna ports of the subset greater than 2, with [*n1-n2* parameter] if the higher layer parameter *codebookType* is set to 'typeI-SinglePanel' or with [*ng*-*n1-n2* parameter] if the higher layer parameter *codebookType* is set to 'typeI-MultiPanel', and, if the corresponding number of antenna ports of the subset is 2, with *twoTX-CodebookSubsetRestriction*, where the parameters [RI restriction], [*n1-n2],* [*ng*-*n1-n2],* *twoTX-CodebookSubsetRestriction* are as described in Clauses 5.2.2.2.1 and 5.2.2.2.2.

- A sub-configuration can be configured with a list of NZP CSI-RS resources, provided by [*nzp-CSI-RS-resourceList*], which indicates one or more NZP CSI-RS resources, within the *NZP-CSI-RS-ResourceSet* contained in the *CSI-ResourceConfig* for channel measurement which corresponds to the *CSI-ReportConfig.*

[The list of NZP CSI-RS resources is identical to or has no intersection with a list of NZP CSI-RS resources configured for any other sub-configuration(s) within the *CSI-ReportConfig*.]

- A sub-configuration can be configured with a power offset provided by [*powerOffse*t].

- If a sub-configurations is not configured with [*nzp-CSI-RS-resourceList*] then the sub-configuration shall be associated with all the NZP CSI-RS resources within the *NZP-CSI-RS-ResourceSet* contained in the *CSI-ResourceConfig* for channel measurement which corresponds to the *CSI-ReportConfig.*

- the UE reports CSI(s) for one or more sub-configurations according to Clauses 5.2.1.5.1, 5.2.1.5.2, 5.2.3 and 5.2.4, and according to the higher layer parameter *reportQuantity* configured for that *CSI-ReportConfig*.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'ssb-Index-RSRP' or 'ssb-Index-RSRP- Index', the UE shall report SSBRI, where SSBRI *k* (*k* ≥ 0) corresponds to the configured (*k*+1)-th entry of the associated *csi-SSB-ResourceList* in the corresponding *CSI-SSB-ResourceSet.*

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'ssb-Index-SINR' or 'ssb-Index-SINR- Index', the UE shall derive L1-SINR conditioned on the reported SSBRI, where SSBRI *k* (*k* ≥ 0) corresponds to the configured (*k*+1)-th entry of the associated *csi-SSB-ResourceList* in the corresponding *CSI-SSB-ResourceSet* for channel measurement, and (*k*+1)-th entry of associated *csi-IM-Resource* in the corresponding *csi-IM-ResourceSet* (if configured) or (*k*+1)-th entry of associated *nzp-CSI-RS-Resources* in the corresponding *NZP-CSI-RS-ResourceSet* (if configured) for interference measurement.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', ' cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', then the UE is not expected to be configured with more than 8 CSI-RS resources in a CSI-RS resource set contained within a resource setting that is linked to the *CSI-ReportConfig*.

If the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to 'cri-RI-LI-PMI-CQI', UE does not expect the *CSI-ReportConfig* to be configured with higher layer parameter *codebookType* set to '*typeII-r16*' or '*typeII-PortSelection-r16*' or '*typeII-PortSelection-r17'*.

If the UE is configured with a *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RSRP', 'cri-SINR', 'none', 'cri-RSRP- Index' or 'cri-SINR- Index and the *CSI-ReportConfig* is linked to a resource setting configured with the higher layer parameter *resourceType* set to 'aperiodic', then the UE is not expected to be configured with more than 16 CSI-RS resources in a CSI-RS resource set contained within the resource setting.

The LI indicates which column of the precoder matrix of the reported PMI corresponds to the strongest layer of the codeword corresponding to the largest reported wideband CQI. If two wideband CQIs are reported and have equal value, the LI corresponds to strongest layer of the first codeword. If the UE is configured with a *CSI-ReportConfig* with *reportQuantity* set to 'cri-RI-LI-PMI-CQI' and the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement is configured with two Resource Groups and Resource Pairs, and the UE reports a CRI associated to a Resource Pair, and a rank combination , the first LI indicates which column of the precoder matrix of the first reported PMI corresponds to the strongest of the first layers of the codeword and the second LI indicates which column of the precoder matrix of the second reported PMI corresponds to the strongest of the last layers of the codeword.

For operation with shared spectrum channel access in FR1, or in FR2-2 when the UE is provided *ChannelAccessMode2-r17* = '*enabled*', if the UE is configured with a *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI ', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI' or 'cri-RI-LI-PMI-CQI', the UE shall derive:

- the CSI parameters without averaging two or more instances of any periodic or semi-persistent *nzp-CSI-RS-Resources* in the corresponding *NZP-CSI-RS-ResourceSet* for channel measurement or for interference measurement located in different DL transmissions,

- the instances of the *nzp-CSI-RS-Resources* are not in the same channel occupancy duration indicated by DCI format 2\_0, if the UE is provided at least one of *SlotFormatIndicator* or co*-DurationList*; or

- the instances of the *nzp-CSI-RS-Resources* occur within a set of consecutive symbols which are not all occupied by PDSCH(s) and/or aperiodic CSI-RS(s) indicated by DCI formats, if any, and the corresponding PDCCH(s), if the UE is neither provided with *CO-DurationsPerCell* nor *SlotFormatIndicator*, but is provided with *csi-RS-ValidationWithDCI*

- the interference measurements for computing CSI value based on periodic/semi-persistent CSI-IM measured only in OFDM symbol(s) that fulfill the same conditions under which the UE is expected to receive periodic/semi-persistent CSI-RS as described in Clause 11.1 and Clause 11.1.1 of [6, TS 38.213].

If the UE is configured with the higher layer parameter *SSB-MTC-AdditionalPCI*, the UE is allowed to report in a single reporting instance up to four SSBRIs for each report setting, where SSB resources are associated with PCI indices referring to the PCI of the serving cell and PCI(s) different from the PCI of the serving cell within the set of PCIs configured.

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#### 5.2.1.5 Triggering/activation of CSI Reports and CSI-RS

##### 5.2.1.5.1 Aperiodic CSI Reporting/Aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology

For CSI-RS resource sets associated with Resource Settings configured with the higher layer parameter *resourceType* set to 'aperiodic', 'periodic', or 'semi-persistent', trigger states for Reporting Setting(s) (configured with the higher layer parameter *reportConfigType* set to 'aperiodic') and/or Resource Setting for channel and/or interference measurement on one or more component carriers are configured using the higher layer parameter *CSI-AperiodicTriggerStateList*. For a reporting setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], one or more trigger states can be configured with each indicating one or more of the sub-configurations. For aperiodic CSI report triggering, a single set of CSI triggering states are higher layer configured, wherein the CSI triggering states can be associated with any candidate DL BWP. A UE is not expected to receive more than one DCI with non-zero *CSI request* field per slot per cell. A UE is not expected to receive DCI with non-zero *CSI request* field within a cell group in a slot overlapping with any slot receiving DCI with non-zero *CSI request* field in the same cell group. A UE is not expected to be configured with different *TCI-StateId*'s for the same aperiodic CSI-RS resource ID configured in multiple aperiodic CSI-RS resource sets with the same triggering offset in the same aperiodic trigger state. A UE is not expected to receive more than one aperiodic CSI report request for transmission in a given slot per cell. A UE is not expected to receive an aperiodic CSI report request for transmission in a slot overlapping with any slot having an aperiodic CSI report transmission in the same cell group. If a UE does not indicate its capability of *CSItriggerStateContainingNonactiveBWP* the UE is not expected to be triggered with a CSI report for a non-active DL BWP. Otherwise, when a UE is triggered with a CSI report for a DL BWP that is non-active when expecting to receive the most recent occasion, no later than the CSI reference resource, of the associated NZP CSI-RS, the UE is not expected to report the CSI for the non-active DL BWP and the CSI report associated with that BWP is omitted. When a UE is triggered with aperiodic NZP CSI-RS in a DL BWP that is non-active when expecting to receive the NZP CSI-RS, the UE is not expected to measure the aperiodic CSI-RS. In the carrier of the serving cell expecting to receive that associated NZP CSI-RS, if the active DL BWP when receiving the NZP CSI-RS is different from the active DL BWP when receiving the triggering DCI,

- the last symbol of the PDCCH span of the DCI carrying the BWP switching shall be no later than the last symbol of the PDCCH span of the DCI carrying the CSI trigger, irrespective of whether they are in the same carrier of a serving cell or not and irrespective of whether they are in the same SCS or not;

- the UE is not expected to have any other BWP switching in that carrier after the last symbol of the PDCCH span covering the DCI carrying the CSI trigger and before the first symbol of the triggered NZP CSI-RS or CSI-IM.

- when the PDCCH reception includes two PDCCH candidates from two respective search space sets, as described in clause 10.1 of [6, TS 38.213], the span that involves the PDCCH candidate that ends later in time is used.

A trigger state is initiated using the *CSI request* field in DCI.

- When all the bits of *CSI request* field in DCI are set to zero, no CSI is requested.

- When the number of configured CSI triggering states in *CSI-AperiodicTriggerStateList* is greater than , where  is the number of bits in the DCI *CSI request* field, the UE receives a subselection indication, as described in clause 6.1.3.13 of [10, TS 38.321], used to map up to  trigger states to the codepoints of the *CSI request* field in DCI.  is configured by the higher layer parameter *reportTriggerSize* where . When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the subselection indication, the corresponding action in [10, TS 38.321] and UE assumption on the mapping of the selected CSI trigger state(s) to the codepoint(s) of DCI CSI request field shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided..

- When the number of CSI triggering states in *CSI-AperiodicTriggerStateList* is less than or equal to , the *CSI request* field in DCI directly indicates the triggering state.

- For each aperiodic CSI-RS resource in a CSI-RS resource set associated with each CSI triggering state, the UE is indicated the quasi co-location configuration of quasi co-location RS source(s) and quasi co-location type(s), as described in clause 5.1.5, through higher layer signaling of *qcl-info* which contains a list of references to *TCI-State's* for the aperiodic CSI-RS resources associated with the CSI triggering state. If a *State* referred toin the list is configured with a reference to an RS configured with *qcl-Type* set to 'typeD', 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.

- If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* is smaller than the UE reported threshold *beamSwitchTiming,* as defined in [13, TS 38.306], when the reported value is one of the values of {14, 28, 48} and *enableBeamSwitchTiming* is not provided, or is smaller than 48 when the UE provides *beamSwitchTiming-r16*, *enableBeamSwitchTiming* is provided and the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *repetition* set to 'off' or configured without the higher layer parameter *repetition,* or is smaller than the UE reported threshold *beamSwitchTiming-r16,* when *enableBeamSwitchTiming* is provided and the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *repetition* set to 'on'.

- If a UE is configured with *enableDefaultTCI-StatePerCoresetPoolIndex* and the UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*

- if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled by a PDCCH associated with the same *coresetPoolIndex* as the PDCCH triggering the aperiodic CSI-RS and scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], aperiodic CSI-RS triggered by a PDCCH associated with the same *coresetPoolIndex* as the PDCCH triggering the aperiodic CSI-RS and scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48} and *enableBeamSwitchTiming* is not provided, aperiodic CSI-RS triggered by a PDCCH associated with the same *coresetPoolIndex* as the PDCCH triggering the aperiodic CSI-RS and scheduled with offset larger than or equal to 48 when the reported value of *beamSwitchTiming-r16* is one of the values {224, 336} and *enableBeamSwitchTiming* is provided, periodic CSI-RS, semi-persistent CSI-RS;

- else, the UE applies the QCL parameter(s) of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* among CORESETs, which are configured with the same value of *coresetPoolIndex* as the PDCCH triggering that aperiodic CSI-RS, in the latest slot in which one or more CORESETs are associated with the same value of *coresetPoolIndex* as the PDCCH triggering that aperiodic CSI-RS

- else if a UE is configured with *enableTwoDefaultTCI-States* and at least one TCI codepoint is mapped to two TCI states

- if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], aperiodic CSI-RS scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48} and *enableBeamSwitchTiming* is not provided, aperiodic CSI-RS scheduled with offset larger than or equal to 48 when the reported value of *beamSwitchTiming-r16* is one of the values {224, 336} and *enableBeamSwitchTiming* is provided, periodic CSI-RS, semi-persistent CSI-RS. If there is a PDSCH indicated with two TCI states in the same symbols as the CSI-RS, the UE applies the first TCI state of the two TCI states when receiving the aperiodic CSI-RS.

- else, the UE applies the first one of two TCI states corresponding to the lowest TCI codepoint among those mapped to two TCI states and applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received when receiving the aperiodic CSI-RS.

- else if a UE is configured with *sfnSchemePdcch* set to *'*sfnSchemeA', it is not configured with *enableTwoDefaultTCI-States,* and the two TCI states are activated for the CORESET by the activation command as described in clause 6.1.3.x of [10, TS 38.321]

- if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with an offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], periodic CSI-RS, semi-persistent CSI-RS, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48} and when *enableBeamSwitchTiming* is not provided or the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *trs-Info* , aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'off' or configured without the higher layer parameters *repetition* and *trs-Info* scheduled with offset larger than or equal to 48 when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'on' scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided;

- else, the UE applies the first one of TCI states indicated for the CORESET with the lowest CORESET ID in the latest slot within the active BWP of the cell in which the CSI-RS is to be received when receiving the aperiodic CSI-RS, if two TCI states are activated for the CORESET. Otherwise, the UE applies the single activated TCI state of the CORESET with the lowest CORESET ID in the latest slot within the active BWP of the cell in which the CSI-RS is to be received, when receiving the aperiodic CSI-RS,

- else if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], periodic CSI-RS, semi-persistent CSI-RS, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48} and when *enableBeamSwitchTiming* is not provided or the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *trs-Info* , aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'off' or configured without the higher layer parameters *repetition* and *trs-Info* scheduled with offset larger than or equal to 48 when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'on' scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided;

- else if the UE is not provided *dl-OrJointTCI-StateList*, and if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored;

- else if the UE is provided *dl-OrJointTCI-StateList* and if the indicated TCI state is associated with a PCI different from the serving cell, regardless of configuration of *followUnifiedTCI-State*, and if at least one CORESET is configured for the BWP in which the aperiodic CSI-RS is received, when receiving the aperiodic CSI-RS, the UE applies the QCL assumption used for the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored. In the CA case, if the 'QCL-TypeD' of the aperiodic CSI-RSs from respective CCs in a band are different in a slot, the QCL-TypeD assumption of the CSI-RS in the CC with lowest CC ID in the band is applied to all the aperiodic CSI-RSs in the CCs in the band;

- else if the UE is provided *dl-OrJointTCI-StateList* and the indicated TCI state is associated with the PCI of the serving cell, regardless of configuration of *followUnifiedTCI-State*, the indicated TCI state is applied to the aperiodic CSI-RS;

- else if the UE is configured with *enableDefaultBeamForCCS* and when receiving the aperiodic CSI-RS, the UE applies the QCL assumption of the lowest-ID activated TCI state applicable to the PDSCH within the active BWP of the cell in which the CSI-RS is to be received.

- If the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in a *NZP-CSI-RS-ResourceSet* is equal to or greater than the UE reported threshold *beamSwitchTiming* when the reported value is one of the values of {14,28,48} and *enableBeamSwitchTiming* is not provided and the *NZP-CSI-RS-ResourceSet* is not configured with higher layer parameter *trs-Info*, or is equal to or greater than the UE reported threshold *beamSwitchTiming* when the reported value is one of the values of {14,28,48} and the *NZP-CSI-RS-ResourceSet* is configured with higher layer parameter *trs-Info*, or is equal to or greater than 48 when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided and the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *repetition* set to 'off' or configured without the higher layer parameters *repetition* and *trs-Info*, or is equal to or greater than the UE reported threshold *beamSwitchTiming-r16,* when *enableBeamSwitchTiming* is provided and the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *repetition* set to 'on', the UE is expected to apply the QCL assumptions in the indicated TCI states for the aperiodic CSI-RS resources in the CSI triggering state indicated by the CSI trigger field in DCI.

- The UE is not expected to receive aperiodic CSI-RS and PDSCH/aperiodic CSI-RS associated with different values of *coresetPoolIndex* in overlapped symbol(s). The UE is not expected to receive aperiodic CSI-RS and semi-persistent/periodic CSI-RS with different 'QCL-type D' in overlapped symbol(s).

- If configured, the UE may assume that a CSI-RS resource in an aperiodic CSI-RS resource set configured without *trs-Info* is quasi co-located with the RS(s) in the indicated TCI state.

- A non-zero codepoint of the CSI request field in the DCI is mapped to a CSI triggering state according to the order of the associated positions of the up to trigger states in *CSI-AperiodicTriggerStateList* with codepoint '1' mapped to the triggering state in the first position.

For a UE configured with the higher layer parameter *CSI-AperiodicTriggerStateList*, if a Resource Setting linked to a *CSI-ReportConfig* has multiple aperiodic resource sets, only one of the aperiodic CSI-RS resource sets from the Resource Setting is associated with the trigger state, and the UE is higher layer configured per trigger state per Resource Setting to select the one CSI-IM/NZP CSI-RS resource set from the Resource Setting.

When aperiodic CSI-RS is used with aperiodic reporting, the CSI-RS offset is configured per resource set by the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16* or *aperiodicTriggeringOffset-r17*. The CSI-RS triggering offset has the values of {0, 1, 2, 3, 4, 5, 6, …, 15, 16, 24} slots for or {0, 4, 8, 12, …, 60, 64, 96} slots for and , where is the subcarrier spacing configurations for CSI-RS. If the UE is not configured with *minimumSchedulingOffsetK0* for any DL BWP and *minimumSchedulingOffsetK2* for any UL BWP and if all the associated trigger states do not have the higher layer parameter *qcl-Type* set to 'typeD' in the corresponding TCI states, the CSI-RS triggering offset is fixed to zero. The aperiodic triggering offset of the CSI-IM follows offset of the associated NZP CSI-RS for channel measurement. The aperiodic CSI-RS is transmitted in a slot , , if UE is configured with ca-SlotOffset for at least one of the triggered and triggering cell, and in slot , otherwise, and where

*- n* is the slot containing the triggering DCI, *X* is the CSI-RS triggering offset according to the higher layer parameter *aperiodicTriggeringOffset* or *aperiodicTriggeringOffset-r16* or *aperiodicTriggeringOffset-r17*,

*-* and are the and the  which are determined by higher-layer configured *ca-SlotOffset* for the cell receiving the PDCCH, and are the and the  which are determined by higher-layer configured *ca-SlotOffset* for the cell transmitting the CSI-RS respectively, as defined in [4, TS 38.211] clause 4.5.

The UE does not expect that aperiodic CSI-RS is transmitted before the OFDM symbol(s) carrying its triggering DCI. When the minimum scheduling offset restriction is applied, UE is not expected to be triggered by CSI triggering state indicated by the CSI request field in DCI in which CSI-RS triggering offset is smaller than the currently applicable minimum scheduling offset restriction *K*0min.

If interference measurement is performed on aperiodic NZP CSI-RS, a UE is not expected to be configured with a different aperiodic triggering offset of the NZP CSI-RS for interference measurement from the associated NZP CSI-RS for channel measurement.

If the UE is configured with a single carrier for uplink, the UE is not expected to transmit more than one aperiodic CSI report triggered by different DCIs on overlapping OFDM symbols.

When the PDCCH reception includes two PDCCH candidates from two respective search space sets, as described in clause 10.1 of [6, TS 38.213], for the purpose of determining scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources, the PDCCH candidate that ends later in time is used, and the UE does not expect that the aperiodic CSI-RS is transmitted before the first symbol of the PDCCH candidate that starts later in time.

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##### 5.2.1.5.2 Semi-persistent CSI/Semi-persistent CSI-RS

For semi-persistent reporting on PUSCH, a set of trigger states are higher layer configured by *CSI-SemiPersistentOnPUSCH-TriggerStateList,* where the CSI request field in DCI scrambled with SP-CSI-RNTI activates one of the trigger states. For a reporting setting for which the *CSI-ReportConfig* contains a list of sub-configurations, provided by the higher layer parameter [*csi-ReportSubConfigList*], one or more trigger states can be configured with each indicating one or more of the sub-configurations. A UE is not expected to receive a DCI scrambled with SP-CSI-RNTI activating one semi-persistent CSI report with the same *CSI-ReportConfigId* as in a semi-persistent CSI report which is activated by a previously received DCI scrambled with SP-CSI-RNTI.

For semi-persistent reporting on PUCCH, the PUCCH resource used for transmitting the CSI report are configured by *reportConfigType*. Semi-persistent reporting on PUCCH is activated by an activation command as described in clause 6.1.3.16 of [10, TS 38.321], which selects one of the semi-persistent Reporting Settings for use by the UE on the PUCCH. For a selected reporting setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], [an/the] activation command can [also] select one or more sub-configurations to use by the UE as described in clause 6.1.3.X of [10, TS 38.321]. When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, the indicated semi-persistent Reporting Setting should be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.

For a UE configured with CSI resource setting(s) where the higher layer parameter *resourceType* set to 'semiPersistent'.

- when a UE receives an activation command, as described in clause 6.1.3.12 of [10, TS 38.321], for CSI-RS resource set(s) for channel measurement and CSI-IM/NZP CSI-RS resource set(s) for interference measurement associated with configured CSI resource setting(s), and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the selection command, the corresponding actions in [10, TS 38.321] and the UE assumptions (including QCL assumptions provided by a list of reference to *TCI-State's,* one per activated resource) on CSI-RS/CSI-IM transmission corresponding to the configured CSI-RS/CSI-IM resource configuration(s) shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided. If a *TCI-State* referred to in the list is configured with a reference to an RS configured with *qcl-Type* set to '*typeD*', that RS can be an SS/PBCH block, periodic or semi-persistent CSI-RS located in same or different CC/DL BWP.

- when a UE receives a deactivation command, as described in clause 6.1.3.12 of [10, TS 38.321], for activated CSI-RS/CSI-IM resource set(s) associated with configured CSI resource setting(s), and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of CSI-RS/CSI-IM transmission corresponding to the deactivated CSI-RS/CSI-IM resource set(s) shall apply starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided.

A codepoint of the CSI request field in the DCI is mapped to a SP-CSI triggering state according to the order of the positions of the configured trigger states in *CSI-SemiPersistentOnPUSCH-TriggerStateList*, with codepoint '0' mapped to the triggering state in the first position. A UE validates, for semi-persistent CSI activation or release, a PDCCH on a DCI only if the following conditions are met:

- the CRC parity bits of the DCI format are scrambled with a SP-CSI-RNTI provided by higher layer parameter *sp-CSI-RNTI*

- Special fields for the DCI format are set according to Table 5.2.1.5.2-1 or Table 5.2.1.5.2-2.

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of semi-persistent CSI transmission on PUSCH, and the UE activates or deactivates a CSI Reporting Setting indicated by CSI request field in the DCI. If validation is not achieved, the UE considers the DCI format as having been detected with a non-matching CRC.

Table 5.2.1.5.2-1: Special fields for semi-persistent CSI activation PDCCH validation

|  |  |
| --- | --- |
|  | DCI format 0\_1/0\_2 |
| HARQ process number  (if present) | set to all '0's |
| Redundancy version  (if present) | set to all '0's |

Table 5.2.1.5.2-2: Special fields for semi-persistent CSI deactivation PDCCH validation

|  |  |
| --- | --- |
|  | DCI format 0\_1/0\_2 |
| HARQ process number  (if present) | set to all '0's |
| Modulation and coding scheme | set to all '1's |
| Resource block assignment | If higher layer configures RA type 0 only, set to all '0's;  If higher layer configures RA type 1 only, set to all '1's;  If higher layer configures dynamic switch between RA type 0 and 1, then if MSB is'0', set to all '0's; else, set to all '1's  For DCI 0\_1, if higher layer configures RA type 2, set to all '1's if *µ* = 0; set to all '0's if *µ* = 1 |
| Redundancy version  (if present) | set to all '0's |

If the UE has an active semi-persistent CSI-RS/CSI-IM resource configuration, or an active semi-persistent ZP CSI-RS resource set configuration, and has not received a deactivation command, the activated semi-persistent CSI-RS/CSI-IM resource set or the activated semi-persistent ZP CSI-RS resource set configurations are considered to be active when the corresponding DL BWP is active, otherwise they are considered suspended.

If the UE is configured with carrier deactivation, the following configurations in the carrier in activated state would also be deactivated and need re-activation configuration(s): semi-persistent CSI-RS/CSI- IM resource, semi-persistent CSI reporting on PUCCH, semi-persistent SRS, semi-persistent ZP CSI-RS resource set.

<omitted text>

#### 5.2.1.6 CSI processing criteria

The UE indicates the number of supported simultaneous CSI calculations with parameter *simultaneousCSI-ReportsPerCC* in a component carrier, and *simultaneousCSI-ReportsAllCC* across all component carriers. If a UE supports simultaneous CSI calculations it is said to have CSI processing units for processing CSI reports. If *L* CPUs are occupied for calculation of CSI reports in a given OFDM symbol, the UE has unoccupied CPUs. If *N* CSI reports start occupying their respective CPUs on the same OFDM symbol on which CPUs are unoccupied, where each CSI report corresponds to , the UE is not required to update the requested CSI reports with lowest priority (according to Clause 5.2.5), where is the largest value such that holds.

A UE is not expected to be configured with an aperiodic CSI trigger state containing more than Reporting Settings. Processing of a CSI report occupies a number of CPUs for a number of symbols as follows:

- for a CSI report with CSI-ReportConfig with higher layer parameter *reportQuantity* set to 'none' and *CSI-RS-ResourceSet* with higher layer parameter *trs-Info* configured

- for a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-SINR', 'ssb-Index-SINR', 'cri-RSRP- Index', 'ssb-Index-RSRP- Index', 'cri-SINR- Index', 'ssb-Index-SINR- Index ' or 'none' (and *CSI-RS-ResourceSet* with higher layer parameter *trs-Info* not configured)

- for a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'cri-RI-PMI-CQI', 'cri-RI-i1', 'cri-RI-i1-CQI', 'cri-RI-CQI', or 'cri-RI-LI-PMI-CQI',

- if max{ *µPDCCH*, *µCSI-RS, µUL*} ≤ 3, and if a CSI report is aperiodically triggered without transmitting a PUSCH with either transport block or HARQ-ACK or both when *L* = 0 CPUs are occupied, where the CSI corresponds to a single CSI with wideband frequency-granularity and to at most 4 CSI-RS ports in a single resource without CRI report and where *codebookType* is set to 'typeI-SinglePanel' or where *reportQuantity* is set to 'cri-RI-CQI', ,

- If a *CSI-ReportConfig* is configured with *codebookType* set to 'typeI-SinglePanel' and the corresponding CSI-RS Resource Set for channel measurement is configured with two Resource Groups and Resource Pairs, , where is the number of CPUs occupied by a pair of CMRs subject to *mTRP-CSI-numCPU-r17* and is defined in clause 5.2.1.4.2.

- If a *CSI-ReportConfig* contains a list of *L* sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*],

- for periodic CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration.

- for aperiodic and semi-persistent CSI reporting, where is the total number of CSI-RS resources corresponding to the *i*-th sub-configuration, and where the *i*-th sub-configuration is from *N* indicated sub-configurations out of *L* sub-configurations contained in a *CSI-ReportConfig*, where and .

- otherwise, , where is the number of CSI-RS resources in the CSI-RS resource set for channel measurement.

For a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* not set to 'none', the CPU(s) are occupied for a number of OFDM symbols as follows:

- A periodic or semi-persistent CSI report (excluding an initial semi-persistent CSI report on PUSCH after the PDCCH triggering the report) occupies CPU(s) from the first symbol of the earliest one of each CSI-RS/CSI-IM/SSB resource for channel or interference measurement, respective latest CSI-RS/CSI-IM/SSB occasion no later than the corresponding CSI reference resource, until the last symbol of the configured PUSCH/PUCCH carrying the report.

- An aperiodic CSI report occupies CPU(s) from the first symbol after the PDCCH triggering the CSI report until the last symbol of the scheduled PUSCH carrying the report. When the PDCCH reception includes two PDCCH candidates from two respective search space sets, as described in clause 10.1 of [6, TS 38.213], for the purpose of determining the CPU occupation duration, the PDCCH candidate that ends later in time is used.

- An initial semi-persistent CSI report on PUSCH after the PDCCH trigger occupies CPU(s) from the first symbol after the PDCCH until the last symbol of the scheduled PUSCH carrying the report. When the PDCCH reception includes two PDCCH candidates from two respective search space sets, as described in clause 10.1 of [6, TS 38.213], for the purpose of determining the CPU occupation duration, the PDCCH candidate that ends later in time is used.

For a CSI report with *CSI-ReportConfig* with higher layer parameter *reportQuantity* set to 'none' and *CSI-RS-ResourceSet* with higher layer parameter *trs-Info* not configured, the CPU(s) are occupied for a number of OFDM symbols as follows:

- A semi-persistent CSI report (excluding an initial semi-persistent CSI report on PUSCH after the PDCCH triggering the report) occupies CPU(s) from the first symbol of the earliest one of each transmission occasion of periodic or semi-persistent CSI-RS/SSB resource for channel measurement for L1-RSRP computation, until symbols after the last symbol of the latest one of the CSI-RS/SSB resource for channel measurement for L1-RSRP computation in each transmission occasion.

- An aperiodic CSI report occupies CPU(s) from the first symbol after the PDCCH triggering the CSI report until the last symbol between symbols after the first symbol after the PDCCH triggering the CSI report and symbols after the last symbol of the latest one of each CSI-RS/SSB resource for channel measurement for L1-RSRP computation.

where are defined in the table 5.4-2.

In any slot, the UE is not expected to have more active CSI-RS ports or active CSI-RS resources in active BWPs than reported as capability. NZP CSI-RS resource is active in a duration of time defined as follows. For aperiodic CSI-RS, starting from the end of the PDCCH containing the request and ending at the end of the scheduled PUSCH containing the report associated with this aperiodic CSI-RS. When the PDCCH candidates are associated with a search space set configured with *searchSpaceLinking*, for the purpose of determining the NZP CSI-RS resource active duration, the PDCCH candidate that ends later in time among the two linked PDCCH candidates is used. For semi-persistent CSI-RS, starting from the end of when the activation command is applied, and ending at the end of when the deactivation command is applied. For periodic CSI-RS, starting when the periodic CSI-RS is configured by higher layer signalling, and ending when the periodic CSI-RS configuration is released. If a CSI-RS resource is referred *N* times by one or more CSI Reporting Settings, the CSI-RS resource and the CSI-RS ports within the CSI-RS resource are counted *N* times. For a CSI-RS Resource Set for channel measurement configured with two Resource Groups and Resource Pairs, if a CSI-RS resource is referred times by one of the CSI-RS resources, where is defined in clause 5.2.1.4.2, and/or one or two Resource Pairs, the CSI-RS resource and the CSI-RS ports within the CSI-RS resource are counted times.

For a CSI report configuration containing sub-configuration(s) indicated in a *CSI-ReportConfig,* if a CSI-RS resource is referred by *M* sub-configurations among *X* sub-configurations, the CSI-RS resource is counted *M* times and the CSI-RS ports within the CSI-RS resource are counted as follows:

- if each sub-configuration, of the *M* sub-configurations, is configured with a CSI-RS antenna port subset, provided by [*port-subsetIndicator*],

- *M* × *P* if each sub-configuration, of the *M* sub-configurations, is configured with a list of one or more CSI-RS resources, provided by [*nzp-CSI-RS-resourceList*], [and/] or is configured with a power offset, provided by *[powerOffset]*,

Where *P* is the number of ports configured by *nrofPorts* and is the number of CSI-RS ports in sub-configuration *s* derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2.<omitted text>

#### 5.2.2.3 Reference signal (CSI-RS)

##### 5.2.2.3.1 NZP CSI-RS

The UE can be configured with one or more NZP CSI-RS resource set configuration(s) as indicated by the higher layer parameters *CSI-ResourceConfig,* and *NZP-CSI-RS-ResourceSet.* Each NZP CSI-RS resource set consists of *K*≥1 NZP CSI-RS resource(s).

The following parameters for which the UE shall assume non-zero transmission power for CSI-RS resource are configured via the higher layer parameter *NZP-CSI-RS-Resource, CSI-ResourceConfig* and *NZP-CSI-RS-ResourceSet* for each CSI-RS resource configuration:

- *nzp-CSI-RS-ResourceId* determines CSI-RS resource configuration identity.

- *periodicityAndOffset* defines the CSI-RS periodicity and slot offset for periodic/semi-persistent CSI-RS. All the CSI-RS resources within one set are configured with the same periodicity, while the slot offset can be same or different for different CSI-RS resources.

- *resourceMapping* defines the number of ports, CDM-type, and OFDM symbol and subcarrier occupancy of the CSI-RS resource within a slot that are given in Clause 7.4.1.5 of [4, TS 38.211].

- *nrofPorts* in *resourceMapping* defines the number of CSI-RS ports, where the allowable values are given in Clause 7.4.1.5 of [4, TS 38.211].

- *density* in *resourceMapping* defines CSI-RS frequency density of each CSI-RS port per PRB, and CSI-RS PRB offset in case of the density value of 1/2, where the allowable values are given in Clause 7.4.1.5 of [4, TS 38.211]. For density 1/2, the odd/even PRB allocation indicated in *density* is with respect to the common resource block grid.

- *cdm-Type* in *resourceMapping* defines CDM values and pattern, where the allowable values are given in Clause 7.4.1.5 of [4, TS 38.211].

*- powerControlOffset*: which is the assumed ratio of PDSCH EPRE to NZP CSI-RS EPRE when UE derives CSI feedback and takes values in the range of [-8, 15] dB with 1 dB step size. For CQI calculation based on a pair of NZP CSI-RS resources, *powerControlOffset* of each NZP CSI-RS resource in the pair of NZP CSI-RS resources for channel measurement is the assumed ratio of EPRE when UE derives CSI feedback and takes values in the range of [-8, 15] dB with 1 dB step size.

*- powerControlOffsetSS*: which is the assumed ratio of NZP CSI-RS EPRE to SS/PBCH block EPRE.

- *scramblingID* defines scrambling ID of CSI-RSwith length of 10 bits.

- *BWP-Id* in *CSI-ResourceConfig* defines which bandwidth part the configured CSI-RS is located in.

- *repetition* in *NZP-CSI-RS-ResourceSet* is associated with a CSI-RS resource set and defines whether UE can assume the CSI-RS resources within the NZP CSI-RS Resource Set are transmitted with the same downlink spatial domain transmission filter or not as described in Clause 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', 'cri-SINR', 'cri-RSRP- Index', 'cri-SINR- Index' or 'none'.

- *qcl-InfoPeriodicCSI-RS* contains a reference to a *TCI-State* indicating QCL source RS(s) and QCL type(s). If the *TCI-State* is configured with a reference to an RS configured with *qcl-Type* set to '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 located in the same or different CC/DL BWP. The reference RS may additionally be an SS/PBCH block associated with a PCI different from the PCI of the serving cell.

- *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 Clause 5.1.6.1.1 and can be configured when reporting setting is not configured or when the higher layer parameter *reportQuantity* associated with all the reporting settings linked with the CSI-RS resource set is set to 'none'.

All CSI-RS resources within one set are configured with same *density* and same *nrofPorts*, except for the NZP CSI-RS resources used for interference measurement.

The UE expects that all the CSI-RS resources of a resource set are configured with the same starting RB and number of RBs and the same *cdm-type*.

For a CSI-RS Resource Set for channel measurement configured with two Resource Groups and Resource Pairs, the slot offsets of the two resources in a Resource Pair are configured within slots, without DL/UL switching in between the two resources, where implies that the two resources are configured in the same slot, and implies that the two resources are configured within two adjacent slots.

The bandwidth and initial common resource block (CRB) index of a CSI-RS resource within a BWP, as defined in Clause 7.4.1.5 of [4, TS 38.211], are determined based on the higher layer parameters *nrofRBs* and *startingRB*, respectively, within the CSI-FrequencyOccupation IE configured by the higher layer parameter *freqBand* within the *CSI-RS-ResourceMapping* IE. Both *nrofRBs* and *startingRB* are configured as integer multiples of 4 RBs, and the reference point for *startingRB* is CRB 0 on the common resource block grid. If the UE shall assume that the initial CRB index of the CSI-RS resource is , otherwise . If , the UE shall assume that the bandwidth of the CSI-RS resource is , otherwise . In all cases, the UE shall expect that .

<omitted text>

#### 5.2.2.5 CSI reference resource definition

The CSI reference resource for a serving cell is defined as follows:

- In the frequency domain, the CSI reference resource is defined by the group of downlink physical resource blocks corresponding to the band to which the derived CSI relates.

- In the time domain, the CSI reference resource for a CSI reporting in uplink slot *n'* is defined by a single downlink slot *,* where is a parameter configured by higher layer as specified in clause 4.2 of [6 TS 38.213], and where is the subcarrier spacing configuration for with a value of 0 for frequency range 1,

- where  and and  are the subcarrier spacing configurations for DL and UL, respectively, and and  are determined by higher-layer configured ca-SlotOffset for the cells transmitting the uplink and downlink, as defined in clause 4.5 of [4, TS 38.211]

- where for periodic and semi-persistent CSI reporting

- if a single CSI-RS/SSB resource is configured for channel measurement *nCSI\_ref* is the smallest value greater than or equal to , such that it corresponds to a valid downlink slot, or

- if multiple CSI-RS/SSB resources are configured for channel measurement *nCSI\_ref* is the smallest value greater than or equal to , such that it corresponds to a valid downlink slot.

- where for aperiodic CSI reporting, if the UE is indicated by the DCI to report CSI in the same slot as the CSI request, *nCSI\_ref* is such that the reference resource is in the same valid downlink slot as the corresponding CSI request, otherwise *nCSI\_ref* is the smallest value greater than or equal to , such that slot *n*- *nCSI\_ref* corresponds to a valid downlink slot, where *Z'* corresponds to the delay requirement as defined in Clause 5.4.

- when periodic or semi-persistent CSI-RS/CSI-IM or SSB is used for channel/interference measurements, the UE is not expected to measure channel/interference on the CSI-RS/CSI-IM/SSB whose last OFDM symbol is received up to *Z'* symbols before transmission time of the first OFDM symbol of the aperiodic CSI reporting.

A slot in a serving cell shall be considered to be a valid downlink slot if:

- it comprises at least one higher layer configured downlink or flexible symbol, and

- it does not fall within a configured measurement gap for that UE

If there is no valid downlink slot for the CSI reference resource corresponding to a CSI Report Setting in a serving cell, CSI reporting is omitted for the serving cell in uplink slot *n'*.

After the CSI report (re)configuration, serving cell activation, BWP change, or activation of SP-CSI, the UE reports a CSI report only after receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement no later than CSI reference resource and drops the report otherwise.

When DRX is configured, the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement in DRX Active Time no later than CSI reference resource and drops the report otherwise. When DRX is configured and the CSI-RS Resource Set for channel measurement corresponding to a CSI report is configured with two Resource Groups and Resource Pairs, as described in clause 5.2.1.4.1, the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion for each CSI-RS resource in a Resource Pair within the same DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitOtherPeriodicCSI* to report CSI with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to quantities other than 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', and 'ssb-Index-RSRP- Index ' when *drx-onDurationTimer* is not started, the UE shall report CSI during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in Clause 5.2.1.4 if receiving at least one CSI-RS transmission occasion for channel measurement and CSI-RS and/or CSI-IM occasion for interference measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise. When the UE is configured to monitor DCI format 2\_6 and if the UE configured by higher layer parameter *ps-TransmitPeriodicL1-RSRP* to report L1-RSRP with the higher layer parameter *reportConfigType* set to 'periodic' and *reportQuantity* set to 'cri-RSRP', 'ssb-Index-RSRP', 'cri-RSRP- Index', or 'ssb-Index-RSRP- Index' when *drx-onDurationTimer* is not started, the UE shall report L1-RSRP during the time duration indicated by *drx-onDurationTimer* in *DRX-Config* also outside active time according to the procedure described in clause 5.2.1.4 and when reportQuantity set to 'cri-RSRP' or *'*cri-RSRP- *Index*' if receiving at least one CSI-RS transmission occasion for channel measurement during the time duration indicated by drx-onDurationTimer in *DRX-Config* outside DRX active time or in DRX Active Time no later than CSI reference resource and drops the report otherwise.

When deriving CSI feedback, the UE is not expected that a NZP CSI -RS resource for channel measurement overlaps with CSI-IM resource for interference measurement or NZP CSI -RS resource for interference measurement.

If configured to report CQI index, in the CSI reference resource, the UE shall assume the following for the purpose of deriving the CQI index, and if also configured, for deriving PMI and RI:

- The first 2 OFDM symbols are occupied by control signaling.

- The number of PDSCH and DM-RS symbols is equal to 12.

- The same bandwidth part subcarrier spacing configured as for the PDSCH reception

- The bandwidth as configured for the corresponding CQI report.

- The IAB-MT shall only assume the frequency resources as indicated by the DL TX power adjustment MAC CE, if indicated for the slot of the CSI reference resource by DL Tx Power Adjustment MAC CE as described in [10, TS 38.321].

- The reference resource uses the CP length and subcarrier spacing configured for PDSCH reception

- No resource elements used by primary or secondary synchronization signals or PBCH.

- Redundancy Version 0.

- The ratio of PDSCH EPRE to CSI-RS EPRE is as given in Clause 5.2.2.3.1.

- In addition, the IAB-MT shall apply the provided DL TX power adjustment, if indicated for the slot of the CSI reference resource by DL Tx Power Adjustment MAC CE as described in [10, TS 38.321].

- Assume no REs allocated for NZP CSI-RS and ZP CSI-RS.

- Assume the same number of front-loaded DM-RS symbols as the maximum front-loaded symbols configured by the higher layer parameter *maxLength* in *DMRS-DownlinkConfig.*

- Assume the same number of additional DM-RS symbols as the additional symbols configured by the higher layer parameter *dmrs-AdditionalPosition*.

- Assume the PDSCH symbols are not containing DM-RS.

- Assume PRB bundling size of 2 PRBs.

- The PDSCH transmission scheme where the UE may assume that PDSCH transmission would be performed with up to 8 transmission layers as defined in Clause 7.3.1.4 of [4, TS 38.211]. For CQI calculation, the UE should assume that PDSCH signals on antenna ports in the set [1000,…, 1000+ν-1] for ν layers would result in signals equivalent to corresponding symbols transmitted on antenna ports [3000,…, 3000+*P*-1], as given by

where  is a vector of PDSCH symbols from the layer mapping defined in Clause 7.3.1.4 of [4, TS 38.211],  is the number of CSI-RS ports. If only one CSI-RS port is configured, *W(i)* is 1. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to either 'cri-RI-PMI-CQI' or 'cri-RI-LI-PMI-CQI', *W(i)* is the precoding matrix corresponding to the reported PMI applicable to *x(i)*. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-CQI', *W(i)* is the precoding matrix corresponding to the procedure described in Clause 5.2.1.4.2. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to 'cri-RI-i1-CQI', *W(i)* is the precoding matrix corresponding to the reported i1 according to the procedure described in Clause 5.2.1.4.2. The corresponding PDSCH signals transmitted on antenna ports [3000,…,3000 + *P* - 1] would have a ratio of EPRE to CSI-RS EPRE equal to the ratio given in Clause 5.2.2.3.1. If the higher layer parameter *reportQuantity* in *CSI-ReportConfig* for which the CQI is reported is set to either 'cri-RI-PMI-CQI' or 'cri-RI-LI-PMI-CQI', the corresponding CSI-RS Resource Set for channel measurement is configured with two Resource Groups and Resource Pairs, as described in clause 5.2.1.4.1, the reported CRI corresponds to an entry of the Resource Pairs, and the reported rank combination is , as described in clause 5.2.1.4.2, for CQI calculation, the UE should assume that

- PDSCH signals on antenna ports in the set for layers would result in signals equivalent to corresponding symbols transmitted on antenna ports of the Group 1 CSI-RS resource in the Resource Pair indicated by the CRI, and PDSCH signals on antenna ports in the set for layers would result in signals equivalent to corresponding symbols transmitted on antenna ports of the Group 2 CSI-RS resource in the Resource Pair indicated by the CRI, as given by

where , are the two precoding matrices corresponding to the two reported PMIs applicable to , as described in clause 5.2.1.4.2; and the indices are associated to the two Resource Groups configured in the corresponding CSI-RS Resource Set for channel measurement; that the signals , , fully overlap in time and frequency, and that, for the calculation of RI, PMI and LI (if configured) of layers, , the interference from the other layers is derived from channel measurement and precoding matrix corresponding to the other layers.

- The UE shall assume that the corresponding PDSCH signals for layers transmitted on the antenna ports of the CSI-RS resource in Group would have a ratio of EPRE to CSI-RS EPRE equal to the *powerControlOffset* of the respective CSI-RS resource, for .

- For a UE configured with a *CSI-ReportConfig* that contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*],

- if a sub-configuration indicates a CSI-RS antenna port subset using the higher layer bitmap parameter [*port-subsetIndicator*], as described in clause 5.2.1.4.2, for CQI calculation for the sub-configuration with the antenna port subset represented by vector [3000 + *p*(*0*), …, 3000 + *p*(*P* – 1)]*T* of size *P*, where *P* corresponds to the number of bits with value 1 in the bitmap [*port-subsetIndicator*], the UE should assume that PDSCH signals on antenna ports in the set [1000,…, 1000+ν-1] for ν layers would result in signals equivalent to corresponding symbols transmitted on antenna ports [3000 + *p*(*0*), …, 3000 + *p*(*P* – 1)] *T*, as given by

where *p*(*j*) corresponds to the *j*-th enabled port in the bitmap [*port-subsetIndicator*], with *p*(*j*)< *p*(*j+1*), *j* =0, …, *P-1*, and *T* , and are as previously described in this Clause, and the corresponding PDSCH EPRE to CSI-RS EPRE is as previously defined in this Clause if the sub-configuration does not indicate a power offset *[powerOffset]*.

- if a sub-configuration indicates a list of NZP CSI-RS resources, provided by [*nzp-CSI-RS-resourceList*] and does not indicate a power offset *[powerOffset]*, for CQI calculation for the sub-configuration the UE follows the procedure previously described in this Clause.

- if a sub-configuration indicates a power offset *[powerOffset]*,for CQI calculation, the UE shall assume the corresponding PDSCH signals transmitted on the antenna ports of a CSI-RS resource would have a ratio of EPRE to CSI-RS EPRE equal to the [difference] between *powerControlOffset* of the CSI-RS resource, given in Clause 5.2.2.3.1, and *[powerOffset]* [, where the differenceis expected to take one of the values that can be configured for *powerControlOffset* of the CSI-RS resource, given in Clause 5.2.2.3.1, and is also expected to take a value that is no larger than the value of *powerControlOffset*]*.*

<omitted text>

### 5.2.3 CSI reporting using PUSCH

A UE shall perform aperiodic CSI reporting using PUSCH on serving cell c upon successful decoding of a DCI format 0\_1 or DCI format 0\_2 which triggers an aperiodic CSI trigger state.

When a DCI format 0\_1 schedules two PUSCH allocations, the aperiodic CSI report is carried on the second scheduled PUSCH. When a DCI format 0\_1 schedules more than two PUSCH allocations, the aperiodic CSI report is carried on the penultimate scheduled PUSCH.

An aperiodic CSI report carried on the PUSCH supports wideband, and sub-band frequency granularities. An aperiodic CSI report carried on the PUSCH supports Type I, Type II, Enhanced Type II and Further Enhanced Type II Port Selection CSI.

A UE shall perform semi-persistent CSI reporting on the PUSCH upon successful decoding of a DCI format 0\_1 or DCI format 0\_2 which activates a semi-persistent CSI trigger state. DCI format 0\_1 and DCI format 0\_2 contains a CSI request field which indicates the semi-persistent CSI trigger state to activate or deactivate. Semi-persistent CSI reporting on the PUSCH supports Type I, Type II with wideband, and sub-band frequency granularities, Enhanced Type II and Further Enhanced Type II Port Selection CSI. The PUSCH resources and MCS shall be allocated semi-persistently by an uplink DCI.

CSI reporting on PUSCH can be multiplexed with uplink data on PUSCH except that semi-persistent CSI reporting on PUSCH activated by a DCI format is not expected to be multiplexed with uplink data on the PUSCH. CSI reporting on PUSCH can also be performed without any multiplexing with uplink data from the UE.

Type I CSI feedback is supported for CSI Reporting on PUSCH. Type I wideband and sub-band CSI is supported for CSI Reporting on the PUSCH. Type II CSI is supported for CSI Reporting on the PUSCH.

For Type I, Type II, Enhanced Type II and Further Enhanced Type II Port Selection CSI feedback on PUSCH, a CSI report comprises of two parts. Part 1 has a fixed payload size and is used to identify the number of information bits in Part 2. Part 1 shall be transmitted in its entirety before Part 2.

- For Type I CSI feedback, Part 1 contains RI (if reported), CRI (if reported), CQI for the first codeword (if reported). Part 2 contains PMI (if reported), LI (if reported) and contains the CQI for the second codeword (if reported) when RI is larger than 4. For a *CSI-ReportConfig* configured with *codebookType* set to 'typeI-SinglePanel' and the corresponding CSI-RS Resource Set for channel measurement configured with two Resource Groups and Resource Pairs, Part 1 contains RI(s), CRI(s), CQI(s) for the first codeword and is zero padded to a fixed payload size (if needed). Part 2 contains the CQI(s) for the second codeword (if reported) when RI is larger than 4, LIs (if reported) and PMI(s). For a *CSI-ReportConfig* that contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], for Type I CSI feedback for one or more of the sub-configurations, Part 1 for a sub-configuration contains corresponding RI (if reported), CRI (if reported), CQI for the first codeword (if reported) and is zero padded to a fixed payload size (if needed). Part 2 for a sub-configuration contains the corresponding CQI for the second codeword (if reported) when RI is larger than 4, LI (if reported) and PMI (if reported).

- For Type II CSI feedback, Part 1 contains RI (if reported), CQI, and an indication of the number of non-zero wideband amplitude coefficients per layer for the Type II CSI (see Clause 5.2.2.2.3). The fields of Part 1 – RI (if reported), CQI, and the indication of the number of non-zero wideband amplitude coefficients for each layer – are separately encoded. Part 2 contains the PMI and LI (if reported) of the Type II CSI. The elements of , (if reported) and (if reported) are reported in the increasing order of their indices, , where the element of the lowest index is mapped to the most significant bits and the element of the highest index is mapped to the least significant bits. Part 1 and 2 are separately encoded.

- For Enhanced Type II CSI feedback (see Clause 5.2.2.2.5) and Further Enhanced Type II Port Selection CSI feedback (see Clause 5.2.2.2.7), Part 1 contains RI (if reported), CQI, and an indication of the overall number of non-zero amplitude coefficients across layers. The fields of Part 1 – RI (if reported), CQI, and the indication of the overall number of non-zero amplitude coefficients across layers – are separately encoded. Part 2 contains the PMI of the Enhanced Type II or Further Enhanced Type II Port Selection CSI. Part 1 and 2 are separately encoded.

A Type II CSI report that is carried on the PUSCH shall be computed independently from any Type II CSI report that is carried on the PUCCH formats 3 or 4 (see Clause 5.2.4 and 5.2.2).

When the higher layer parameter *reportQuantity* is configured with one of the values 'cri-RSRP', 'ssb-Index-RSRP', 'cri-SINR' or 'ssb-Index-SINR', or 'cri-RSRP- Index', 'ssb-Index-RSRP- Index ', 'cri-SINR- Index ', 'ssb-Index-SINR- Index ',the CSI feedback consists of a single part.

For both Type I and Type II reports configured for PUCCH but transmitted on PUSCH, the determination of the payload for CSI part 1 and CSI part 2 follows that of PUCCH as described in Clause 5.2.4.

When CSI reporting on PUSCH comprises two parts, the UE may omit a portion of the Part 2 CSI. Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1, where  is the number of CSI reports configured to be carried on the PUSCH. Priority 0 is the highest priority and priority  is the lowest priority and the CSI report *n* corresponds to the CSI report with the *n*th smallest Prii,CSI(*y,k,c,s*) value among the  CSI reports as defined in Clause 5.2.5. The subbands for a given CSI report *n* indicated by the higher layer parameter *csi-ReportingBand* with value '1' are numbered continuously in increasing order with the lowest subband of *csi-ReportingBand* with value set to '1' as subband 0. When omitting Part 2 CSI information for a particular priority level, the UE shall omit all of the information at that priority level, except when the corresponding CSI report contains multiple Part 2 CSIs each of which corresponding to a sub-configuration from a list of sub-configurations contained in the *CSI-ReportConfig* as described in Clause 5.2.1.1.

- For Enhanced Type II reports, for a given CSI report , each reported element of indices and , indexed by and , is associated with a priority value , with with , , and , and where is defined in Clause 5.2.2.2.5. The element with the highest priority has the lowest associated value . Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1, where

- Group 0 includes indices (if reported), (if reported) and ().

- Group 1 includes indices (if reported), (if reported), the highest priority elements of , , the highest priority elements of and the highest priority elements of ().

- Group 2 includes the lowest priority elements of , the lowest priority elements of and the lowest priority elements of ().

- For Further Enhanced Type II Port Selection reports, for a given CSI report , each reported element of and , indexed by , and , is associated with a priority value , with , and . The element with the highest priority has the lowest associated value . Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1, where:

- Group 0 includes (if reported), () and (if reported).

- Group 1 includes the highest priority elements of (if reported), , the highest priority elements of and the highest priority elements of ().

- Group 2 includes the lowest priority elements of (if reported), the lowest priority elements of and the lowest priority elements of ().

- For a Reporting Setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], for a corresponding CSI report which contains one or more CSIs, omission of Part 2 CSI is done at a sub-configuration level within the same priority level defined by Table 5.2.3-1 where a sub-configuration with an index, provided by [*csi-ReportSubConfigID*], with lower value has higher priority.

Table 5.2.3-1: Priority reporting levels for Part 2 CSI

|  |
| --- |
| Priority 0:  For CSI reports 1 to , Group 0 CSI for CSI reports configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 wideband CSI for CSI reports configured otherwise |
| Priority 1:  Group 1 CSI for CSI report 1, if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 subband CSI of even subbands for CSI report 1, if configured otherwise |
| Priority 2:  Group 2 CSI for CSI report 1, if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 subband CSI of odd subbands for CSI report 1, if configured otherwise |
| Priority 3:  Group 1 CSI for CSI report 2, if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 subband CSI of even subbands for CSI report 2, if configured otherwise |
| Priority 4:  Group 2 CSI for CSI report 2, if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'. Part 2 subband CSI of odd subbands for CSI report 2, if configured otherwise |
| ⁞ |
| Priority :  Group 1 CSI for CSI report , if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 subband CSI of even subbands for CSI report , if configured otherwise |
| Priority :  Group 2 CSI for CSI report , if configured as 'typeII-r16', 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'; Part 2 subband CSI of odd subbands for CSI report , if configured otherwise |

When the UE is scheduled to transmit a transport block on PUSCH not using repetition type B multiplexed with a CSI report(s), Part 2 CSI is omitted only when  is larger than , where parameters , , , , , , , , and are defined in Clause 6.3.2.4 of [5, TS 38.212].

Part 2 CSI is omitted level by level, beginning with the lowest priority level until the lowest priority level is reached which causes the  to be less than or equal to .

When the UE is scheduled to transmit a transport block on PUSCH using repetition type B multiplexed with a CSI report(s), Part 2 CSI is omitted only when

is larger than

,

where parameters , , , , , , , , , , , and are defined in Clause 6.3.2.4 of [5, TS 38.212].

Part 2 CSI is omitted level by level, beginning with the lowest priority level until the lowest priority level is reached which causes

to be less than or equal to

.

When part 2 CSI is transmitted on PUSCH with no transport block, lower priority bits are omitted until Part 2 CSI code rate, which is given by where , , are given in clause 6.3.2.4 of [5, 38.212] before HARQ-ACK puncturing part 2 CSI if any, is below a threshold code rate lower than one, where



- is the CSI offset value from Table 9.3-2 of [6, TS 38.213]

- *R* is signaled code rate in DCI

If the UE is in an active semi-persistent CSI reporting configuration on PUSCH, the CSI reporting is deactivated when either the downlink BWP or the uplink BWP is changed. Another activation command is required to enable the semi-persistent CSI reporting.

### 5.2.4 CSI reporting using PUCCH

A UE is semi-statically configured by higher layers to perform periodic CSI Reporting on the PUCCH. A UE can be configured by higher layers for multiple periodic CSI Reports corresponding to multiple higher layer configured CSI Reporting Settings, where the associated CSI Resource Settings are higher layer configured. For a Reporting Setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], CSI reporting is provided for all the sub-configurations in each corresponding reporting instance. Periodic CSI reporting on PUCCH formats 2, 3, 4 supports Type I CSI with wideband granularity.

A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from the first slot that is after slot when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command described in clause 6.1.3.16 of [10, TS 38.321]where ** is the SCS configuration for the PUCCH. The activation command will contain one or more Reporting Settings, [with or without containing one or more sub-configurations for each Reporting Setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*]], where the associated CSI Resource Settings are configured. Semi-persistent CSI reporting on the PUCCH supports Type I CSI. Semi-persistent CSI reporting on the PUCCH format 2 supports Type I CSI with wideband frequency granularity. Semi-persistent CSI reporting on PUCCH formats 3 or 4 supports Type I CSI with wideband and sub-band frequency granularities and Type II CSI Part 1.

When the PUCCH carry Type I CSI with wideband frequency granularity, the CSI payload carried by the PUCCH format 2 and PUCCH formats 3, or 4 are identical and the same irrespective of RI (if reported), CRI (if reported). A CSI-ReportConfig with *codebookType* set to 'typeI-SinglePanel' and the corresponding CSI-RS Resource Set for channel measurement configured with two Resource Groups and Resource Pairs can be configured with wideband frequency granularity only with *csi-ReportMode* set to 'Mode1' and *numberOfSingleTRP-CSI-Mode1* set to . For type I CSI sub-band reporting on PUCCH formats 3, or 4, the payload is split into two parts. The first part contains RI (if reported), CRI (if reported), CQI for the first codeword. The second part contains PMI (if reported), LI (if reported) and contains the CQI for the second codeword (if reported) when RI > 4. For a *CSI-ReportConfig* configured with subband reporting, *codebookType* set to 'typeI-SinglePanel' and the corresponding CSI-RS Resource Set for channel measurement configured with two Resource Groups and Resource Pairs, Part 1 contains RI(s), CRI(s), CQI(s) for the first codeword and is zero padded to a fixed payload size (if needed). Part 2 contains the CQI(s) for the second codeword (if reported) when RI is larger than 4, LIs (if reported) and PMI(s). For a *CSI-ReportConfig* containing a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], and configured with subband reporting, for Type I CSI for one or more of the sub-configurations, Part 1 for a sub-configuration contains corresponding RI (if reported), CRI (if reported), CQI for the first codeword (if reported) and is zero padded to a fixed payload size (if needed). Part 2 for a sub-configuration contains the corresponding CQI for the second codeword (if reported) when RI is larger than 4, LI (if reported) and PMI (if reported).

A semi-persistent report carried on the PUCCH formats 3 or 4 supports Type II CSI feedback, but only Part 1 of Type II CSI feedback (See Clause 5.2.2 and 5.2.3). Supporting Type II CSI reporting on the PUCCH formats 3 or 4 is a UE capability *type2-SP-CSI-Feedback-LongPUCCH*. A Type II CSI report (Part 1 only) carried on PUCCH formats 3 or 4 shall be calculated independently of any Type II CSI reports carried on the PUSCH (see Clause 5.2.3).

When the UE is configured with CSI Reporting on PUCCH formats 2, 3 or 4, each PUCCH resource is configured for each candidate UL BWP.

If the UE is in an active semi-persistent CSI reporting configuration on PUCCH and has not received a deactivation command, the CSI reporting takes place when the BWP in which the reporting is configured to take place is the active BWP, otherwise the CSI reporting is suspended.

A UE is not expected to report CSI with a total number of UCI bits and CRC bits larger than 115 bits when configured with PUCCH format 4. For CSI reports transmitted on a PUCCH, if all CSI reports consist of one part, the UE may omit a portion of CSI reports. Omission of CSI is according to the priority order determined from the Prii,CSI(*y,k,c,s*) value as defined in Clause 5.2.5. CSI report is omitted beginning with the lowest priority level until the CSI report code rate is less or equal to the one configured by the higher layer parameter *maxCodeRate*.

If any of the CSI reports consist of two parts, the UE may omit a portion of Part 2 CSI. Omission of Part 2 CSI is according to the priority order shown in Table 5.2.3-1. For a Reporting Setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter [*csi-ReportSubConfigList*], for a given CSI report which contains one or more CSIs, omission of Part 2 CSI is defined in Clause 5.2.3. Part 2 CSI is omitted beginning with the lowest priority level until the Part 2 CSI code rate is less or equal to the one configured by higher layer parameter *maxCodeRate*.

<omitted text>

## 6.2 UE reference signal (RS) procedure

### 6.2.1 UE sounding procedure

The UE may be configured with one or more Sounding Reference Signal (SRS) resource sets as configured by the higher layer parameter *SRS-ResourceSet* or *SRS-PosResourceSet*. For each SRS resource set configured by *SRS-ResourceSet*, a UE may be configured with SRS resources (higher layer parameter *SRS-Resource*), where the maximum value of K is indicated by UE capability[13, 38.306]. When SRS resource set is configured with the higher layer parameter *SRS-PosResourceSet,* a UE may be configured with *K* ≥1 SRS resources (higher layer parameter *SRS-PosResource*), where the maximum value of K is 16. The SRS resource set applicability is configured by the higher layer parameter *usage* in *SRS-ResourceSet.* When the higher layer parameter *usage* is set to 'beamManagement'*,* only one SRS resource in each of multiple SRS resource sets may be transmitted at a given time instant, but the SRS resources in different SRS resource sets with the same time domain behaviour in the same BWP may be transmitted simultaneously.

During non-active periods of cell DRX, the UE configured with cell DRX is not expected to transmit the periodic SRS, or semi-persistent SRS for channel acquisition. SRS for positioning is not impacted by cell DRX operation.

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