**3GPP TSG-RAN WG1 Meeting #114 *R1-23xxxxx***

**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 mobility enhancements |
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| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_Mob\_enh2 |  | ***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 canbe 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 mobility enhancemets NR. |
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| ***Summary of change:*** | Introduction of specification support for mobility enhancemets NRIn clause 5.2.1.1 – Added the top level configuration details of a LTM-CSI-Report-Config.In clause 5.2.1.2 – Added the details that a LTM-CSI-Resource-Config contains a LTM-CSI-SSB-ResourceSet comprising of a list of SSBs and associated cell indications.In clause 5.2.1.4.2 – Added the details on SSBRI determnation for LTMIn clause 5.2.1.4.3 – Added the report quantization details for LTM Removed a few brackets based on the latest RAN1 RRC parameter list |
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| --- | --- |
| ***Consequences if not approved:*** | Specification does not support mobility enhancements. |
|  |  |
| ***Clauses affected:*** | 5.2.1, 5.2.1.1, 5.2.1.2, 5.2.1.4.1, 5.2.1.4.2,  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.213  |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

<omitted text>

## 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 and/or [X≥1 *LTM-CSI-ReportConfig* Reporting Settings], M≥1 *CSI-ResourceConfig* Resource Settings and/or [Y≥1 *LTM-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* [and/or *LTM-CSI-ReportConfigs]* indicating the Resource Set IDs for channel and optionally for interference [where a Resource Set for interference can only be present for a Report Setting given by a *CSI-ReportConfig]*. Each trigger state in *CSI-SemiPersistentOnPUSCH-TriggerStateList* contains one associated *CSI-ReportConfig [or LTM-CSI-ReportConfig]*.

#### 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.

Each Reporting Setting [*LTM-CSI-ReportConfig]* is associated with a [*LTM-CSI-ResourceConfig*] for channel measurement and contains the parameters(s) for time-domain behavior, the number of cells and the number of reference signals per cell provided by [*noOfReportedCells*]*,* and [*noOfReportedRSPerCell*], respectively, comprising L1 measurement results associated with current SpCell by *SpCellInclusion*.

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’.

The time domain behavior of *[LTM-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.

#### 5.2.1.2 Resource settings

Each CSI Resource Setting *CSI-ResourceConfig* contains a configuration of a list of S≥1 CSI Resource Sets (given by higher layer parameter *csi-RS-ResourceSetList*), where the list is comprised of references to either or both of NZP CSI-RS resource set(s) and SS/PBCH block set(s) or the list is comprised of references to CSI-IM resource set(s). Each CSI Resource Setting is located in the DL BWP identified by the higher layer parameter *BWP-id*, and all CSI Resource Settings linked to a CSI Report Setting have the same DL BWP.

The time domain behavior of the CSI-RS resources within a CSI Resource Setting are indicated by the higher layer parameter *resourceType* and can be set to aperiodic, periodic, or semi-persistent. For periodic and semi-persistent CSI Resource Settings, when the UE is configured with *groupBasedBeamReporting-r17*, the number of CSI Resource Sets configured is S=2, otherwise the number of CSI-RS Resource Sets configured is limited to S=1. For periodic and semi-persistent CSI Resource Settings, the configured periodicity and slot offset is given in the numerology of its associated DL BWP, as given by *BWP-id.* When a UE is configured with multiple *CSI-ResourceConfigs* consisting the same NZP CSI-RS resource ID, the same time domain behavior shall be configured for the *CSI-ResourceConfigs*. When a UE is configured with multiple *CSI-ResourceConfigs* consisting the same CSI-IM resource ID, the same time-domain behavior shall be configured for the *CSI-ResourceConfigs*. All CSI Resource Settings linked to a CSI Report Setting shall have the same time domain behavior.

The following are configured via higher layer signaling for one or more CSI Resource Settings for channel and interference measurement:

- CSI-IM resource for interference measurement as described in Clause 5.2.2.4.

- NZP CSI-RS resource for interference measurement as described in Clause 5.2.2.3.1.

- NZP CSI-RS resource for channel measurement as described in Clause 5.2.2.3.1.

The UE may assume that the NZP CSI-RS resource(s) for channel measurement and the CSI-IM resource(s) for interference measurement configured for one CSI reporting are resource-wise QCLed with respect to 'typeD'. When NZP CSI-RS resource(s) is used for interference measurement, the UE may assume that the NZP CSI-RS resource for channel measurement and the CSI- IM resource or NZP CSI-RS resource(s) for interference measurement configured for one CSI reporting are QCLed with respect to 'typeD'.

For L1-SINR measurement:

- When one Resource Setting is configured, the Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel and interference measurement on NZP CSI-RS for L1-SINR computation. UE may assume that same 1 port NZP CSI-RS resource(s) with density 3 REs/RB is used for both channel and interference measurements.

- When two Resource Settings are configured, the first one Resource Setting (given by higher layer parameter *resourcesForChannelMeasurement*) is for channel measurement on SSB or NZP CSI-RS 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 1 port NZP CSI-RS with density 3 REs/RB, where each SSB or NZP CSI-RS resource for channel measurement is associated with one CSI-IM resource or one NZP CSI-RS resource for interference measurement by the ordering of the SSB or NZP CSI-RS resource for channel measurement and CSI-IM resource or NZP CSI-RS resource for interference measurement in the corresponding resource sets. The number of SSB(s) or CSI-RS resources for channel measurement equals to the number of CSI-IM resources or the number of NZP CSI-RS resource for interference measurement.

- UE may apply the SSB, or 'typeD' RS configured with *qcl-Type* set to 'typeD' to the NZP CSI-RS resource for channel measurement, as the reference RS for determining 'typeD' assumption for the corresponding CSI-IM resource or the corresponding NZP CSI-RS resource for interference measurement configured for one CSI reporting.

- UE may expect that the NZP CSI-RS resource set for channel measurement and the NZP-CSI-RS resource set for interference measurement, if any, are configured with the higher layer parameter *repetition*.

Eeach LTM CSI Resource Setting *[LTM-CSI-ResourceConfig]* contains configuration of a [*LTM-CSI-SSB-ResourceSet*] which comprises of a list of [Z ≥ 1 SS/PBCH blocks indices (given by [*LTM-csi-SSB-ResourceList*]) and a list of Z [PCI indices] (given by [*LTM-CandidateId-list*]) referring to cells associated with the SS/PBCH block indices. The UE determines the time domain behavior of a SS/PBCH block from *ssb-Periodicity* and *ssb-PositionsInBurst* and the frequency domain behavior of a SS/PBCH block is determined by the higher layer parameters *subcarrierspacing*, *ssbFrequency*.

#### 5.2.1.3 (void)

#### 5.2.1.4 Reporting configurations

The UE shall calculate CSI parameters (if reported) assuming the following dependencies between CSI parameters (if reported)

- LI shall be calculated conditioned on the reported CQI, PMI, RI and CRI

- CQI shall be calculated conditioned on the reported PMI, RI and CRI

- PMI shall be calculated conditioned on the reported RI and CRI

- RI shall be calculated conditioned on the reported CRI.

The Reporting configuration for CSI can be aperiodic (using PUSCH), periodic (using PUCCH) or semi-persistent (using PUCCH, and DCI activated PUSCH). The CSI-RS Resources can be periodic, semi-persistent, or aperiodic. Table 5.2.1.4-1 shows the supported combinations of CSI Reporting configurations and CSI-RS Resource configurations and how the CSI Reporting is triggered for each CSI-RS Resource configuration. Periodic CSI-RS is configured by higher layers. Semi-persistent CSI-RS is activated and deactivated as described in Clause 5.2.1.5.2. Aperiodic CSI-RS is configured and triggered/activated as described in Clause 5.2.1.5.1.

Table 5.2.1.4-1: Triggering/Activation of CSI Reporting for the possible CSI-RS Configurations.

|  |  |  |  |
| --- | --- | --- | --- |
| CSI-RS Configuration | Periodic CSI Reporting | Semi-Persistent CSI Reporting | Aperiodic CSI Reporting |
| Periodic CSI-RS | No dynamic triggering/activation | For reporting on PUCCH, the UE receives an activation command, as described in clause 6.1.3.16 of [10, TS 38.321]; for reporting on PUSCH, the UE receives triggering on DCI | Triggered by DCI; additionally, subselection indication as described in clause 6.1.3.13 of [10, TS 38.321] possible as defined in Clause 5.2.1.5.1. |
| Semi-Persistent CSI-RS | Not Supported | For reporting on PUCCH, the UE receives an activation command, as described in clause 6.1.3.16 of [10, TS 38.321]; for reporting on PUSCH, the UE receives triggering on DCI | Triggered by DCI; additionally, subselection indication as described in clause 6.1.3.13 of [10, TS 38.321] possible as defined in Clause 5.2.1.5.1. |
| Aperiodic CSI-RS | Not Supported | Not Supported | Triggered by DCI; additionally, subselection indication as described in clause 6.1.3.13 of [10, TS 38.321] possible as defined in Clause 5.2.1.5.1. |

When the UE is configured with higher layer parameter *NZP-CSI-RS-ResourceSet* and when the higher layer parameter *repetition* is set to 'off', the UE shall determine a CRI from the supported set of CRI values as defined in Clause 6.3.1.1.2 of [5, TS 38.212] and report the number in each CRI report. When the higher layer parameter *repetition* for a CSI-RS Resource Set for channel measurement is set to 'on', CRI for the CSI-RS Resource Set for channel measurement is not reported. CRI reporting is not supported when the higher layer parameter *codebookType* is set to 'typeII', 'typeII-PortSelection', 'typeII-r16', to 'typeII-PortSelection-r16', or 'typeII-PortSelection-r17'.

For a periodic or semi-persistent CSI report on PUCCH, the periodicity $T\_{CSI}$ (measured in slots) and the slot offset $T\_{offset}$ are configured by the higher layer parameter *reportSlotConfig*. Unless specified otherwise, the UE shall transmit the CSI report in frames with SFN $n\_{f}$ and slot number within the frame $n\_{s,f}^{μ}$ satisfying

 $\left(N\_{slot}^{frame,μ}n\_{f}+n\_{s,f}^{μ}-T\_{offset}\right)mod T\_{CSI}=0$

where $ μ$ is the SCS configuration of the UL BWP the CSI report is transmitted on.

For a semi-persistent CSI report on PUSCH, the periodicity $T\_{CSI}$ (measured in slots) is configured by the higher layer parameter *reportSlotConfig.* Unless specified otherwise, the UE shall transmit the CSI report in frames with SFN $n\_{f}$ and slot number within the frame $n\_{s,f}^{μ}$ satisfying

 $\left(N\_{slot}^{frame,μ}(n\_{f}-n\_{f}^{start}) +n\_{s,f}^{μ}-n\_{s,f}^{start}\right)mod T\_{CSI}=0$

where $n\_{f}^{start}$ and $n\_{s,f}^{start}$ are the SFN and slot number within the frame respectively of the initial semi-persistent PUSCH transmission according to the activating DCI.

For a semi-persistent or aperiodic CSI report on PUSCH, the allowed slot offsets are configured by the following higher layer parameters:

- if triggered/activated by DCI format 0\_2 and the higher layer parameter reportSlotOffsetListDCI-0-2 or *reportSlotOffsetListDCI-0-2-r17* is configured, the allowed slot offsets are configured by reportSlotOffsetListDCI-0-2or *reportSlotOffsetListDCI-0-2-r17*, and

- if triggered/activated by DCI format 0\_1 and the higher layer parameter reportSlotOffsetListDCI-0-1 or *reportSlotOffsetListDCI-0-1-r17* is configured, the allowed slot offsets are configured by reportSlotOffsetListDCI-0-1or *reportSlotOffsetListDCI-0-1-r17,* and

- otherwise, the allowed slot offsets are configured by the higher layer parameter *reportSlotOffsetList* or *reportSlotOffsetList-r17.*

The offset is selected in the activating/triggering DCI.

For CSI reporting, a UE can be configured via higher layer signaling with one out of two possible subband sizes, where a subband is defined as  contiguous PRBs and depends on the total number of PRBs in the bandwidth part according to Table 5.2.1.4-2.

Table 5.2.1.4-2: Configurable subband sizes

|  |  |
| --- | --- |
| **Bandwidth part (PRBs)** | **Subband size (PRBs)** |
| 24 – 72 | 4, 8 |
| 73 – 144 | 8, 16 |
| 145 – 275 | 16, 32 |

The *reportFreqConfiguration* contained in a *CSI-ReportConfig* indicates the frequency granularity of the CSI Report. A CSI Reporting Setting configuration defines a CSI reporting band as a subset of subbands of the bandwidth part, where the *reportFreqConfiguration* indicates:

- the *csi-ReportingBand* as a contiguous or non-contiguous subset of subbands in the bandwidth part for which CSI shall be reported.

- A UE is not expected to be configured with *csi-ReportingBand* which contains a subband where a CSI-RS resource linked to the CSI Report setting has the frequency density of each CSI-RS port per PRB in the subband less than the configured density of the CSI-RS resource.

- If a CSI-IM resource is linked to the CSI Report Setting, a UE is not expected to be configured with *csi-ReportingBand* which contains a subband where not all PRBs in the subband have the CSI-IM REs present.

- wideband CQI or subband CQI reporting, as configured by the higher layer parameter *cqi-FormatIndicator*. When wideband CQI reporting is configured, a wideband CQI is reported for each codeword for the entire CSI reporting band. When subband CQI reporting is configured, one CQI for each codeword is reported for each subband in the CSI reporting band.

- wideband PMI or subband PMI reporting as configured by the higher layer parameter *pmi-FormatIndicator*. When wideband PMI reporting is configured, a wideband PMI is reported for the entire CSI reporting band. When subband PMI reporting is configured, except with 2 antenna ports, a single wideband indication (*i1* in Clause 5.2.2.2) is reported for the entire CSI reporting band and one subband indication (*i2* in clause 5.2.2.2) is reported for each subband in the CSI reporting band. When subband PMIs are configured with 2 antenna ports, a PMI is reported for each subband in the CSI reporting band.

- a UE is not expected to be configured with *pmi-FormatIndicator* if *codebookType* is set to 'typeII-r16' or 'typeII-PortSelection-r16' or 'typeII-PortSelection-r17'.

A CSI Reporting Setting is said to have a wideband frequency-granularity if

- *reportQuantity* is set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI', *cqi-FormatIndicator* is set to 'widebandCQI' and *pmi-FormatIndicator* is set to 'widebandPMI', or

- *reportQuantity* is set to 'cri-RI-PMI-CQI', *codebookType* is set to 'typeII-PortSelection-r17' with $M=1$ and *cqi-FormatIndicator* is set to 'widebandCQI', or

- *reportQuantity* is set to 'cri-RI-i1' or

- *reportQuantity* is set to 'cri-RI-CQI' or 'cri-RI-i1-CQI' and *cqi-FormatIndicator* is set to 'widebandCQI', or

- *reportQuantity* is set to 'cri-RSRP' or 'ssb-Index-RSRP' or 'cri-SINR', or 'ssb-Index-SINR' or 'cri-RSRP-Index' or 'ssb-Index-RSRP-Index' or 'cri-SINR-Index', or 'ssb-Index-SINR-Index'

otherwise, the CSI Reporting Setting is said to have a subband frequency-granularity.

A CSI Reporting Setting with *codebookType* set to 'typeI-SinglePanel' and the corresponding CSI-RS Resource Set for channel measurement configured with two Resource Groups and $N$ Resource Pairs, as described in clause 5.2.1.4.1, can be configured with wideband frequency-granularity only if *csi-ReportMode* is set to 'Mode1' and *numberOfSingleTRP-CSI-Mode1* is set to $X=0$, as described in clause 5.2.1.4.2.

If the UE is configured with a CSI Reporting Setting for a bandwidth part with fewer than 24 PRBs, the CSI reporting setting is expected to have a wideband frequency-granularity, and, if applicable, the higher layer parameter *codebookType* is set to 'typeI-SinglePanel'.

The first subband size is given by  and the last subband size given by  if  and if 

If a UE is configured with semi-persistent CSI reporting, the UE shall report CSIwhen both CSI-IM and NZP CSI-RS resources are configured as periodic or semi-persistent. If a UE is configured with aperiodic CSI reporting, the UE shall report CSIwhen both CSI-IM and NZP CSI-RS resources are configured as periodic, semi-persistent or aperiodic.

A UE configured with DCI format 0\_1 or 0\_2 does not expect to be triggered with multiple CSI reports with the same *CSI-ReportConfigId*.

##### 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.

For a UE configured with *[LTM*-*CSI-ReportConfig],* the aperiodic, semi-persistent or periodic CSI are associated with [one Resource Setting given by [*LTM-resourcesForChannelMeasurement]* for L1-RSRP measurement.

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 $2\leq K\_{s}\leq 8$ resources can be configured with two Resource Groups, with $K\_{1}\geq 1$ resources in Group 1 and $K\_{2}\geq 1$ resources in Group 2, such that $K\_{1}+K\_{2}=K\_{s}$, and with $N\in \{1,2\}$ 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.

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 $K\_{s}>1 $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 $K\_{s}=2 $CSI-RS resources are configured, each resource shall contain at most 16 CSI-RS ports. If $2<K\_{s}\leq 8 $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 $K\_{s}\geq 2$ resources, two Resource Groups with $K\_{1}\geq 1$ resources in Group 1, $K\_{2}\geq 1$ resources in Group 2, $K\_{1}+K\_{2}=K\_{s}$, and $N$ Resource Pairs:

- each resource can contain, subject to UE capability, at most 32 CSI-RS ports. For two Resource Groups with $K\_{i}$ resources (i=1,2), if $max\left\{K\_{1},K\_{2}\right\}=1$, the resource in NZP-CSI-RS-ResourceSet shall contain at most 32 CSI-RS ports; if $ max\left\{K\_{1},K\_{2}\right\}=2$, each resource in NZP-CSI-RS-ResourceSet shall contain at most 16 CSI-RS ports; if $2<max\left\{K\_{1},K\_{2}\right\}<8$, each resource in NZP-CSI-RS-ResourceSet shall contain at most 8 CSI-RS ports.

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

- The *CSI-ReportConfig* may be configured with higher layer parameter *sharedCMR*. $M\_{1}$ and $M\_{2}$ 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 $M=M\_{1}+M\_{2}$, such that the total number of CRI values configured for the *CSI-ReportConfig* is $M+N$.

- If the higher layer parameter *csi-ReportMode* is set to 'Mode1' and the higher layer parameter *numberOfSingleTRP-CSI-Mode1* is set to $X\in \{0\}$, $M\_{1}=M\_{2}=0$; otherwise,

- if the higher layer parameter *csi-ReportMode* is set to 'Mode1' and the higher layer parameter *numberOfSingleTRP-CSI-Mode1* is set to $X\in \{1,2\}$, or if *csi-ReportMode* is set to 'Mode2',

- if *sharedCMR* is configured: $M\_{1}=K\_{1}$ and $M\_{2}=K\_{2}$; 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, $M+N$ resources are configured in the corresponding *csi-IM-ResourceSet*. The $M$ resources for channel measurement defined above are resource-wise associated with the first $M$ CSI-IM resources by the ordering of the CSI-RS resources and CSI-IM resources in the corresponding Resource Set. The $N$ Resource Pairs for channel measurement are associated to the last $N$ 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 $N$ 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 $X\in \{0,1,2\}$, $X+1$ CRI(s) are reported:

- one CRI $k\_{1} \left(k\_{1}\geq 0\right)$ corresponds to the configured $(k\_{1}+1)$-th entry of the associated $N$ Resource Pairs in the corresponding CSI-RS Resource Set for channel measurement, and $(M+k\_{1}+1)$-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 $(k\_{1}+1)$-th Resource Pair, and one CQI; and

- if $X=1$, one CRI $k\_{2}$ ($k\_{2}\geq 0$) corresponds to the configured $(k\_{2}+1)$-th entry of the associated $M$ resources in the corresponding CSI-RS Resource Set for channel measurement, and $(k\_{2}+1)$-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 $k\_{2}$; or

- if $X=2$, one CRI $k\_{2}$ $(k\_{2}\geq 0)$ corresponds to the configured $(k\_{2}+1)$-th entry of the associated $M\_{1}$ resources in Group 1 of the corresponding CSI-RS Resource Set for channel measurement, and $(k\_{2}+1)$-th entry of the associated resources in the corresponding CSI-IM Resource Set, if configured, and one CRI $k\_{3}$ $(k\_{3}\geq 0)$ corresponds to the configured $(k\_{3}+1)$-th entry of the associated $M\_{2}$ resources in Group 2 of the corresponding CSI-RS Resource Set for channel measurement, and $(M\_{1}+k\_{3}+1)$-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 $k\_{2}$ and one RI, one PMI, one LI (if configured) and one or two CQIs conditioned on CRI $k\_{3}$.

- If the higher layer parameter *csi-ReportMode* is set to 'Mode2', one CRI $k\_{1}$ $(k\_{1}\geq 0)$ is reported, which corresponds to the $(k\_{1}+1)$-th entry of the $M+N$ resources or Resource Pairs in the corresponding CSI-RS Resource Set for channel measurement, and $(k\_{1}+1)$-th entry of the associated resources in the corresponding CSI-IM Resource Set, if configured. The first $M$ codepoints of the CRI correspond to resources associated to Group 1 and Group 2. The last $N$ codepoints of the CRI correspond to the $N$ configured Resource Pairs. The UE shall report one RI, one PMI, one LI, if configured, and one or two CQIs conditioned on CRI $k\_{1}$ if $k\_{1}<M$; 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 $(k\_{1}-M+1)$-th Resource Pair, and one CQI, otherwise.

- For a reported CRI corresponding to an entry of the $N$ 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: $\left\{1,1\right\}, \left\{1,2\right\}, \left\{2,1\right\}, \{2,2\}$.

- 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 $M$ 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 $N$ 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* 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 $N$ Resource Pairs, and the UE reports a CRI associated to a Resource Pair, and a rank combination $\{ν\_{1},ν\_{2}\}$, the first LI indicates which column of the precoder matrix of the first reported PMI corresponds to the strongest of the first $ν\_{1}$ 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 $ν\_{2}$ 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.

If a UE is configured with a [*LTM-CSI-ReportConfig*],

- if the UE is configured with [*SpCellInclusion* set to ‘enabled’], the UE shall report in a single reporting instance [*noOfReportedRSPerCell different SSBRI* for the current SpCell and each of the *nrofReportedCells -1* cells].Otherwise, the UE shall report in a single reporting instance *[noOfReportedRSPerCell]* different SSBRI for each of the *[noOfReportedCell]* cells.

- where SSBRI *k* (*k* ≥ 0) corresponds to the configured (*k*+1)-th entry of the associated [*LTM-csi-SSB-ResourceList*] in the corresponding[*LTM-CSI-SSB-ResourceSet*]*.*

##### 5.2.1.4.3 L1-RSRP Reporting

For L1-RSRP computation

- the UE may be configured with CSI-RS resources, SS/PBCH Block resources or both CSI-RS and SS/PBCH block resources, when resource-wise quasi co-located with 'type C' and 'typeD' when applicable.

- the UE may be configured with CSI-RS resource setting up to 16 CSI-RS resource sets having up to 64 resources within each set. The total number of different CSI-RS resources over all resource sets is no more than 128.

For L1-RSRP reporting, if the higher layer parameter *nrofReportedRS* in *CSI-ReportConfig* is configured to be one, or if the higher layer parameters [*noOfReportedCells*] and [*noOfReportedRSPerCell*] are both configured to be one, the reported L1-RSRP value is defined by a 7-bit value in the range [-140, -44] dBm with 1dB step size, if the higher layer parameter *nrofReportedRS* is configured to be larger than one, or if the higher layer parameter *groupBasedBeamReporting* is configured as 'enabled', or if the higher layer parameter *groupBasedBeamReporting-r17* is configured*,* or if any of the higher layer parameters [*noOfReportedCells*] and [*noOfReportedRSPerCell*] is configured to be larger than one, the UE shall use differential L1-RSRP based reporting, where the largest measured value of L1-RSRP is quantized to a 7-bit value in the range [-140, -44] dBm with 1dB step size, and the differential L1-RSRP is quantized to a 4-bit value. The differential L1-RSRP value is computed with 2 dB step size with a reference to the largest measured L1-RSRP value which is part of the same L1-RSRP reporting instance. The mapping between the reported L1-RSRP value and the measured quantity is described in [11, TS 38.133].

When the higher layer parameter *groupBasedBeamReporting-r17*in *CSI-ReportConfig* is configured, the UE shall indicate the CSI Resource Set associated with the largest measured value of L1-RSRP, and for each group, CRI or SSBRI of the indicated CSI Resource Set is present first.

If the higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to "*notConfigured*", the UE shall derive the channel measurements for computing L1-RSRP value reported in uplink slot *n* based on only the SS/PBCH or NZP CSI-RS, no later than the CSI reference resource, (defined in TS 38.211[4]) associated with the CSI resource setting.

If the higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to "*Configured*", the UE shall derive the channel measurements for computing L1-RSRP reported in uplink slot *n* based on only the most recent, no later than the CSI reference resource, occasion of SS/PBCH or NZP CSI-RS (defined in [4, TS 38.211]) associated with the CSI resource setting.

When the UE is configured with *SSB-MTC-AddtionalPCI*, a CSI-SSB-ResourceSet configured for L1-RSRP reporting includes one set of SSB indices and one set of PCI indices, where each SSB index is associated with a PCI index.

When the UE is configured with a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to ' cri-RSRP- Index' or 'ssb-Index-RSRP- Index' an index of UE capability value set, indicating the maximum supported number of SRS antenna ports, is reported along with the pair of SSBRI/CRI and L1-RSRP.

##### 5.2.1.4.4 L1-SINR Reporting

For L1-SINR computation, for channel measurement the UE may be configured with NZP CSI-RS resources and/or SS/PBCH Block resources, for interference measurement the UE may be configured with NZP CSI-RS or CSI-IM resources.

- for channel measurement, the UE may be configured with CSI-RS resource setting with up to 16 resource sets, with a total of up to 64 CSI-RS resources or up to 64 SS/PBCH Block resources.

For L1-SINR reporting, if the higher layer parameter *nrofReportedRS* in *CSI-ReportConfig* is configured to be one, the reported L1-SINR value is defined by a 7-bit value in the range [-23, 40] dB with 0.5 dB step size, and if the higher layer parameter *nrofReportedRS* is configured to be larger than one, or if the higher layer parameter *groupBasedBeamReporting* is configured as 'enabled', the UE shall use differential L1-SINR based reporting, where the largest measured value of L1-SINR is quantized to a 7-bit value in the range [-23, 40] dB with 0.5 dB step size, and the differential L1-SINR is quantized to a 4-bit value. The differential L1-SINR is computed with 1 dB step size with a reference to the largest measured L1-SINR value which is part of the same L1-SINR reporting instance. When NZP CSI-RS is configured for channel measurement and/or interference measurement, the reported L1-SINR values should not be compensated by the power offset(s) given by higher layer parameter *powerControOffsetSS* or *powerControlOffset*.

When one or two resource settings are configured for L1-SINR measurement

- If the higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to *'notConfigured'*, the UE shall derive the channel measurements for computing L1-SINR reported in uplink slot n based on only the SSB or NZP CSI-RS, no later than the CSI reference resource, (defined in TS 38.211[4]) associated with the CSI resource setting.

- If the higher layer parameter *timeRestrictionForChannelMeasurements* in *CSI-ReportConfig* is set to *'configured'*, the UE shall derive the channel measurements for computing L1-SINR reported in uplink slot n based on only the most recent, no later than the CSI reference resource, occasion of SSB or NZP CSI-RS (defined in [4, TS 38.211]) associated with the CSI resource setting.

- If the higher layer parameter *timeRestrictionForInterferenceMeasurements* in *CSI-ReportConfig* is set to *'notConfigured'*, the UE shall derive the interference measurements for computing L1-SINR reported in uplink slot n based on only the CSI-IM or NZP CSI-RS for interference measurement (defined in [4, TS 38.211]) or NZP CSI-RS for channel and interference measurement no later than the CSI reference resource associated with the CSI resource setting.

- If the higher layer parameter *timeRestrictionForInterferenceMeasurements* in *CSI-ReportConfig* is set to *'configured'*, the UE shall derive the interference measurements for computing the L1-SINR reported in uplink slot n based on the most recent, no later than the CSI reference resource, occasion of CSI-IM or NZP CSI-RS for interference measurement (defined in [4, TS 38.211]) or NZP CSI-RS for channel and interference measurement associated with the CSI resource setting.

When the UE is configured a *CSI-ReportConfig* with the higher layer parameter *reportQuantity* set to ' cri-SINR- Index' or 'ssb-Index-SINR- Index' an index of UE capability value, indicating the maximum supported number of SRS antenna ports, is reported along with the pair of SSBRI/CRI and L1-SINR.

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