**3GPP TSG-RAN WG1 Meeting #116bis  R1-240xxxx**

**Changsha, China, 15 – 19 April, 2024**

**Agenda Item: 8.4**

**Source: Moderator (Huawei)**

**Title: FLS#1 for maintenance of SD-PD adaptation R18 NES**

**Document for: Discussion and decision**

# Introduction

This document contains discussion summarized for maintenance of spatatial and power domain adaptataion for R18 NES.

# Recommandation for online

[Tbd]

# Discussion

1. **RRC parameters related**

Google

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| ***Reason for change:*** | Currently the *CSI-ReportSubConfig* is defined as follows. The NW can configure a codebook sub-configuration based on codebookConfig, where the NW can configure the configuration of N1, N2, Ng, RI-restriction and codebook mode. However, in current 38.214, the description on codebook mode is missing. Then it is unclear whether UE should calculate the CSI sub-report based on the codebook mode configured in the *codebookSubConfig* or *codebookConfig*.  CSI-ReportSubConfig-r18 ::= SEQUENCE {  reportSubConfigId-r18 CSI-ReportSubConfigId-r18,  reportSubConfigParams CHOICE {  a1-parameters SEQUENCE {  codebookSubConfig-r18 CodebookConfig OPTIONAL, -- Need R  portSubsetIndicator-r18 CHOICE {  p2 BIT STRING (SIZE (2)),  p4 BIT STRING (SIZE (4)),  p8 BIT STRING (SIZE (8)),  p12 BIT STRING (SIZE (12)),  p16 BIT STRING (SIZE (16)),  p24 BIT STRING (SIZE (24)),  p32 BIT STRING (SIZE (32))  } OPTIONAL, -- Need R  non-PMI-PortIndication-r18 PortIndexFor8Ranks OPTIONAL -- Need R  },  a2-parameters SEQUENCE {  nzp-CSI-RS-ResourceList-r18 SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourcesPerSet)) OF NZP-CSI-RS-ResourceIndex-r18  }  } OPTIONAL, -- Need R  powerOffset-r18 INTEGER(0..23) OPTIONAL -- Need R  } |
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| ***Summary of change:*** | * Clarify the UE should calculate the CSI sub-report based on the codebook mode configured in the *codebookSubConfig*, and correct the RRC parameter name for CSI report sub-configuration. |
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| ***Consequences if not approved:*** | * It is unclear whether UE should calculate the CSI sub-report based on the codebook mode configured in the *codebookSubConfig* or *codebookConfig*, and the RRC parameter name is not aligned with 38.331. |

Ericsson

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| ***Reason for change:*** | Some higher layer parameter names for spatial/power domain adaptation based on sub-configurations are not aligned (i.e. are incorrect and/or in square brackets) with those used in RRC specification.  Parts of a sentence in subclause 5.2.1.5.2 related to for spatial/power domain adaptation based on sub-configurations are in square brackets.  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]. |
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| ***Summary of change:*** | Correct the higher layer parameter names to align with RRC specification.  Update the sentence in subclause 5.2.1.5.2 as follows :  For a selected reporting setting for which the *CSI-ReportConfig* contains a list of sub-configurations provided by the higher layer parameter *csi-ReportSubConfigToAddModList*, 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]. |
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| ***Consequences if not approved:*** | Incorrect specification. |

Nokia, NSB

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| Observation 1: Parameter field description about *a1-parameter* and *a2-parameter* were not captured appropriately in the RRC specification.  Proposal 1: Add parameter field description about *a1-parameter* and *a2-parameter* in the RRC specification.  Observation 2: Rel-15 *CodebookConfig* IE definition contains all the parameters needed for a1-parameter case and are mandatory parameters except for *typeISinglePanel-codebookSubsetRestriction-i2*.  Proposal 2: It is proposed to add further information in the field description of *codebookSubConfig*, and state that for the case when reportQuantity is set to 'cri-RI-i1-CQI', the parameter *typeISinglePanel-codebookSubsetRestriction-i2* is mandatory to be configured in the *CodebookConfig* included for each sub-configuration that includes port-SubsetIndicator.  Proposal 3: Send an LS to RAN2 providing clarity on the a1-parameters in *codebookSubConfig*. |

ZTE

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| ***Reason for change:*** | 1. In NR, each Reporting Setting *CSI-ReportConfig* is associated *CSI-ResourceConfig* for channel measurement, which means a sub-configuration in a CSI report configuration always corresponds to one or more CSI-RS resource for channel measurement even if the sub-configuration is not configured with [*nzp-CSI-RS-ResourceList*]. Therefore, the wording “sub-configuration corresponds to a list of one or more CSI-RS resources” is not equivalent to a sub-configuration which is configured with [*nzp-CSI-RS-ResourceList*]. |
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| ***Summary of change:*** | 1. Add the corresponding high layer parameter for the sub-configuration when a *CSI-ReportConfig* is configured with one or more sub-configurations. |
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| ***Consequences if not approved:*** | 1. The definition of sub-configuration is unclear. |

To align with RAN2 specifications as well as with previous RAN1 agreements, a joint draftCR is provided below, merging the changes suggested from Google, Ericsson, Nokia/NSB (about mandating *typeI-SinglePanel-codebookSubsetRestriction-i2*) and ZTE (about the correspondency of RRC parameters).

**###### Proposal 1-1**

**Agree on the following joint draftCR on corrections on relevant RRC parameters.**



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| **Company** | **Comments** |
| **ZTE, Sanechips** | OK with the draftCR. |
| **Samsung** | We are generally fine with the CR.  In addition, similar to *typeI-SinglePanel-codebookSubsetRestriction-i2*, the following change should be applied to *codebookMode*, (also a typo is corrected by adding “and”):  - If a sub-configuration is configured with an antenna port subset, and if the *CSI-ReportConfig* that contains a mix of sub-configuration(s) each corresponding to 'typeI-SinglePanel' and some other sub-configuration(s) each corresponding to 'typeI-MultiPanel', then the sub-configuration(s) ~~can be~~ is configured with the higher layer parameter *codebookMode.* |
| **LG Electronics** | Support Proposal 1-1 and Samsung’s proposal is also OK. |

**###### Proposal 1-2**

* **For *a1-parameters* in TS 38.331, the field description is:**
* **Parameters for configuration of Type 1 spatial domain adaptation. The network configures at least one of *a1-parameters* and *a2-parameters* in *CSI-ReportSubConfig*.**
* **For *a2-parameters* in TS38.331, the field description is:**
* **Parameters for configuration of Type 2 spatial domain adaptation. The network configures at least one of *a1-parameters* and *a2-parameters* in *CSI-ReportSubConfig*.**
* **For *codebookSubConfig* in TS38.331, add in the field description that for the case when *reportQuantity* set to 'cri-RI-i1-CQI', the parameter *typeI-SinglePanel-codebookSubsetRestriction-i2* is mandatory to be configured in the *CodebookConfig* included for each sub-configuration that includes *portSubsetIndicator*.**
* **Send LS to RAN2 to clarify the above.**

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| **Company** | **Comments** |
| **ZTE, Sanechips** | For PD only case, there is no need to configure a1 and a2 parameters. Thus, the following is proposed:   * **For *a1-parameters* in TS 38.331, the field description is:** * **Parameters for configuration of Type 1 spatial domain adaptation. ~~The network configures at least one of~~ *~~a1-parameters~~* ~~and~~ *~~a2-parameters~~* ~~in~~ *~~CSI-ReportSubConfig~~*~~.~~** * **For *a2-parameters* in TS38.331, the field description is:** * **Parameters for configuration of Type 2 spatial domain adaptation. ~~The network configures at least one of~~ *~~a1-parameters~~* ~~and~~ *~~a2-parameters~~* ~~in~~ *~~CSI-ReportSubConfig~~*~~.~~** |
| **Samsung** | For *typeI-SinglePanel-codebookSubsetRestriction-i2*, the red texts are added as follows for the alignment with the conditions specified in TS 38.214:  **For *codebookSubConfig* in TS38.331, add in the field description that for the case when *reportQuantity* set to 'cri-RI-i1-CQI' and if the higher layer parameter *codebookType* is set to 'typeI-SinglePanel'**, **the parameter *typeI-SinglePanel-codebookSubsetRestriction-i2* is mandatory to be configured in the *CodebookConfig* included for each sub-configuration that includes *portSubsetIndicator*.**  Similar as the comment on proposal 1-1, the following statement should be added for *codebookMode*:  **For *codebookSubConfig* in TS38.331, add in the field description that for the case if the *CSI-ReportConfig* that contains a mix of sub-configuration(s) each corresponding to 'typeI-SinglePanel' and some other sub-configuration(s) each corresponding to 'typeI-MultiPanel', the parameter *codebookMode* is mandatory to be configured in the *CodebookConfig* included for each sub-configuration that includes *portSubsetIndicator*.** |
| **LG Electronics** | We wonder if sending LS to RAN2 is necessary.   * The third bullet point is already captured in TS 38.214. So, if it is added to 331 spec, it seems duplicated. * Description relevant to the first and second bullet points has been sent to RAN2 in the previous LS of RRC parameter spreadsheet. In addition, such restriction is captured in 214 spec (i.e., “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.”). |

1. **Power scaling for Type 1 SD due to definition of powerControlOffset**

Samsung

In case of Type 1 SD adaptation without PD adaptation (i.e., a sub-configuration is configured with *port-subsetIndicator* and without the indication of *powerOffset*), for CQI calculation for the sub-configuration according to 38.214-i20, *powerControlOffset* is directly used for the UE assumption of EPRE between PDSCH and CSI-RS.

However, this is incorrect. The key issue is that the total number of ports for each report PMI (sub-configuration) in a CSI report is different due to the corresponding port subset indications. If the EPRE ratio between PDSCH and CSI-RS for the same CSI-RS resource is assumed to be constant across different sub-configurations (i.e., different total PDSCH ports), it actually results in spatial adaptation (antenna port muting) as well as power adaptation (antenna port level power adjustment) at the same time.

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| **Conclusion (RAN1#96bis)**  It is common understanding in RAN1 that:   * The *powerControlOffset* (“Pc”) ratio is defined as  dB * Where   + - *PPDSCH* is the energy of total PDSCH ports multiplexed on one subcarrier of one OFDM symbol     - *PCSIRS* is the energy of all CSI-RS ports multiplexed on one subcarrier of one OFDM symbol |

Based on the RAN1 conclusion in RAN1#96bis, the definition of *powerControlOffset* is cited above. Assuming that all resource within CMR set share the same CDM group, the denominator of the equation (i.e., PCSIRS) for all sub-configuration is the same across different sub-configurations. Also, since *powerControlOffset* is constant, the nominator of the equation (i.e., PPDSCH) is also the same across different sub-configurations. By definition, PPDSCH = P\*PPDSCH, port, where PPDSCH is the energy of total PDSCH ports multiplexed on one subcarrier of one OFDM symbol, PPDSCH, port is the energy of a PDSCH port on one subcarrier of one OFDM symbol and P is the number of ports within port subset indicated by *portSubsetIndicator*. Assuming PPDSCH, port = PPDSCH / P and PPDSCH is constant (indicated by *powerControlOffset*), PPDSCH, port actually linearly scales with 1/P. This is problematic since it mandates spatial adaptation (antenna port muting) to be tied with power domain adaptation (antenna port level power adaptation).

To address this issue, a simple solution is to add a power scaling factor to PDSCH EPRE assumption subject to each sub-configuration. For a sub-configuration, the EPRE ratio between PDSCH and CSI-RS is assumed to be *powerControlOffset* +10log10(P/P0) instead of *powerControlOffset*, where P0 is the number of ports configured by *nrofPorts*. For example, a CMR set consist of a CSI-RS resource of 32 ports (by *nrofPorts*) and *powerControlOffset*, and two sub-configurations (sub-config#1 and sub-config#2) are associated with 32 ports and 16 ports, respectively. For CQI calculation of sub-config#1, *powerControlOffset* is assumed since P = P0, which is consistent with the CQI calculation using full CSI-RS ports. For CQI calculation of sub-config#2, *powerControlOffset* – 3dB is assumed since P = 0.5P0.

**Reason for change:** The UE assumption of EPRE ratio between PDSCH and CSI-RS for CQI calculation is incorrect when the port subset indicated by *portSubsetIndicator* and *powerOffset* is not indicated for the sub-configuration.

**Summary of change:** The UE assumption of EPRE ratio between PDSCH and CSI-RS for CQI calculation scales with the number of ports within indicated port subset when the port subset is indicated by *portSubsetIndicator* and *powerOffset* is not indicated for the sub-configuration.

**Consequences if not approved:** Incorrect UE assumption of EPRE ratio between PDSCH and CSI-RS for CQI calculation when the port subset indicated by *portSubsetIndicator* and *powerOffset* is not indicated for the sub-configuration.

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| **TP for TS 38.214 Clause 5.2.2.5.1 UE assumptions for CQI/PMI/RI calculation**  <omitted texts>  - For a UE configured with a *CSI-ReportConfig* that contains a list of sub-configurations provided by [*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, antenna ports corresponding to all bits with value of 1 in [*port-subsetIndicator*] are mapped to consecutive antenna ports starting at CSI-RS antenna port 3000 in increasing order of the bit position in [*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, …, 3000+P-1] *T*, as given by  where *P* corresponds to the number of bits with value 1 in the bitmap *[port-subsetIndicator]* 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 CSI-RS antenna port subset using the higher layer bitmap parameter *portSubsetIndicator* and does not indicate a power offset *powerOffset*,for CQI calculation for the sub-configuration, 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 summation of*powerControlOffset* of the CSI-RS resource and , where *P* is the number of antenna ports corresponding to all bits with value of 1 in the *portSubsetIndicator*, *P*0 is the number of ports configured by *nrofPorts* of the CSI-RS resource.  - 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 texts> |

**###### Proposal 2**

**Discuss the above proposal/TP on power scaling for Type 1 SD without PD adaptation, for TS38.214.**

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| **Company** | **Comments** |
| **ZTE, Sanechips** | Not support.  The *powerControlOffset* is the assumed ratio of PDSCH EPRE to NZP CSI-RS EPRE. For type 1 SD adaptation, the CSI-RS resource is common resource, and the NZP CSI-RS EPRE will not change.Thus, we think the powerControlOffset will not be impact by Type 1 SD adaptation. |
| **Samsung** | Support the TP.  As the discussion text above pointed out, the *powerControlOffset* is defined as the ratio of PDSCH EPRE **(for total PDSCH ports i.e., all ports within indicated port subset)** to NZP CSI-RS EPRE. In case of type 1 SD adaptation, the number of indicated ports within port subset are different across sub-configurations. The use of common *powerControlOffset* for all sub-configuration will result in port-level power adaptation, which is not the intention of Type 1 SD without PD adaptation. |
| **LG Electronics** | We are open to discuss this issue. But we have one question for better understanding.  It seems the proponent assumes that the denominator (i.e., *PCSIRS*) in the previous RAN1 conclusion is constant. However, couldn’t it be varied depending on port subset indicator? For example, assuming 8-port CSI-RS as shown in the following figure, there could be two patterns to mute 4 antenna ports out of 8 ports:   * Pattern 1: All antenna ports corresponding to CDM-0 are muted, i.e., ports 3000, 3001, 3002, and 3003 are muted. * Pattern 2: Antenna ports corresponding to parts of CDM-0 and CDM-1 are muted, i.e., ports 3001, 3003, 3005, and 3007 are muted.     For pattern 1, it seems obvious that the denominator (i.e., *PCSIRS*) of 8-ports is the same as that of 4-ports, as the energy of all CSI-RS ports multiplexed on one subcarrier of one OFDM symbol the same.  On the other hand, for pattern 2, the denominator (i.e., *PCSIRS*) of 8-ports is the same as that of 4-ports? Or, the denominator (i.e., *PCSIRS*) of 8-ports is twice as much as that of 4-ports? |

1. **CSI reference resource definition and relevant dropping**

ZTE

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| ***Reason for change:*** | 1. In previous RAN1 meetings, the conditions of dropping CSI report when CSI report configuration containing a list of sub-configurations were discussed and captured. However, the case when both cell DTX and CSI report configuration containing a list of sub-configurations are configured is missed and should be resolved. |
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| ***Summary of change:*** | 1. When cell DTX of is activated, the condition of dropping CSI report when a CSI report configuration containing a list of sub-configurations is specified. |
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| ***Consequences if not approved:*** | 1. UE may need to report CSI report for a sub-configuration even no CSI-RS transmission occasion is available for the sub-configuration. |

**###### Proposal 3**

**Discuss the following TP for TS38.214.**

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| 5.2.2.5 CSI reference resource definition  **<Unchanged parts are omitted>**  For the CSI report configuration in CSI-*ReportConfig* associated with the higher layer parameter *reportQuantity* comprising at least 'RI', the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion of each periodic CSI-RS resource or semi-persistent CSI-RS resource on a serving cell with cell DTX activated [10, TS 38.321] for channel measurement and/or interference measurement in active periods of cell DTX of the serving cell no later than CSI reference resource, and the UE drops the CSI report otherwise. For a CSI report configuration containing a list of sub-configurations provided by *csi-ReportSubConfigList*, the UE reports a CSI report only if receiving at least one CSI-RS transmission occasion of each periodic CSI-RS resource or semi-persistent CSI-RS resource on a serving cell with cell DTX activated [10, TS 38.321] for channel measurement and/or interference measurement in active periods of cell DTX of the serving cell, per sub-configuration, no later than CSI reference resource, and the UE drops the CSI report otherwise, where the sub-configuration is the activated/triggered one for AP/SP-CSI reporting, or the configured one for P-CSI reporting.  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.  **<Unchanged parts are omitted>** |

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| **Company** | **Comments** |
| **ZTE, Sanechips** | Support this CR.  In RAN1#116 meeting, the conditions of dropping CSI report when CSI report configuration containing a list of sub-configurations were discussed and captured, except the case when cell DTX is configured. Thus, we propose to support this CR. |
| **Samsung** | Support. |
| **LG Electronics** | This TP seems to be also captured in cell DTX/DRX related summary 😊.  We have one minor suggest as follows (considering the commonality with other paragraphs as previously agreed).  For a CSI report configuration containing a list of sub-configurations provided by *csi-ReportSubConfigList*, the UE reports a CSI report including one or more sub-reports only if receiving at least one CSI-RS transmission occasion of each periodic CSI-RS resource or semi-persistent CSI-RS resource on a serving cell with cell DTX activated [10, TS 38.321] for channel measurement and/or interference measurement in active periods of cell DTX of the serving cell, per sub-configuration, no later than CSI reference resource, and the UE drops the CSI report otherwise, where the sub-configuration is the activated/triggered one for AP/SP-CSI reporting, or the configured one for P-CSI reporting. |

1. **CSI-RS resource/port counting**

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| 42-1a | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration. | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4} |
| 42-1c | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration. | Component 2 candidate values: {2,3,4}  Component 3 candidate values: {2,3,4} |
| 42-1b | Spatial domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values {2,3,4} |
| 42-2a | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUSCH | 1. The max number of sub-configurations Lmax in one CSI report configuration on PUSCH  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration. | Component 1 candidate values: {2,3,4,5,6,7,8}  Component 2 candidate values: {2,3,4} |
| 42-2c | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for semi-persistent CSI reporting on PUCCH | 1. The max number of sub-configurations Lmax in one CSI report configuration  2. Report of N CSI sub-report(s) included in one SP-CSI report where each CSI sub-report corresponds to one sub-configuration. | Component 1 candidate values: {2,3,4}  Component 2 candidate values: {2,3,4} |
| 42-2b | Power domain adaptation with CSI feedback based on CSI report sub-configuration(s) for aperiodic CSI reporting | 2. The max number of sub-configurations Lmax in one CSI report configuration  3. Report of N CSI sub-report(s) included in one CSI report where each CSI sub-report corresponds to one sub-configuration | Component 2 candidate values: {2,3,4,5,6,7,8}  Component 3 candidate values: {2,3,4} |

In RAN1#116 meeting [1], it was agreed that UE separately reports the maximum number of *K* CSI sub-reports included in a single semi-persistent or aperiodic CSI report and the value range of *K* is {2, 3, 4}, as highlighted above.

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| **5.2.1.6 CSI processing criteria**  <Omitted>  For a *CSI-ReportConfig* containing a list of *L* sub-configuration(s) provided by higher layer parameter *csi-ReportSubConfigList,* if a CSI-RS resource is referred by *M* sub-configurations among *N* triggered sub-configurations for CSI reporting for aperiodic CSI-RS resource, or *L* configured sub-configurations for CSI reporting for periodic or semi-persistent CSI-RS resource, the CSI-RS resource is counted *M* times and the CSI-RS ports within the CSI-RS resource are counted , where *P* is the number of ports configured by *nrofPorts* and is the number of CSI-RS ports in *s*-th sub-configuration from *M* sub-configurations derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise . |

Following the current 214 specification above, CSI-RS resource/port counting rule is defined based on *L* configured sub-configurations for CSI reporting for P/SP CSI-RS resource. This is because a UE is not able to be aware of how many sub-configurations will be activated/triggered via MAC-CE/DCI when the UE receives P/SP CSI-RS resource. However, if the UE reports *K* (=the maximum number of CSI sub-reports included in a single semi-persistent or aperiodic CSI report) that is less than *L*, CSI-RS resource/port counting rule based on *L* configured sub-configurations can be improved, since UE indicating *K* as UE capability already knows that at most *K* out of *L* sub-configurations will be activated/triggered via MAC-CE/DCI.

**###### Proposal 4**

**For a periodic or semi-persistent CSI-RS resource configured with semi-persistent or aperiodic CSI reporting, the number of CSI-RS resource/port is counted based on minimum of *M* and *K* (instead of based on *M* as in current 214 specification), where *K* is the maximum number of CSI sub-reports included in a CSI report configuration (subject to UE capability) and *M* is defined as in TS38.214.**

* **If agreeable, endorse one of the TP-1 and TP-2**
* TP-1

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| **Reason for Change:**   * For a periodic or semi-persistent CSI-RS resource configured with semi-persistent or aperiodic CSI reporting, the current CSI-RS resource/port counting rule is based on referred *M* sub-configurations amoung *L* configured sub-configurations. If a UE reports the maximum number (=*K*) of CSI sub-reports included in a CSI report configuration (subject to UE capability) as the value smaller than *M*, the UE has to count unnecessarily large number of CSI-RS resource/port although more than *K* sub-configuraitons can not be activated/triggered.   **Summary of Change:**   * For a periodic or semi-persistent CSI-RS resource configured with semi-persistent or aperiodic CSI reporting,   + The CSI-RS resource is counted as minumum of *M* and *K*.   + The CSI-RS ports within the CSI-RS resource are counted , where is the total number of CSI-RS ports in the min(*M*, *K*) sub-configurations resulting with the largest value among *M* sub-configurations.   **Consequences if not approved:**   * The UE may count unnecessarily large number of CSI-RS resources/ports although more than *K* sub-configuraitons can not be activated/triggered.   **5.2.1.6 CSI processing criteria**  <Unchanged texts omitted>  For a *CSI-ReportConfig* containing a list of *L* sub-configuration(s) provided by higher layer parameter *csi-ReportSubConfigList,* if a CSI-RS resource is referred by *M* sub-configurations among *N* triggered sub-configurations for CSI reporting for aperiodic CSI-RS resource, or *L* configured sub-configurations for CSI reporting for periodic or semi-persistent CSI-RS resource, the CSI-RS resource is counted min(*M*, *K*) times and the CSI-RS ports within the CSI-RS resource are counted , where is the total number of in the min(*M*, *K*) sub-configurations resulting with the largest value among *M* sub-configurations, *K* is the maximum number of CSI sub-reports included in one CSI report subject to UE capability if the CSI-RS resource is periodic or semi-persistent and configured for semi-persistent or aperiodic CSI reporting, otherwise , *P* is the number of ports configured by *nrofPorts* and is the number of CSI-RS ports in *s*-th sub-configuration from *M* sub-configurations derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise . |

* TP-2

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| **Reason for Change:**   * For a periodic or semi-persistent CSI-RS resource configured with semi-persistent or aperiodic CSI reporting, the current CSI-RS resource/port counting rule is based on referred *M* sub-configurations amoung *L* configured sub-configurations. If a UE reports the maximum number (=*K*) of CSI sub-reports included in a CSI report configuration (subject to UE capability) as the value smaller than *M*, the UE has to count unnecessarily large number of CSI-RS resource/port although more than *K* sub-configuraitons can not be activated/triggered.   **Summary of Change:**   * For a periodic or semi-persistent CSI-RS resource configured with semi-persistent or aperiodic CSI reporting,   + The CSI-RS resource is counted as minumum of *M* and *K*.   + The CSI-RS ports within the CSI-RS resource are counted .   + In order to guarantee that results in the largest value that can be obtained by using any configurations, the number of antenna ports of the subset corresponding to n-th sub-configuration is not less than the number of antenna ports of the subset corresponding to (n+1)-th sub-configuration.   **Consequences if not approved:**   * The UE may count unnecessarily large number of CSI-RS resource/port although more than *K* sub-configuraitons can not be activated/triggered.   **5.2.1.4.2 Report quantity configurations**  <Unchanged texts omitted>  If the UE is configured with a *CSI-ReportConfig* that contains a list of sub-configurations, provided by [*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 a *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. For the derivation of PMI, antenna ports corresponding to all bits with value of 1 in [*port-subsetIndicator*] are mapped to consecutive antenna ports starting at CSI-RS antenna port 3000 in increasing order of the bit position in [*port-subsetIndicator*].  - 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. If a sub-configuration is configured with an antenna port subset, and if higher layer parameter *reportQuantity* is set to 'cri-RI-i1-CQI', and if the higher layer parameter *codebookType* is set to 'typeI-SinglePanel', then the sub-configuration can be configured with higher layer parameter *typeI*-*SinglePanel-codebookSubsetRestriction-i2*, where *typeI*-*SinglePanel-codebookSubsetRestriction-i2* is as described in Clause 5.2.2.2.1.  - If a sub-configuration is configured with an antenna port subset, and if the *CSI-ReportConfig* that contains a mix of sub-configuration(s) each corresponding to 'typeI-SinglePanel' some other sub-configuration(s) each corresponding to 'typeI-MultiPanel', then the sub-configuration(s) can be configured with the higher layer parameter *codebookMode.*  - If a sub-configuration is configured with an antenna port subset, the number of antenna ports of the subset corresponding to *n*-th sub-configuration is not less than the number of antenna ports of the subset corresponding to (*n*+1)-th sub-configuration.  <Unchanged texts omitted>  **5.2.1.6 CSI processing criteria**  <Unchanged texts omitted>  For a *CSI-ReportConfig* containing a list of *L* sub-configuration(s) provided by higher layer parameter *csi-ReportSubConfigList,* if a CSI-RS resource is referred by *M* sub-configurations among *N* triggered sub-configurations for CSI reporting for aperiodic CSI-RS resource, or *L* configured sub-configurations for CSI reporting for periodic or semi-persistent CSI-RS resource, the CSI-RS resource is counted min(*M*, *K*) times and the CSI-RS ports within the CSI-RS resource are counted , where *K* is the maximum number of CSI sub-reports included in one CSI report subject to UE capability if the CSI-RS resource is periodic or semi-persistent and configured for semi-persistent or aperiodic CSI reporting, otherwise , *P* is the number of ports configured by *nrofPorts* and is the number of CSI-RS ports in *s*-th sub-configuration from *M* sub-configurations derived from the corresponding antenna port subset indicator [*port-subsetIndicator*] according to clause 5.2.1.4.2 if configured, otherwise . |

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No, or Preferred TP** | **Comments** |
| **ZTE, Sanechips** | No | This issue has been discussed many times in previous meetings. Usually, gNB will not configure the number of sub-configurations beyond the UE capability. Thus, we think this CR is not needed. |
| **Samsung** |  | Open to further disucss. But the proponent should clarify the intention of adding the following texts:  “If a sub-configuration is configured with an antenna port subset, the number of antenna ports of the subset corresponding to *n*-th sub-configuration is not less than the number of antenna ports of the subset corresponding to (*n*+1)-th sub-configuration.” |
| **LG Electronics** | Yes as the proponent | **@ ZTE,**  We have a totally different understanding on the use case of indicating max. N (i.e., the number of activated/triggered sub-configs) smaller than Lmax (i.e., the number of configured sub-configs). We believe usually gNB configures L sub-configs (larger than N reported by UE) and activates/triggeres up to N sub-configs. Otherwise, the motivation to separately report max. N and Lmax is quite unclear.  **@ Samsung,**  Thanks for the question.  As explained in “**Summar of Change**” in TP-2, this is to guarantee that results in the largest value that can be obtained by using any configurations, the number of antenna ports of the subset corresponding to n-th sub-configuration is not less than the number of antenna ports of the subset corresponding to (n+1)-th sub-configuration.  For example, without that kind of limitation, if *min(M, K)* equals to 2, the largest summation of antenna ports from two sub-configs is obtained by Sub-config #1 and Sub-config #4 (i.e., involved sub-config indexes could be arbitrary depending on gNB’s configuration).   * Sub-config #1: 16 antenna ports * Sub-config #2: 2 antenna ports * Sub-config #3: 4 antenna ports * Sub-config #4: 8 antenna ports   On the other hand, with that kind of limitation, as long as the first two sub-configs are taken, we can easily obtain the largest summation of antenna ports from two sub-configs.   * Sub-config #1: 16 antenna ports * Sub-config #2: 8 antenna ports * Sub-config #3: 4 antenna ports * Sub-config #4: 2 antenna ports   If this limitation is not acceptable, we can simply take TP-1 as the intention of two TPs are exactly same 😊. |

# Reference

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R1-2402152**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402152.zip) | Correction of Rel-18 NES cell DTX/DRX operations | Intel Corporation |
| [**R1-2402153**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402153.zip) | Discussion on maintanence issues on NES | Intel Corporation |
| [**R1-2402275**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402275.zip) | Draft CR on Correction of CSI Report Subconfiguration | Google |
| [**R1-2402409**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402409.zip) | Maintenance on Network Energy Savings for NR | Nokia, Nokia Shanghai Bell |
| [**R1-2402445**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402445.zip) | Remaining issues on network energy saving | Samsung |
| [**R1-2402446**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402446.zip) | Correction on power assumption for type 1 spatial domain adaptation | Samsung |
| [**R1-2402447**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402447.zip) | Correction on Cell DTX operation for CSI report | Samsung |
| [**R1-2402448**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402448.zip) | Correction on Cell DTX operation for CSI-RS reception and SRS transmission | Samsung |
| [**R1-2402636**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402636.zip) | Draft CR on Rel-18 NES with operation of Cell DtxDrx | Nokia, Nokia Shanghai Bell |
| [**R1-2402641**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402641.zip) | Draft CR on UE behavior on DCI 2-9 monitoring for network energy saving | Xiaomi |
| [**R1-2402912**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402912.zip) | Correction on Cell DTX operation for PDSCH reception | Samsung |
| [**R1-2403033**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403033.zip) | Correction on CSI report with cell DTX | ZTE, Sanechips |
| [**R1-2403034**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403034.zip) | Correction on CSI report for NES | ZTE, Sanechips |
| [**R1-2403115**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403115.zip) | CSI-RS resource/port counting for NES | LG Electronics |
| [**R1-2403172**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403172.zip) | Impact of cell DRX operation on uplink DMRS bundling | Qualcomm Incorporated |
| [**R1-2403270**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403270.zip) | Draft CR for 38.214 on cell DTX/DRX | Ericsson |
| [**R1-2403288**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403288.zip) | Draft CR for 38.214 on spatial/power domain adaptation | Ericsson |
| [**R1-2403351**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403351.zip) | Correction on SRS transmission for cell DRX | Huawei, HiSilicon |
| [**R1-2403352**](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403352.zip) | Correction on SR transmission for cell DRX | Huawei, HiSilicon |

# Appendix

## A. Agreements sorted per technical issue by RAN1#115

**NZP CSI-RS resource configuration for channel measurement**

**Agreement@112**

For the purpose of further discussions in RAN1 on NES spatial domain adaptations, consider the following cases

* Type 1: all antenna elements associated to a logical antenna port is disabled/enabled
* Type 2: part/subset of antenna elements associated to a logical antenna port is disabled/enabled

**Agreement @112bis-e**

Define necessary enhancements to support both types of spatial adaptation cases (as defined in RAN1#112) in Rel-18.

* Note: This does not imply explicit definition in specifications for adaptation types.
* Note: This does not imply explicit specification changes are made for both cases

**Agreement@112**

For spatial element adaptation, further study the following

* A1-1) Each CSI-RS resource/resource set/resource setting can be associated with only one spatial adaptation pattern
  + FFS: Details on how the association is done
* A1-2) Each CSI-RS resource/resource set/resource setting can be associated with one or more spatial adaptation patterns
  + FFS: Details on how the association is done
* FFS: Details on the definition of “spatial adaptation patterns”

**Agreement@112bis-e**

Support configurability of NZP CSI-RS resource(s) for channel measurement within one resource setting corresponding to more than one spatial adaptation patterns with at least one of the following

* A1-1-revised: a resource set with multiple resources is configured within a resource setting, where each resource is associated with only one spatial adaptation pattern
* A1-2-revised: For a resource configured in a resource set within a resource setting, the resource can be associated with more than one spatial adaptation patterns
  + One or more resources can be configured in the resource set for channel measurement.

**Agreement@112bis-e**

* + - For R18 NES, only legacy port configuration values (N1, N2) or (Ng, N1, N2) are supported.
    - FFS: Whether/what restriction for A1-1-revised and A-1-2-revised w.r.t number of ports

**Agreement@113**

* For A1-1-revised for Type 2, one or more CSI-RS resources from a CSI-RS resource set for channel measurement can be associated with the same sub-configuration provided in a CSI report configuration
  + Resources in the resource set for channel measurement have the same number of antenna ports
* For A1-2-revised for Type 1, all CSI-RS resource(s) (which can be one or more) in the CSI-RS resource set for channel measurement are associated with each sub-configuration provided in a CSI report configuration
  + i.e. each CSI-RS resource is associated with all the sub-configurations
  + Resources in the resource set for channel measurement have the same number of antenna ports
* FFS: restriction on total number of CSI-RS resources for channel measurement in a CSI-ReportConfig and/or sub-configuration.

**Working Assumption@112bis-e**

Al-1-revised and A1-2-revised are supported

* + - FFS: Which Type of SD adaptation A1-1-revised and A1-2-revised are applicable for

**Agreement@113**

Confirm the working assumption with the following update (in blue)

* + - Al-1-revised and A1-2-revised are supported
      * For Type 1 SD adaptation
        + A1-2-revised is supported
      * For Type 2 SD adaptation
        + A1-1-revised is supported.

**Conclusion@112bis-e**

New CSI-RS resource (RE mapping) pattern is not introduced for R18 network energy savings purpose.

* Note: CSI-RS resource (RE mapping) pattern above refers to a row in TS 38.211 Table 7.4.1.5.3-1 determining CSI-RS locations within a slot.

**Agreement@114bis**

Only codebook type 1 for PMI is supported for type 2 SD adaptation and PD adaptation.

**CSI report configuration including the sub-configurations**

**Agreement@112**

For spatial element adaptation, further study the following

* A2-1) Independent/separate CSI report configurations where each CSI report configuration corresponds to one spatial adaptation pattern
* A2-2) One CSI report configuration contains multiple CSI report sub-configurations where each sub-configuration corresponds to one spatial adaptation pattern
  + FFS: Details of sub-configuration

**Agreement@112**

For spatial domain adaptation, further study necessary enhancements for multiple CSI(s) where each CSI corresponds to a spatial adaptation pattern, e.g.

* FFS: gNB indicates to UE which CSI(s) the UE shall report
* FFS: the UE selects which CSI(s) are reported
* FFS: multiple CSI(s) are reported in a joint CSI report
* FFS: Overhead reduction for multiple CSI(s)

Note: UE complexity needs to be taken into account.

**Agreement@112bis-e**

At least support A2-2, i.e. one CSI report configuration contains multiple CSI report sub-configurations where each sub-configuration corresponds to one spatial adaptation pattern.

* FFS: impact on CSI processing requirement

**Agreement@112bis-e**

For CSI report configuration, if L>1 in a CSI report configuration, at least the following can be included for each sub-configuration for Type 1 SD adaptation

* N1, N2 for single-panel and N1, N2, Ng for multi-panel
  + FFS: details on explicit indication or implicit derivation
* Port subset indication when A1-2 is used (if A1-2 is supported)
  + FFS: details on explicit indication or implicit derivation
* FFS: rank restriction
* FFS: codebook subset restriction
* FFS: supported codebook types for PMI, e.g., Type-I or Type-II
* FFS: report quantity
* FFS: reportFreqConfiguration
* FFS: Group identity of NZP CSI-RS resource(s) in a resource set for channel measurement when A1-1 is used

For CSI report configuration for type 2 SD adaptation, further study under which cases sub-configurations may or may not be needed including sub-configuration content

**Agreement@113**

For a CSI report configuration with L>1, for Type 1 SD, at least when A1-2-revised is used for the associated codebook configuration,

* Only common codebook type for PMI across sub-configurations is supported
  + Codebook type-1 for PMI is supported

**Agreement@113**

For Type 1 adaptation, for each sub-configuration,

* Port subset indication is based bitmap is supported
  + - One bit per port for single panel case (i.e. turning off in a port level)
    - FFS: One bit per panel for multi-panel case (i.e. turning off in panel level)
    - Note: It is up to the gNB to ensure the mapping of the bit to a uniform x-pol rectangular array

**Agreement@113**

For Type 1 adaptation, for each sub-configuration, for multi-panel case,

* One bit per port based on bitmap is supported
* Note: It is up to the gNB to ensure the mapping of the bit to a uniform x-pol rectangular array for each of the activated panel(s). Additionally, if more than one panel is activated, uniformity across panels is ensured by the gNB (i.e., the same N1, N2 across multiple activated panels)

**Agreement@113**

For the sub-configuration(s) in a CSI report configuration with L>1,

* for Type 1 SD with A1-2-revised, the following is configured in each sub-configuration
  + - codebook subset restriction,
    - rank restriction
    - N1, N2 and Ng
    - FFS: the case when the number of ports is less than 4
* for Type 2 SD adaptation with A1-1-revised, for each sub-configuration
  + - a list of CSI-RS resource ID
    - FFS: codebookConfig (including codebookSubsetRestriction/ ri-Restriction)
    - FFS: CQI table indication
    - FFS: reportFreqConfiguration
    - FFS: report quantity

Above is agreed in addition to what was agreed in previous RAN1 agreements

**Agreement@114**

* For each sub-configuration in a CSI reportConfig, for Type 1 SD adaptation only, and Type 2 SD adaptation only, support,
  + {codebookConfig (for Type 2 SD only) is common for all sub-configurations
  + {reportQuantity, reportFreqConfiguration} is not configured in any sub-configuration and the legacy/original parameters are used for all sub-configurations.
  + cqi-Table is common for all sub-configurations
  + for indicating # of ports in a port subset = 2, legacy IE twoTX-CodebookSubsetRestriction can be used for this subConfig in Type 1 SD.

**Agreement@114**

For Type 1 SD for multi-panel case,

* Introduce a new mixed codebook combination {Type 1 Single Panel, Type 1 Multi Panel, Null} in R18 for FG *codebookComboParameterAddition* (indicating the UE supports the mixed codebook combinations in a slot)
* Note: gNB can configure either Type 1 single panel codebook or Type 1 multi-panel codebook for a sub-configuration from one or multiple sub-configurations within one CSI report configuration if a UE reports support of multi-panel operation.

**Conclusion@114**

No simultaneous configuration of Type 1 SD and Type 2 SD adaptation in a same CSI report configuration.

**Agreement@115**

For Type 2 SD adaptation or joint operation of Type 2 SD and PD adaptation,

* + - The *non-PMI-PortIndication*, or *typeISinglePanel-codebookSubsetRestriction-i2* can be configured in CSI-ReportConfig instead of in sub-configuration.

**Agreement@115**

**For Type 2 SD only**,

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

**Agreement@115**

**For Type 1 SD adaptation, or joint operation of Type 1 SD and PD adaptation,**

* + - For a CSI report with *reportQuantity* set to 'cri-RI-i1-CQI', UE expects that *typeISinglePanel-codebookSubsetRestriction-i2* to be configured in each sub-configuration that contains *port-subsetIndicator*
    - If there is at least one sub-configuration corresponding to 'typeI-SinglePanel' and at least one sub-configuration corresponding to 'typeI-MultiPanel' in the same CSI report configuration, UE expects that *codebookMode* to be configured in each sub-configuration that contains *port-subsetIndicator*

**Agreement@115**

**For Type 1 SD adaptation, or joint operation of Type 1 SD and PD adaptation**, for a CSI report with *reportQuantity* set to 'cri-RI-CQI',

* + - UE expects that *non-PMI-PortIndication*, if configured, to be configured in each sub-configuration containing port-subsetIndicator
      * Ports selected in the *non-PMI-PortIndication correspond to* enabled ports in the bitmap *port-subsetIndicator*
    - If *non-PMI-PortIndication* is not configured in a sub-configuration, UE applies legacy behavior for the case where *non-PMI-PortIndication* is not configured after re-indexing CSI-RS port indices, by replacing P with the number of enabled ports in the bitmap *port-subsetIndicator* configured for the sub-configuration

**CSI reporting framework**

**Agreement@112**

For spatial domain adaptation, further study necessary enhancements for multiple CSI(s) where each CSI corresponds to a spatial adaptation pattern, e.g.

* FFS: gNB indicates to UE which CSI(s) the UE shall report
* FFS: the UE selects which CSI(s) are reported
* FFS: multiple CSI(s) are reported in a joint CSI report
* FFS: Overhead reduction for multiple CSI(s)

Note: UE complexity needs to be taken into account.

**Agreement@112bis-e**

For a CSI report config with *L* sub-configuration(s), support a framework that enables a UE to report *N* CSI(s) in one reporting instance where the *N* CSI(s) are associated with *N* sub-configuration(s) from *L* (where ) and each CSI corresponds to one sub-configuration.

* For discussion purpose, N=1 refers to single-CSI while N>1 refers to multi-CSI.
* For Semi-persistent/Aperiodic CSI reporting, support gNB trigger/indicate/activate report of N≤L CSIs where N>=1
* The maximum value of N and L are subject to UE capability
* Further study how to address/minimize additional UE complexity

The following bullet not agreed due to objection from Apple and vivo

* For Periodic CSI reporting, at least the case of N=L is supported where N>=1

**Agreement@114bis**

From RAN1 perspective, up to 4 CSI report configurations can be configured in a BWP for SP CSI reporting on PUCCH where one or more report configurations can contain a list of sub-configuration(s)

* Send an LS to RAN2 inlcuding the relevant agreements made in UE feature discussions. Final LS is endorsed in R1-2310578.

**Conclusion@114bis**

There is no consensus on the following proposal:

For a P/SP-CSI report configuration containing a list of *L* sub-configurations, if at least one subConfig (which is the triggered one for SP-CSI reporting, or configured one for P-CSI report) is associated with more than one CSI-RS resource, nCSI\_ref is the smallest value >=5\*2μDL; otherwise, it is the smallest value no smaller than 4\*2μDL

**Agreement@114bis**

For CSI reporting on PUCCH and PUSCH, at least one new table is introduced for the scenarios of Table 6.3.1.1.2-11 and Table 6.3.2.1.2-5 in TS38.212, with update corresponding to the CSI mapping order of part 2 CSI even/odd subbands for CSI reporting corresponding to one or more sub-configurations.

**Agreement@114bis**

Adopt the following TP for TS 38.213.

---------------------------------Start of Text Proposal on TS 38.213 v18.0.0------------------

**9.2.5 UE procedure for reporting multiple UCI types**

< Unchanged parts are omitted >

If a UE would multiplex CSI reports that include Part 2 CSI reports in a PUCCH resource, the UE determines the PUCCH resource and a number of PRBs for the PUCCH resource or a number of Part 2 CSI reports assuming that each of the CSI reports indicates rank 1, or rank combination of {1, 1}, or rank 1 per CSI sub-report, if applicable. If the higher layer parameter *csi-ReportMode* of CSI reports is set to 'Mode2', the UE determines the PUCCH resource and a number of PRBs for the PUCCH resource or a number of Part 2 CSI reports assuming that each CRI in the CSI report is associated with a resource pair.

< Unchanged parts are omitted >

---------------------------------End of Text Proposal on TS 38.213 v18.0.0--------------------

|  |  |
| --- | --- |
| Reason for changes | Clarify the rank assumption for determination of PUCCH resource. |
| Summary of changes | Added the assumed rank for CSI sub-report. |
| Consequences if not approved | Unclear rank assumption when PUCCH resource is to be determined. |
| Note: this table is added by Rapporteur | |

**Agreement@115**

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

For the above “per sub-configuration”, it is a sub-configuration that is

* Alt 1: the activated/triggered one for SP-CSI reporting

**CSI payload/reportQuantity, UCI mapping**

**Agreement@112bis-e**

* For CSI feedback with CSI overhead/report payload reduction, further study whether/how to report a common value and/or a differential and/or joint coded value across same CSI quantity of different sub-configurations/adaptation patterns, at least for the following
  + CRI
  + RI
  + PMI
  + CQI
  + FFS: L1-RSRP
  + Other (new) report quantity, if any
* Further study whether/how it is feasible/possible for the UE to skip the evaluations of some sub-configurations/adaptation patterns to reduce the burden at the UE

**Agreement@113**

For both spatial domain NES, when UE reports CSIs corresponding to one or more sub-configurations provided in a CSI report configuration,

* At least support baseline: Report CSI for each indicated sub-configuration, according to reportQuantity configuration
  1. FFS: details on how to map CSI(s) in a CSI report
* Further enhancement on CSI payload reduction is not precluded

**Conclusion@114**

* No further enhancements for PMI reduction in R18 NES.
* No further enhancements for RI reduction in R18 NES.
* No support of UE reporting PDSCH power reduction tolerance in R18 NES.

**Agreement@114bis**

Support gNB can configure report quantities of 'cri-RI-i1-CQI', 'cri-RI-CQI', or 'cri-RI-i1'.

**Agreement@114bis**

Report quantities of 'cri-RSRP', 'cri-SINR', or 'cri-SINR- Index ' are NOT applicable to NES

**Agreement@115**

Report quantities of 'cri-RSRP-Index', 'none', 'ssb-Index-RSRP', 'ssb-Index-SINR', 'ssb-Index-RSRP- Index', 'ssb-Index-SINR- Index' or 'tdcp' are NOT applicable to Rel-18 NES.

**Conclusion@114bis**

There is no consensus to support the following:

* A UE only reports PMI in CSI part 2 for the first sub-configuration among the sub-configurations with the same RI reported across sub-configurations.

**Agreement@115**

|  |
| --- |
| * Reason for changes:   + There is no description on the mapping between CRI and CSI-RS resource for a sub-configuration configured with CSI-RS ID list * Summary of changes:   + Add the mapping between CRI and CSI-RS resource for a sub-configuration configured with CSI-RS ID list * Consequences if not approved   + The mapping between CRI and CSI-RS resource for a sub-configuration configured with CSI-RS ID list is unclear   <omitted texts>  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*.]  - If a sub-configuration is configured with a list of NZP CSI-RS resources with more than one resources, the UE shall derive the CSI parameters other than CRI conditioned on the reported CRI, where the CRI k (k ≥ 0) for the sub-configuration corresponds to the configured (k+1)-th entry of associated nzp-CSI-RS-Resources in the list of NZP CSI-RS resources.  - 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*.  <omitted texts> |

**Agreement@114**

Down-select from the below for priority rule determination for CSI reporting of multiple sub-configurations

* Option 1: The priority of the CSI report containing CSIs for multiple sub-configurations, is determined according to the clause 5.2.5 of TS 38.214.
  + 1-b) A sub-configuration level priority is determined by the order of sub-configuration index. For Part 2 CSI corresponding to each sub-configuration, omission is at subConfig level. Follow legacy dropping rules for a CSI report containing multiple CSIs.
    - CSI mapping rule across sub-configurations follow legacy specification principle
    - Sub-configuration index with lower value has higher priority
    - Sub-configuration index is configured in CSI report config

**Agreement@114**

For CSIs across multiple sub-configurations in one CSI reportConfig map different sub-configurations based on RAN1#114 agreement in 9.7.1

* For Part 2 priority reporting level
  + Option 1: for a given band type from {wideband, even subband, odd subband}, the omission order follows the priority order determined by sub-configuration index

**Agreement@114**

For N(>1) CSIs reporting with multiple sub-configurations without payload/complexity reduction,

* Each CSI can be a single-part, or two-part CSI, and contains the same types of CSI parameters/quantities as legacy, when applicable/if reported;
* The mapping order of CSI fields of one sub-configuration is as legacy mapping order of CSI fields of one CSI report;
* Part 2 CSI priority reporting level follows wideband CSI first, then even subband CSI and odd subband CSI;

**Agreement@114bis**

For CSI mapping of subbands for a CSI report having multiple sub-configurations, odd sub-band CSI(s) of all sub-configurations in one multi-CSI reporting are mapped after all even sub-band CSI(s) in one multi-CSI reporting.



**Conclusion@114bis**

No consensus to have spec update with respect to the issue 6 in R1-2310307.

**Agreement@114bis**

For a CSI report having sub-configuration including port subset indication, CSI-RS port re-indexing is supported.

**Agreement@114bis**

Adopt the following TP for TS 38.214 for the above agreements

**5.2.1.4.2 Report Quantity Configurations**

---------------------------------------------------- Unchanged text is omitted ---------------------------------------------------------

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

* ~~t~~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. For the derivation of PMI, antenna ports corresponding to all bits with value of 1 in [*port-subsetIndicator*] are mapped to consecutive antenna ports starting at CSI-RS antenna port 3000 in increasing order of the bit position in [*port-subsetIndicator*].



---------------------------------------------------- Unchanged text is omitted -------------------------------------------------------

|  |  |
| --- | --- |
| Reason for changes | To enable contiguous antenna port indexing for PMI derivation for Type 1 SD with port subset indication. |
| Summary of changes | Port re-indexing procedure is added. |
| Consequences if not approved | Antenna port will be non-consecutive which cause misalignment for PMI derivation. |
| Note: this table is added by Rapporteur | |

**Agreement@115**

For a CSI report containing Type 1 SD sub-configuration(s), support port re-indexing to enable consecutive port indices for CQI calculation purpose.

**Agreement@114bis**

* Reason for changes
  + Current text incorrectly implies that all CSI reports contain sub-reports
  + Variable used for number of CSI sub-reports is incorrect
  + Current text “upper part to lower part” does not accurate in the context of sub-reports when not all CSI reports necessarily contain sub-reports, which should be a segment of the UCI sequence only for the corresponding sub-report(s)
* Summary of changes
  + Changes to note in Tables 6.3.1.1.2-13, 6.3.1.1.2-14, 6.3.2.1.2-6, and 6.3.2.1.2-7 to fix the above issues
* Consequences if not approved
  + Incorrect CSI mapping to UCI bit sequence for both CSI on PUCCH and PUSCH

------------------------------ Text Proposal (TP#1) for 38.212, Sections 6.3.1.1.2 and 6.3.2.1.2 --------------------------

\*\*\* Unchanged text omitted \*\*\*

If none of the CSI reports for transmission on a PUCCH is of two parts, the CSI fields of all CSI reports, in the order from upper part to lower part in Table 6.3.1.1.2-12, are mapped to the UCI bit sequence  starting with . The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to.

**Table 6.3.1.1.2-12: Mapping order of CSI reports to UCI bit sequence , without two-part CSI report(s)**

|  |  |
| --- | --- |
| **UCI bit sequence** | **CSI report number** |
|  | CSI report #1  as in Table 6.3.1.1.2-7/7A/8/8B |
| CSI report #2  as in Table 6.3.1.1.2-7/7A/8/8B |
| … |
| CSI report #n  as in Table 6.3.1.1.2-7/7A/8/8B |
| Note: For a CSI report #i containing *Ni*CSI sub-reports, where ~~i=1,2,…,n~~, all CSI sub-reports within the CSI report #i are mapped to the corresponding ~~part~~ segment of the UCI bit sequence of CSI report #i, from upper part to lower part of the segment, in increasing order of CSI sub-report number. CSI sub-report #1, CSI sub-report #2, …, CSI sub-report #~~n~~*Ni* correspond to the CSI sub-reports in increasing order of *CSI-ReportSubConfigID*. | |

If at least one of the CSI reports for transmission on a PUCCH is of two parts, two UCI bit sequences are generated,  and . The CSI fields of all CSI reports, in the order from upper part to lower part in Table 6.3.1.1.2-13, are mapped to the UCI bit sequence  starting with . The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to. The CSI fields of all CSI reports, in the order from upper part to lower part in Table 6.3.1.1.2-14, are mapped to the UCI bit sequence  starting with . The most significant bit of each field is mapped to the lowest order information bit for that field, e.g. the most significant bit of the first field is mapped to . If the length of UCI bit sequence  is less than 3 bits, zeros shall be appended to the UCI bit sequence until its length equals 3.

**Table 6.3.1.1.2-13: Mapping order of CSI reports to UCI bit sequence ,   
with two-part CSI report(s)**

|  |  |
| --- | --- |
| **UCI bit sequence** | **CSI report number** |
|  | CSI report #1 if CSI report #1 is not of two parts, or  CSI report #1, CSI part 1, if CSI report #1 is of two parts,  as in Table 6.3.1.1.2-7/7A/8/8B/9/9A/9B |
| CSI report #2 if CSI report #2 is not of two parts, or  CSI report #2, CSI part 1, if CSI report #2 is of two parts,  as in Table 6.3.1.1.2-7/7A/8/8B/9/9A/9B |
| … |
| CSI report #n if CSI report #n is not of two parts, or  CSI report #n, CSI part 1, if CSI report #n is of two parts,  as in Table 6.3.1.1.2-7/7A/8/8B/9/9A/9B |
| Note: For a CSI report #i containing *Ni* CSI sub-reports, where ~~i=1,2,…,n~~, either all CSI sub-reports not of two parts or CSI part 1 of all CSI sub-reports of two parts, ~~either a CSI sub-report without two-part, or CSI part 1 of a CSI sub-report with two-part CSI,~~ are mapped to the corresponding ~~part~~ segment of the UCI bit sequence of CSI report #i, from upper part to lower part of the segment, in increasing order of CSI sub-report number. CSI sub-report #1, CSI sub-report #2, …, CSI sub-report #~~n~~*Ni* correspond to the CSI sub-reports in increasing order of *CSI-ReportSubConfigID*. | |

where CSI report #1, CSI report #2, …, CSI report #n in Table 6.3.1.1.2-13 correspond to the CSI reports in increasing order of CSI report priority values according to Clause 5.2.5 of [6, TS38.214].

**Table 6.3.1.1.2-14: Mapping order of CSI reports to UCI bit sequence ,   
with two-part CSI report(s)**

|  |  |
| --- | --- |
| **UCI bit sequence** | **CSI report number** |
|  | CSI report #1, CSI part 2 wideband, as in Table 6.3.1.1.2-10/10A/10B if CSI part 2 exists for CSI report #1 |
| CSI report #2, CSI part 2 wideband, as in Table 6.3.1.1.2-10/10A/10B if CSI part 2 exists for CSI report #2 |
| … |
| CSI report #n, CSI part 2 wideband, as in Table 6.3.1.1.2-10/10A/10B if CSI part 2 exists for CSI report #n |
| CSI report #1, CSI part 2 subband, as in Table 6.3.1.1.2-11/11A/11B/[New Table] if CSI part 2 exists for CSI report #1 |
| CSI report #2, CSI part 2 subband, as in Table 6.3.1.1.2-11/11A/11B/[New Table] if CSI part 2 exists for CSI report #2 |
| … |
| CSI report #n, CSI part 2 subband, as in Table 6.3.1.1.2-11/11A/11B/[New Table] if CSI part 2 exists for CSI report #n |
| Note: For a CSI report #i containing *Ni* CSI sub-reports, where ~~i=1,2,…,n~~,   * ~~all the~~ CSI part 2 wideband~~s~~ of all CSI sub-reports are mapped to the corresponding ~~part~~ segment of the UCI bit sequence of CSI report #i, from upper part to lower part of the segment, in increasing order of CSI sub-report number; * CSI sub-report #1, CSI sub-report #2, …, CSI sub-report #~~n~~*Ni* correspond to the CSI sub-reports in increasing order of *CSI-ReportSubConfigID*. | |

where CSI report #1, CSI report #2, …, CSI report #n in Table 6.3.1.1.2-14 correspond to the CSI reports in increasing order of CSI report priority values according to Clause 5.2.5 of [6, TS38.214].

\*\*\* Unchanged text omitted \*\*\*

**Table 6.3.2.1.2-6: Mapping order of CSI reports to UCI bit sequence ,   
with two-part CSI report(s)**

|  |  |
| --- | --- |
| **UCI bit sequence** | **CSI report number** |
|  | CSI part 1 of CSI report #1 as in Table 6.3.2.1.2-3/3A/3B or Table 6.3.1.1.2-8/8A/8B |
| CSI part 1 of CSI report #2 as in Table 6.3.2.1.2-3/3A/3B or Table 6.3.1.1.2-8/8A/8B |
| … |
| CSI part 1 of CSI report #n as in Table 6.3.2.1.2-3/3A/3B or Table 6.3.1.1.2-8/8A/8B |
| Note: For a CSI report #i containing *Ni* CSI sub-reports, where ~~i=1,2,…,n~~, CSI part 1 of all CSI sub-reports are mapped to the corresponding ~~part~~ segment of the UCI bit sequence of CSI report #i, from upper part to lower part of the segment, in increasing order of CSI sub-report number. CSI sub-report #1, CSI sub-report #2, …, CSI sub-report #~~n~~ *Ni* correspond to the CSI sub-reports in increasing order of *CSI-ReportSubConfigID*. | |

where CSI report #1, CSI report #2, …, CSI report #n in Table 6.3.2.1.2-6 correspond to the CSI reports in increasing order of CSI report priority values according to Clause 5.2.5 of [6, TS38.214].

**Table 6.3.2.1.2-7: Mapping order of CSI reports to UCI bit sequence ,   
with two-part CSI report(s)**

|  |  |
| --- | --- |
| **UCI bit sequence** | **CSI report number** |
|  | CSI report #1, CSI part 2 wideband, as in Table 6.3.2.1.2-4/4A/4B,  or CSI part 2 with group 0, as in Table 6.3.2.1.2-5A/5B, if CSI part 2 exists for CSI report #1 |
| CSI report #2, CSI part 2 wideband, as in Table 6.3.2.1.2-4/4A/4B,  or CSI part 2 with group 0, as in Table 6.3.2.1.2-5A/5B, if CSI part 2 exists for CSI report #2 |
| … |
| CSI report #n, CSI part 2 wideband, as in Table 6.3.2.1.2-4/4A/4B,  or CSI part 2 with group 0, as in Table 6.3.2.1.2-5A/5B, if CSI part 2 exists for CSI report #n |
| CSI report #1, CSI part 2 subband, as in Table 6.3.2.1.2-5/5C/5D/[New Table],  or CSI part 2 with group 1 and 2, as in Table 6.3.2.1.2-5A/5B, if CSI part 2 exists for CSI report #1 |
| CSI report #2, CSI part 2 subband, as in Table 6.3.2.1.2-5/5C/5D/[New Table],  or CSI part 2 with group 1 and 2, as in Table 6.3.2.1.2-5A/5B,  if CSI part 2 exists for CSI report #2 |
| … |
| CSI report #n, CSI part 2 subband, as in Table 6.3.2.1.2-5/5C/5D/[New Table],  or CSI part 2 with group 1 and 2, as in Table 6.3.2.1.2-5A/5B,  if CSI part 2 exists for CSI report #n |
| Note: For a CSI report #i containing *Ni* CSI sub-reports, where ~~i=1,2,…,n~~,   * CSI part 2 wideband of all CSI sub-reports are mapped to the corresponding ~~part~~ segment of the UCI bit sequence of CSI report #i, from upper part to lower part of the segment, in increasing order of CSI sub-report number; * CSI sub-report #1, CSI sub-report #2, …, CSI sub-report # ~~n~~ *Ni* correspond to the CSI sub-reports in increasing order of *CSI-ReportSubConfigID*. | |

where CSI report #1, CSI report #2, …, CSI report #n in Table 6.3.2.1.2-7 correspond to the CSI reports in increasing order of CSI report priority values according to Clause 5.2.5 of [6, TS38.214].

\*\*\* Unchanged text omitted \*\*\*

---------------------------------------------------------- End Text Proposal --------------------------------------------------------

**Conclusion@115**

For CSI report with multiple sub-configurations,

* When a CSI report with only one part/part 1 CSI is determined as the lowest priority and to be omitted, the one part/part1 CSI corresponding to all sub-configurations is dropped together

**Agreement@115**

For CPU occupation time for CSI report with one or more sub-configurations,

* For periodic CSI report which contains a list of sub-configurations,
  + It occupies CPU(s) from the first symbol of the earliest one of each CSI-RS/CSI-IM~~/SSB~~ resource for channel or interference measurement within all L configured sub-configurations, 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.
* For semi-persistent CSI report on PUSCH (excluding an initial semi-persistent CSI report on PUSCH after the PDCCH triggering the report) or semi-persistent CSI report on PUCCH which contains a list of sub-configurations
  + It occupies CPU(s) from the first symbol of the earliest one of each CSI-RS/CSI-IM~~/SSB~~ resource for channel or interference measurement within N triggered sub-configurations, until the last symbol of the configured PUSCH/PUCCH carrying the report.

For CSI computation time (Z2, Z2’),

* For a CSI-ReportConfig with sub-configurations, the definition of the corresponding CSI computation time is based on the CSI-RS resources for channel measurement, the CSI-RS resources for interference measurement and the CSI-IM resources for all triggered sub-configurations for AP-CSI report.

Editors to draft TP if needed.

**Agreement@115**

Adpot the following TP for TS 38.214, 5.2.1.4.2

|  |
| --- |
| * Reason for changes:   + The Rel-18 spec in Section 5.2.1.4.2 seems to limit a CSI-ReportConfig to be associated with only a single CSI-RS resource set the due to the word “the” in the text * Summary of changes:   + Remove the restriction for the association of single resource set * Consequences if not approved   + The association of resource set and reportConfig is single, which is against legacy function   5.2.1.4.2 Report quantity configurations  \*\*\* Text omitted \*\*\*  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 a *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 a *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-configuration is not configured with [*nzp-CSI-RS-resourceList*] then the sub-configuration shall be associated with all the NZP CSI-RS resources within a *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*.  \*\*\* Text omitted \*\*\* |

**CPU/active resource/antenna ports counting**

**Agreement@113**

For spatial domain adaptation or power domain adaptation, for CSIs reporting corresponding to N indicated sub-configurations from L sub-configurations in a CSI report, for the case without CSI payload reduction

* , where is the total number of CSI-RS resources corresponding to i-th sub-configuration in the CSI-RS resource set for channel measurement.
  + the summation is over N for A-CSI RS
  + This is for CSI processing criteria for NES in Clause 5.2.1.6 of TS 38.214

**Agreement@113**

Alt 2: For P-CSI reporting from L configured sub-configurations, support:

* All L configured sub-configurations are reported in every periodic occasion.
* The maximum value of L can be different for A-CSI, SP-CSI, and P-CSI.
* , where is the total number of CSI-RS resources corresponding to i-th sub-configuration in the CSI-RS resource set for channel measurement. (N=L in the equation)
* FFS: Details on active CSI-RS resource / port counting

**Agreement@114**

For SD and/or PD adaptation without UE complexity reduction, CPU counting of A/SP-CSI reporting is based on for CSIs reporting corresponding to N indicated sub-configurations from L configured sub-configurations in a CSI report.

**Agreement@114**

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

* Option 2A: for Type 1 SD adaptation, and for Type 2 SD or PD adaptation.
* is nrofPorts configured in NZP-CSI-RS-Resource and is the number of CSI-RS ports in sub-configuration s derived from port subset indication.
* It is understood that further discussions are necessary.

**Agreement@114bis**

* For a CSI report config containing sub-configuration(s), support in Table 5.4-2 of TS 38.214 for CSI computation delay requirements.



* For CPU occupation and update, if there are not enough CPUs for processing the entire CSI report, legacy UE behavior is used

Only Z2, Z2’ will be supported.

**Agreement@114bis**

* For CSI reporting in PUCCH, Table 6.3.1.1.2-7, Table 6.3.1.1.2-9 and Table 6.3.1.1.2-10 in TS38.212 are applicable for NES
* For CSI reporting on PUSCH, Table 6.3.2.1.2-3 and Table 6.3.2.1.2-4 in TS38.212 are applicable for NES
* Further discuss in this meeting about the applicability of below for NES
  + Table 6.3.1.1.2-8/8A/11 in TS38.212 (or a new table for replacement of Table 6.3.1.1.2-11)
  + Table 6.3.2.1.2-5 in TS38.212 (or a new table for replacement)

**Agreement@115**

|  |
| --- |
| **Reason for change:**   * The definition of X sub-configuration is not clear. * The SD and PD joint operation case Is not counted |
| **Summary of change:**   * Clarified the definition of X sub-configurations. * Added the counting rule for consideration of SD and PD joint operation |
| **Consequences if not approved:**   * The result of CSI-RS resource/port counting for CSI report configuration containing sub-configurations is not clear. * The counting rule is not clear when PD adaptation is jointly operated |
| -----------------------------------------------------------Text proposal -----------------------------------------------------------  5.2.1.6 CSI processing criteria  <omitted text>  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 not configured with higher layer parameter [*csi-ReportSubConfigList*], 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~~ *CSI-ReportConfig* containing a list of *L* sub-configuration(s) ~~indicated in a~~ *~~CSI-ReportConfig~~* provided by higher layer parameter [*csi-ReportSubConfigList*]*,* if a CSI-RS resource is referred by *M* sub-configurations among *~~X~~N* triggered sub-configurations for CSI reporting for aperiodic CSI-RS resource, or *L* configured sub-configurations for CSI reporting for semi-persistent CSI-RS resource or periodic CSI-RS resource, 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~~*~~], or is configured with a list of one or more CSI-RS resources, provided by [nzp-CSI-RS-resourceList], or is configured with a power offset, provided by [powerOffset],~~  ~~-~~ *~~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 if configured, otherwise equals to *P*.  <omitted text>  -------------------------------------------------------End of Text proposal ------------------------------------------------------ |

**Power domain (PD) adaptation and joint operation**

**Agreement@112**

For adaptation of power offset values between PDSCH and CSI-RS, further study the following

* Where/how to configure multiple power offset values
  + Whether/how one or more power offset values are dynamically indicated to UE for CSI measurement/reporting, and PDSCH reception
  + Overhead reduction for CSI reports associated with multiple power offset values between PDSCH and CSI-RS
  + Whether other UE report content can be included

**Agreement@112bis-e**

For power domain adaptation, for CSI(s) reporting, support configuration of more than one power offset values for PDSCH relative to CSI-RS

* FFS: impact on CSI processing requirement
* FFS: details on configuration/indication of the power offset values
* FFS: whether/how to additionally consider the case where CSI-RS power is changed

**Agreement@112bis-e**

For power domain adaptation, support the following configuration(s) for CSI-RS resource configuration,

* A1-2-power: one or more resources can be configured in a resource set within a resource setting and each resource can be associated with one or more power offset values
* FFS: A1-1-power: a resource set with multiple resources is configured within a resource setting, where resources can have different power offset values
* FFS: Details of how the different power offset values(s) are configured/indicated.

**Agreement@113**

Joint operation of SD and PD adaptation is supported.

**Agreement@114**

For power domain adaptation only, all CSI-RS resource(s) (which can be one or more) in the CSI-RS resource set for channel measurement are associated with each sub-configuration provided in a CSI report configuration

* Each sub-configuration contains an offset value (e.g. X) that is commonly applied to all the resources within the resource set. For a CSI-RS resource in CSI resource configuration, the *PDSCH to CSI-RS EPRE offset* (e.g. Y) for CSI calculation is determined based on *powerControlOffset* (e.g. Z) value in CSI resource configuration and the offset value configured in CSI sub-configuration in the report configuration.
  + Only legacy values are applicable for the resulted power control offset values
  + It is expected that the sub-configuration leads to a value no larger than power control offset value provided in CSI resource configuration

**Agreement@114**

For joint operation of SD and PD, each subConfig contains corresponding parameters for an SD adaptation and/or parameters for a PD adaptation.

**Agreement@114bis**

Remove the square brackets as below for TS 38.214

|  |
| --- |
| **5.2.2.5 CSI reference resource definition**  <omitted text>  - 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> |

* The range of [powerOffset] in the above TP is [0…23] in dB with step size of 1 dB.

**Agreement@114bis**

Adopt the following TP for TS 38.214, Clause 5.2.1.1

=== start of TP===

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, CapabilityIndex-related or TDCP-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, Further Enhanced Type II Port Selection, Enhanced Type II for coherent joint transmission (CJT), Further Enhanced Type II Port Selection for CJT, Enhanced Type II for predicted PMI, or Further Enhanced Type II Port Selection for predicted PMI 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 additional to *powerControlOffset* of the CSI-RS resource. 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.

=== end of TP===

|  |  |
| --- | --- |
| Reason for changes | Clarify that the power offset is an additional RRC parameter, i.e. not the parameter PowerControlOffset thus not the power of PDSCH relative to CSI-RS. |
| Summary of changes | Adding clarification. |
| Consequences if not approved | There can be misunderstanding that the powerOffset is used as replacement of PowerControlOffset |
| Note: this table is added by Rapporteur | |

**Interference measurement**

**Agreement@115**

* CSI-IM is supported for Rel-18 NES without need of spec update, i.e. resource-wise association is maintained between NZP CSI-RS for CM and CSI-IM.
* NZP CSI-RS for IM is supported for Rel-18 NES
  + Above applies only for
    - the case of PD only adaptation with a single CSI-RS resource for channel measurement

**L1 signaling aspects**

**Agreement@112**

Discuss the signalling aspects for spatial/power domain adaptation for Rel-18 NES-capable UEs considering that

* Whether there is a need for transition time per adaptation (for UE)
* Whether/How to inform UE on spatial adaptation pattern update and/or PDSCH/CSI-RS transmission power change due to adaptation.

**Agreement@112bis-e**

For Semi-persistent/Aperiodic CSI reporting with , study what enhancements to the current DCI and MAC-CE mechanisms are needed for gNB triggering/indication/activation of the N CSI(s) in a reporting instance, where the N CSI(s) are associated with N sub-configuration(s) from L in a report config.

**Agreement@113**

For N>=1 CSI reporting corresponding to N out of L sub-configurations in one reportConfig where each sub-configuration corresponding to an SD adaptation pattern or/[and] a powerControlOffset value,

* For A-CSI and SP-CSI on PUSCH report, support DCI-based triggering
  + For A-CSI-RS, CPU and CSI-RS resource/port counting depend on N indicated sub-configurations
    - FFS: How to do the counting
  + FFS: For P-CSI-RS/SP-CSI-RS, CPU and CSI-RS resource/port counting depend on L or N sub-configurations
* For SP-CSI on PUCCH report, support MAC-CE-based triggering
  + FFS: For P-CSI-RS/SP-CSI-RS, CPU and CSI-RS resource/port counting depend on L or N sub-configurations

Note: UE complexity reduction is not precluded

* For DCI-based triggering,
  + Alt 1: A triggering state corresponding to N sub-configurations is indicated via the existing CSI request field in DCI. Different triggering states could represent different subsets of L sub-configurations.
    - The DCI is UE specific (in this case, legacy DCI format applies)
* For MAC-CE based triggering
  + Opt 2: An indication to select to N sub-configurations in a MAC-CE is supported
    - It is up to RAN2 to decide the signaling designs of the MAC-CE (including whether it is a new MAC CE or an existing MAC CE)
    - Only one MAC CE is used for this triggering

**Agreement@114**

For sub-configuration triggering of A-CSI, an indication for N sub-configurations out of L sub-configurations for a triggering state is configured in *CSI-AssociatedReportConfigInfo*.

* No change to current CSI request field in DCI.

**Agreement@114**

For sub-configuration triggering of SP-CSI on PUSCH report, an indication for N sub-configurations out of L sub-configurations for a triggering state is configured in *CSI-SemiPersistentOnPUSCH-TriggerState*.

* No change to current CSI request field in DCI.

**Conclusion@114**

There is no consensus to support the following:

Option 1: support indication of spatial and/or transmission power adaptation in one of the following approaches (same approach for SD and PD adaptation) in addition to the agreed triggering/activation signalling

* Alt 1: MAC-CE/RRC for indication of corresponding subConfig ID that gNB has applied as adaptation
  + Note: need to take this RAN2 LS in [R1-2306380](file:///C:\Users\younsun\Documents\3GPP%20documents\RAN1%20tdocs\TSGR1_114\Docs\R1-2306380.zip) into account
* Alt 2: UE specific DCI
  + A new field in existing non-fallback UE specific DCI formats is introduced
    - If agreed, the number of bits are to be discussed at CR stage.

**BM/TCI states related aspects**

**Agreement@113**

* Downselect one of the following for BM enhancements in RAN1#114
  + - Case 1: Support scaling the threshold of beam failure detection and threshold of candidate beam identification for power domain network energy saving
    - Case 2: Support UE to send hypothetical beam failure and/or radio link failure (RLF) reports for the indicated hypothetical power offset values.
    - Case 3: No further work on BM enhancements
* Downselect one of the following for TCI configuration enhancement in RAN1#114
  + - Method 1: Configure multiple candidate CSI-RS resources as reference signal for QCL information or for spatial relation information, and switch one of them based on L1/L2 signaling
    - Method 2: Configure multiple candidate sets of TCI state(s) associated with DL/UL signal/channel and switch one of them based on L1/L2 signaling
    - Method 3: No further work on TCI configuration enhancement

**Conclusion@114**

* No further work on BM enhancements for R18 NES.
* No further work on TCI configuration enhancement for R18 NES.

**Other logistics for SD/PD adaptation**

**Agreement@112**

For spatial and power domain adaptation, solution(s) based on adaptation within an active BWP is considered as baseline

**Conclusion@115**

The powerControlOffset configured in TRS still indicates the power offset between PDSCH and TRS.

* New L1 signalling is not introduced
* No spec impact is needed

**Conclusion@115**

NC-JT operation is not applicable for Rel-18 NES

* No further spec impact is needed

**Agreement@115**

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| --- |
| * Reason for changes   + Terminology of CSIs between 38.214 and 38.212 is misaligned for the description of CSI Part 2 omission * Summary of changes   + Change “CSIs” in 38.214 to “CSI sub-reports” * Consequences if not approved   + Inconsistent terminology between different specifications for description of CSI Part 2 omission   -------------------------------- Text Proposal for 38.214, Section 5.2.3 and 5.2.4 -----------------------------------  \*\*\* Unchanged text omitted \*\*\*  5.2.3 CSI reporting using PUSCH  \*\*\* Unchanged text omitted \*\*\*  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~~ CSI~~s~~ sub-reports with Part 2 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.  \*\*\* Unchanged text omitted \*\*\*  - 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 CSI~~s~~ sub-reports, 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.  \*\*\* Unchanged text omitted \*\*\*  5.2.4 CSI reporting using PUCCH  \*\*\* Unchanged text omitted \*\*\*  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 CSI~~s~~ sub-reports, 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*.  \*\*\* Unchanged text omitted \*\*\*  ----------------------------------------------------------- End Text Proposal --------------------------------------------------------- |

## B. Objectives

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| The objectives of the work item are the following:   1. Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell’s time/frequency synchronization (including downlink AGC), and L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2] 2. Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DTX/DRX and UE DRX in RRC\_CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]  * Note: No change for SSB transmission due to cell DTX/DRX. * Note: The impact to IDLE/INACTIVE UEs due to the above enhancement should be avoided.  1. Specify the following techniques in spatial and power domains  * Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains) [RAN1, RAN2] * Specify necessary enhancements on CSI related procedures including measurement and report, and signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS [RAN1, RAN2] * Note: Above objectives are only for UE specific channels/signals * Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements  1. Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, if necessary [RAN2] 2. Specify CHO procedure enhancement(s) in case source/target cell is in NES mode [RAN2] 3. Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]. 4. Specify the corresponding RRM/RF core requirements, if necessary, for the above features [RAN4] |