3GPP TSG RAN WG1 #104-e R1-210xxxx

e-Meeting, January 25th – February 5th, 2021

**Agenda item:** 7.1

**Source:** Moderator (Qualcomm Incorporated)

**Title:** [104-e-NR-7.1CRs-12]

**Document for:** Discussion and Decision

# Background

In [R1-2101431](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_104-e/Docs/R1-2101431.zip), the following 4 potential ambiguities have been noted with respect to following topics in NR Rel-15:

* Interpretation of the Frequency-domain Occupation for ZP-CSIRS
* NZP CSI-RS resource association to a CSI-ResourceConfig
* Rate match NZP CSI-RS resources of the active BWP only
* Semi-persistent NZP CSI-RS resources are rate matched only if active

# Frequency-domain Occupation for ZP-CSIRS

In NR Rel-15 specification, the CSI-FrequencyOccupation IE of 38.331 is used for both NZP and ZP-CSI frequency domain configuration. In 38.331, in the description of the “startingRB” field, it is described that the reference point is CRB#0.



The maximum value of “maxNPRBs” is 275. It is generally known that CRB0 can be farther away from the BWP of the UE than 275 PRBs, and this is why, with regards to the NZP CSI-RS, the following text appears in 38.214 was agreed to clarify the scenarios for which the $startingRB<N\_{BWP}^{start}$.

|  |
| --- |
| 5.2.2.3 Reference signal (CSI-RS) 5.2.2.3.1 NZP CSI-RS…The bandwidth and initial common resource block (CRB) index of a CSI-RS resource within a BWP, as defined in Clause 7.4.1.5 of [4, TS 38.211], are determined based on the higher layer parameters *nrofRBs* and *startingRB*, respectively, within the CSI-FrequencyOccupation IE configured by the higher layer parameter *freqBand* within the *CSI-RS-ResourceMapping* IE. Both *nrofRBs* and *startingRB* are configured as integer multiples of 4 RBs, and the reference point for *startingRB* is CRB 0 on the common resource block grid. If $startingRB<N\_{BWP}^{start},$ the UE shall assume that the initial CRB index of the CSI-RS resource is $N\_{initial RB}=N\_{BWP}^{start}$, otherwise $N\_{initial RB}=startingRB$. If $nrofRBs>N\_{BWP}^{size}+N\_{BWP}^{start}-N\_{initial RB}$, the UE shall assume that the bandwidth of the CSI-RS resource is $N\_{CSI-RS}^{BW}=N\_{BWP}^{size}+N\_{BWP}^{start}-N\_{initial RB}$, otherwise $N\_{CSI-RS}^{BW}=nrofRBs$. In all cases, the UE shall expect that $N\_{CSI-RS}^{BW}\geq min⁡(24, N\_{BWP}^{size})$. |

# Discussion

We observe that the above text is within a section called “NZP CSI-RS”, whereas a corresponding text does not appear for ZP-CSIRS. Therefore, one may get confused on how to interpret the CSI-FrequencyOccupation field when it is used for a ZP-CSIRS resource.

**Question 2.1: Do you agree that the CSI-FrequencyOccupation IE of TS 38.331 should be interpreted the same way for both NZP-CSI-RS and ZP-CSI-RS resources?**

|  |  |  |
| --- | --- | --- |
| Company name | Answer (Yes/no) | If the answer is no, please provide reference / justification |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| ZTE | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Samsung | Yes |  |
| Ericsson | Yes |  |
| OPPO | Yes |  |
| HW | Yes |  |
| Nokia | Yes |  |

**Question 2.2: Do you have a preference to**

* **Option 1: agree on a CR after the first phase of discussion?**
* **Option 2: make a conclusion in the Chairman Notes?**
* **Option 3: No CR or conclusion is needed because it is already clear in the specification**

|  |  |  |
| --- | --- | --- |
| Company name | Answer | Comments |
| Qualcomm | Option 1 or 2 | Preference with Option 1 |
| Intel | Option 2 or 3 |  |
| ZTE | Option 2 or 3 |  |
| Apple | Option 1 or 2 |  |
| CATT | Option 1 or 2 | We should also do the same thing to CSI-IM. |
| Vivo | Option 1 or 2 |  |
| Samsung | Option 2 or 3 | Option 3 is preferred.  |
| Ericsson | Option 1 or 2 |  |
| OPPO | Option 1 or 2 |  |
| HW | Option 2  |  |
| Nokia |  Option 1 or 2 |  |

# NZP CSI-RS resource association to a CSI-ResourceConfig

An NZP CSI-RS Resource IE does not contain the BWP ID nor a “resourceType”, but rather it is included in the CSI-ResourceConfig. This was done to enable sharing of basic configuration parameters across BWPs (e.g. have one underlying NZP CSI-RS resource config, which is connected to multiple CSI-ResourceConfigs, each one associated to a different BWP).

|  |
| --- |
| *CSI-ResourceConfig* information element-- ASN1START-- TAG-CSI-RESOURCECONFIG-STARTCSI-ResourceConfig ::= SEQUENCE {csi-ResourceConfigId CSI-ResourceConfigId,csi-RS-ResourceSetList CHOICE { nzp-CSI-RS-SSB SEQUENCE { nzp-CSI-RS-ResourceSetList SEQUENCE (SIZE (1..maxNrofNZP-CSI-RS-ResourceSetsPerConfig)) OF NZP-CSI-RS-ResourceSetId OPTIONAL, -- Need R csi-SSB-ResourceSetList SEQUENCE (SIZE (1..maxNrofCSI-SSB-ResourceSetsPerConfig)) OF CSI-SSB-ResourceSetId OPTIONAL -- Need R }, csi-IM-ResourceSetList SEQUENCE (SIZE (1..maxNrofCSI-IM-ResourceSetsPerConfig)) OF CSI-IM-ResourceSetId},bwp-Id BWP-Id,resourceType ENUMERATED { aperiodic, semiPersistent, periodic },…}-- TAG-CSI-RESOURCECONFIG-STOP-- ASN1STOP |

# Discussion

If there is a NZP CSI-RS resource configured that is not associated with any CSI-ResourceConfig, how can the UE know the BWP ID for which this NZP CSI-RS resource is applicable, and how can it know whether it is aperiodic semi-persistent or periodic?

**Question 3.1: Do you agree that a UE should expect that each NZP CSI-RS resource would belong in at least one CSI-ResourceConfig? If not, how can a UE identify the BWP ID of the NZP CSI-RS resource or its time-domain behavior (P/SP/AP)?**

|  |  |  |
| --- | --- | --- |
| Company name | Answer (Yes/no) | If the answer is no, please provide reference / justification |
| Qualcomm | Yes |  |
| Intel | Yes |  |
| ZTE | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Samsung | Yes |  |
| Ericsson | Yes |  |
| OPPO | Yes |  |
| Huawei | Yes |  |
| Nokia | Yes |  |

**Question 3.2: Do you have a preference to**

* **Option 1: agree on a CR after the first phase of discussion?**
* **Option 2: make a conclusion in the Chairman Notes?**
* **Option 3: No CR or conclusion is needed because it is already clear in the specification**

|  |  |  |
| --- | --- | --- |
| Company name | Answer | Comments |
| Qualcomm | Option 1 or 2 | Preference with Option 1 |
| Intel | Option 3 | Reasonable gNB implementation would ensure the corresponding configuration. There is no point for gNB to have configuration for the UE that creates such ambiguities. We don’t need to discuss / preclude all possible configurations that don’t make sense. |
| ZTE | Option 3 | The same view as Intel. If gNB configures a resource not belonging to any CSI-ResourceConfig, it will be an error case. We don’t need to capture/conclude all error cases.  |
| Apple | Option 1 or 2 |  |
| CATT | Option 3 | We share the view with Intel and ZTE. |
| Vivo | Option 1 or 2 |  |
| Samsung | Option 3 | We share the same view with Intel, ZTE and CATT.  |
| Ericsson | Option 3 | Agree with comments from Intel, ZTE, CATT, and Samsung. |
| OPPO | Option 3 |  |
| Huawei | Option 2 or 3 |  |
| Nokia | Option 3 | Agree with Intel et al. |

# Rate match NZP CSI-RS resources of the active BWP only

Rate matching of NZP CSI-RS resources is written in 38.211 Section 7.3.1.5, as shown below.

|  |
| --- |
| The UE shall, for each of the antenna ports used for transmission of the physical channel, assume the block of complex-valued symbols $y^{\left(p\right)}\left(0\right), …, y^{\left(p\right)}(M\_{symb}^{ap}-1)$ conform to the downlink power allocation specified in [6, TS 38.214] and are mapped in sequence starting with $y^{\left(p\right)}\left(0\right)$ to resource elements $\left(k^{'},l\right)\_{p,μ}$ in the virtual resource blocks assigned for transmission which meet all of the following criteria: - they are in the virtual resource blocks assigned for transmission; - the corresponding physical resource blocks are declared as available for PDSCH according to clause 5.1.4 of [6, TS 38.214];- the corresponding resource elements in the corresponding physical resource blocks are- not used for transmission of the associated DM-RS or DM-RS intended for other co-scheduled Ues as described in clause 7.4.1.1.2;- not used for non-zero-power CSI-RS according to clause 7.4.1.5 if the corresponding physical resource blocks are for PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCH with SPS, except if the non-zero-power CSI-RS is a CSI-RS configured by the higher-layer parameter *CSI-RS-Resource-Mobility* in the *MeasObjectNR* IE or except if the non-zero-power CSI-RS is an aperiodic non-zero-power CSI-RS resource; |

# Discussion

Should a UE should rate match NZP CSI-RS resources associated with a CSI-ResourceConfig of the active BWP only, or should the UE rate match all the NZP CSI-RS resources independent of whether they are associated with the active BWP? We believe the intention is the UE to rate match CSI-RS resources of the active BWP only.

**Question 4.1: Should the UE rate match the NZP CSI-RS resources of the active BWP only, or independent of whether they are associated with an active BWP or not?**

|  |  |  |
| --- | --- | --- |
| Company name | Answer  | Comments |
| Qualcomm | Only active BWP |  |
| Intel | Only active BWP |  |
| ZTE | Only active BWP |  |
| Apple | Only active BWP |  |
| CATT | Only active BWP |  |
| vivo | Only active BWP |  |
| Samsung | Only active BWP |  |
| Ericsson | Only active BWP |  |
| Huawei | Only active BWP |  |
| Nokia | Only active BWP |  |

**Question 4.2: Do you have a preference to**

* **Option 1: agree on a CR after the first phase of discussion?**
* **Option 2: make a conclusion in the Chairman Notes?**
* **Option 3: No CR or conclusion is needed because it is already clear in the specification**

|  |  |  |
| --- | --- | --- |
| Company name | Answer | Comments |
| Qualcomm | Option 1 or 2 | Preference with Option 1 |
| Intel | Option 2 or 3 |  |
| ZTE | Option 2 or 3 |  |
| Apple | Option 1 or 2 |  |
| CATT | Option 2 or 3 |  |
| vivo | Option 1 or 2 |  |
| Samsung | Option 3 |  |
| Ericsson | Option 2 or 3 |  |
| Huawei | Option 2  |  |
| Nokia | Option 2 or 3 |  |

# Semi-persistent NZP CSI-RS resources are rate matched only if active

Should a UE should rate match Semi-persistent NZP CSI-RS resources that are activated or should it rate match resources that are configured but not active? We believe that the UE is expected to rate match only active Semi-persistent resources.

# Discussion

**Question 5.1: Should a UE rate match the Semi-persistent (SP) NZP CSI-RS resources which are activated or should it rate match all the SP NZP-CSIRS resources independent of whether they are activated or not?**

|  |  |  |
| --- | --- | --- |
| Company name | Answer  | Comments |
| Qualcomm | Only the activated SP NZP CSI-RS resource |  |
| Intel | Only the activated SP NZP CSI-RS |  |
| ZTE | Only the activated SP NZP CSI-RS resource |  |
| Apple | Only the activated SP NZP-CSI-RS-Resource |  |
| CATT | Only the activated SP NZP CSI-RS resource |  |
| vivo | Only the activated SP NZP CSI-RS resource |  |
| Ericsson | Only the activated SP NZP CSI-RS resources |  |
| Huawei | Only the activated SP NZP CSI-RS resources |  |
| Nokia | Only the activated SP NZP CSI-RS resources |  |

**Question 5.2: Do you have a preference to**

* **Option 1: agree on a CR after the first phase of discussion?**
* **Option 2: make a conclusion in the Chairman Notes?**
* **Option 3: No CR or conclusion is needed because it is already clear in the specification**

|  |  |  |
| --- | --- | --- |
| Company name | Answer | Comments |
| Qualcomm | Option 1 or 2 | Preference with Option 1 |
| Intel | Option 2 or 3 |  |
| ZTE | Option 2 or 3 |  |
| Apple | Option 1 or 2 |  |
| CATT | Option 2 or 3 |  |
| vivo | Option 1 or 2 |  |
| Ericsson | Option 2 or 3 |  |
| Huawei  | Option 2 or 3 |  |
| Nokia | Option 2 or 3 |  |

# Summary of 1st Round

Thanks to all the companies for providing views. Please find below a summary and a 2nd Round of Disucssion

# 2nd Round: Frequency-domain Occupation for ZP-CSIRS

**Answers to 2.1:**

* **Yes:** 11 companies
* **No:** 0 companies

**Answers to 2.2:**

* **Option 1:** QC (preference), Apple, CATT, Vivo, Ericsson, OPPO, Nokia (7)
* **Option 2:** QC, Intel, ZTE, Apple, CATT, Vivo, Samsung, Ericsson, OPPO, HW, Nokia (11)
* **Option 3:** Intel, ZTE, Samsung (preference) (3)

1 company (CATT) pointed out that the same interpretation of the ***CSI-FrequencyOccupation* IE** should be used also for CSI-IM resources.

**Proposal 1: Conclude in the Chairman Notes as follows:**

* **With regards to the frequency domain occupation of a ZP CSI-RS resource, the *CSI-FrequencyOccupation* IE field is interpreted in a same way as for the case of a NZP CSI-RS resource following the description in Section 5.2.2.3.1 of TS 38.214:**

|  |
| --- |
| Both *nrofRBs* and *startingRB* are configured as integer multiples of 4 RBs, and the reference point for *startingRB* is CRB 0 on the common resource block grid. If $startingRB<N\_{BWP}^{start},$ the UE shall assume that the initial CRB index of the CSI-RS resource is $N\_{initial RB}=N\_{BWP}^{start}$, otherwise $N\_{initial RB}=startingRB$. If $nrofRBs>N\_{BWP}^{size}+N\_{BWP}^{start}-N\_{initial RB}$, the UE shall assume that the bandwidth of the CSI-RS resource is $N\_{CSI-RS}^{BW}=N\_{BWP}^{size}+N\_{BWP}^{start}-N\_{initial RB}$, otherwise $N\_{CSI-RS}^{BW}=nrofRBs$. In all cases, the UE shall expect that $N\_{CSI-RS}^{BW}\geq min⁡(24, N\_{BWP}^{size})$. |

|  |  |  |
| --- | --- | --- |
| Company name | Support (Yes/No) | Comments |
| Qualcomm | Yes |  |
| Samsung | Yes |  |

**Proposal 2: Include in the above conclusion that the *CSI-FrequencyOccupation* IE of a CSI-IM resource should be interpreted in the same way also.**

|  |  |  |
| --- | --- | --- |
| Company name | Support Yes/No | If the answer is no, please provide reference / justification |
| Qualcomm | Yes |  |
| Samsung | Yes |  |

# 2nd Round: NZP CSI-RS resource association to a CSI-ResourceConfig

**Answers to 3.1:**

* **Yes:** 11 companies
* **No:** 0 companies

**Answers to 3.2:**

* **Option 1:** Qualcomm, Apple, Vivo (3)
* **Option 2:** Qualcomm, Apple, Vivo, Huawei (4)
* **Option 3:** Intel, ZTE, CATT, Samsung, Ericsson, OPPO, Huawei, Nokia (8)

Even though there is consensus from the replied companies, there is still some support for a conclusion to be captured in the chairman Notes. Suggest for a 2nd a final round where only 2 options are present. Each company can be one of the 2 options.

**Continuation Question (3.2B): Suggest to down select between the following 2 Alternatives:**

* **Alt. 1: Conclude in the Chairman Notes as follows: A UE expects that each NZP CSI-RS resource would belong in at least one CSI-ResourceConfig.**
* **Alt. 2: No need of a Chairman Notes Conclusion**

|  |  |  |
| --- | --- | --- |
| Company name | Alt (Single option per company) | Comments |
| Qualcomm | Alt 1 | Preference to have at least a conclusion and avoid future commercialization ambiguities. If we leave these errors unspecified would require UE vendors to subjectively judge reasonable versus unreasonable configurations out of a 3GPP spec framework. |
| Samsung  | Alt 1 | This is a straightforward understanding but if it makes the interpretation clearer, we support its inclusion on Chairman Notes |

# 2nd Round: Rate match NZP CSI-RS resources of the active BWP only

**Answers to 4.1:**

* **Only Active BWP:** 10 companies
* **Other answer:** 0 companies

**Answers to 4.2:**

* **Option 1:** Qualcomm, Apple, Vivo (3)
* **Option 2:** Qualcomm, Intel, ZTE, Apple, CATT, Vivo, Ericsson, Huawei, Nokia (9)
* **Option 3:** Intel, ZTE, CATT, Samsung, Ericsson, Nokia (6)

**Proposal 3: Conclude in the Chairman Notes as follows:**

* **A UE is not expected to rate match an NZP CSI-RS resource which is not associated with an active BWP.**

|  |  |  |
| --- | --- | --- |
| Company name | Support (Yes/No) | Comments |
| Qualcomm | Yes |  |
| Samsung | Yes | Straightforward understanding but we are OK with supporting the conclusion.  |

# 2nd Round: Semi-persistent NZP CSI-RS resources are rate matched only if active

**Answers to 5.1:**

* **Only the activated SP NZP CSI-RS resource**: 9 companies
* **Other answer:** 0 companies

**Answers to 5.2:**

* **Option 1: Qualcomm, Apple, Vivo (3)**
* **Option 2: Qualcomm, Intel, ZTE, Apple, CATT, Vivo, Ericsson, Huawei, Nokia (9)**
* **Option 3: Intel, ZTE, CATT, Ericsson, Huawei, Nokia (6)**

**Proposal 4: Conclude in the Chairman Notes as follows:**

* **A UE is not expected to rate match a Semi Persistent NZP CSI-RS resource which is not activated.**

|  |  |  |
| --- | --- | --- |
| Company name | Support (Yes/No) | Comments |
| Qualcomm | Yes |  |
| Samsung | Yes | Straightforward understanding but we are OK with supporting the conclusion.  |

# Conclusions

**The be finalized after the end of 2nd round**