**3GPP TSG RAN WG1 Meeting #108-e R1-22xxxxx**

**e-Meeting, February 21– March 3, 2022**

**Agenda Item: 5**

**Source: Moderator (Huawei)**

**Title: [Draft] Summary of email discussion [108-e-AI5-LSs-05] on cross PUCCH-group CSI reporting related UE capability**

**Document for: Discussion and Decision**

# Introduction

In the previous meeting, a LS [1] from RAN4 is sent to RAN1. Companies had heated discussion on the questions in the LS and achieved a reply [2] for the questions as follows.

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| **Q1:** Whether UE can report CSI (e.g. L1-RSRP) of the target being-activated PUCCH SCell belonging to secondary PUCCH group by configuring CSI report setting (e.g. CSI-ReportConfig) on any active serving cells belonging to primary PUCCH group**Answer**: There is no restriction in the current RAN1 specification that would not allow UE to report CSI of a SCell belonging to secondary/primary PUCCH group by PUSCH or PUCCH of active serving cells belonging to primary/secondary PUCCH group. But there is no RAN1 consensus on whether all UEs supporting NR-CA with dual PUCCH-groups for the BC support such CSI report in Rel-15 and Rel-16. Support of such CSI report is indicated in Rel-17 with a new UE capability. Potential CSI processing timeline relaxation for UEs reporting the new UE capability can be discussed.**Q2:** Whether the above observation is correct, i.e. the identified four cases are not supported by the current RAN1 and RAN2 specification.**Answer**: RAN1 is not able to answer the question on whether the identified four cases are supported or not by current RAN1 specification.**Q3:** Whether the above identified cases can be supported by RAN1 and RAN2 spec updates within Rel-17 timeframe.**Answer**: RAN1 is not able to answer the question. However, RAN1 expects that reporting CSI (e.g. L1-RSRP) of the target being-activated PUCCH SCell belonging to secondary PUCCH group by configuring CSI report setting (e.g. *CSI-ReportConfig*) on any active serving cells belonging to primary PUCCH group supports the identified four cases. |

In the reply LS, some remaining issues need to be further discussed. The first issue is detailed design for the new UE capability, while the second issue is whether CSI processing timeline relaxation for UEs reporting the new UE capability is needed.

As per chair’s guidance, the discussion is arranged as below and is expected to complete by **February 25**, considering the deadline requested by RAN2,

 [108-e-AI5-LSs-05] Email discussion on cross PUCCH-group CSI reporting related UE capability ([R1-2202429](../../Docs/R1-2202429.zip)) by February 25 – Frank (Huawei)

* Including [R1-2201803](../../Docs/R1-2201803.zip), [R1-2202055](../../Docs/R1-2202055.zip) from agenda item 8.16.17.

# Discussions

## Issue 1: Detailed design for the new UE capability

In the reply [2], RAN1 agrees to introduce a new UE capability in Rel-17 for cross PUCCH group CSI report on PUCCH. In RAN2, as shown in Appendix, the details of the capability is expected to be input from RAN1.

In [3], the new Rel-17 UE feature is proposed as below.

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| Rel-17 Further RRM enhancement for NR and MR-DC | x-1 | CSI reporting cross PUCCH group | 1. Support reporting CSI of an active/being activated SCell belonging to secondary PUCCH group by PUSCH or PUCCH of active serving cells belonging to primary PUCCH group.
2. Support reporting CSI of an active/being activated SCell belonging to primary PUCCH group by PUSCH or PUCCH of active serving cells belonging to secondary PUCCH group.
 | [6-7] | Yes | N/A | Cross-PUCCH group CSI report is not supported | Per UE | No | No | N/A |  | Conditional mandatory if the UE supports two PUCCH groups |

In [4], it is proposed as below,

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differe-ntiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 39-1 | Cross PUCCH group CSI report | 1. Support of cross PUCCH group CSI report (the CSI measurement and the CSI report are performed in different PUCCH group) for the following CSI reports (1) periodic CSI report (P-CSI) on PUCCH (2) semi-persistent CSI report (SP-CSI) on PUCCH (1) semi-periodic CSI report (SP-CSI) on PUSCH (1) aperiodic CSI report (AP-CSI) on PUSCH
2. Supported band pair(s) for cross PUCCH group CSI report
 | 2-35 | Yes | N/A |  | Per BC | No | No |  | Component 1: candidate values with bitmap {P-CSI on PUCCH, SP-CSI on PUCCH, SP-CSI on PUSCH, AP-CSI on PUSCH}Component 2: A list of up to 16 band pairs.For each band pair, it contains {band in which CSI measurement is performed, band in which CSI report is performed}  | Optional with capability signaling |

In [5], it is proposed as below,

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 39. NR\_Cross\_PUCCH\_group\_CSI\_report | 39-1 | Cross-PUCCH-group CSI report on PUCCH | Support cross-PUCCH-group CSI report on PUCCH | 6-7 | Y |  | UE does not support cross-PUCCH-group CSI report on PUCCH | Per UE | N | N | N |  | Optional with capability signaling |

### Question 1-1: Regarding the columns “Feature group” and “Components”, whether the following contents are acceptable?

**Proposal 1-1**: For the new UE capability xx-1 for cross-PUCCH group CSI reporting,

* In column “Feature group”, it is “CSI reporting cross PUCCH group”
* In column “Components”, it is as follows,
	+ Support reporting CSI of an active/being activated SCell belonging to secondary PUCCH group by PUSCH or PUCCH of active serving cells belonging to primary PUCCH group.
	+ Support reporting CSI of an active/being activated SCell belonging to primary PUCCH group by PUSCH or PUCCH of active serving cells belonging to secondary PUCCH group.

Companies’ views are very welcome.

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### Question 1-2: Regarding the column “Type”, which the following options are acceptable?

* **Option 1**: Per UE
* **Option 2**:Per BC

Companies’ views are very welcome.

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### Question 1-3: Regarding the column “Prerequisite feature groups”, which the following options are acceptable?

* **Option 1**: FG 6-7 (Two NR PUCCH group with same numerology)
* **Option 2**: FG 2-35 (CSI report framework)
* **Option 3**: both FG 6-7 and 2-35

Companies’ views are very welcome.

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### Question 1-4: Regarding the column “Mandatory/Optional”, which the following options are acceptable?

* **Option 1**: Conditional mandatory if the UE supports two PUCCH groups.
* **Option 2**: Optional with capability signaling.

Companies’ views are very welcome.

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### Question 1-5: Regarding the columns “Need for the gNB to know if the feature is supported”, “Applicable to the capability signalling exchange between UEs” and “Consequence if the feature is not supported by the UE”, whether the following contents are acceptable?

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| Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Consequence if the feature is not supported by the UE |

**Proposal 1-5**: For the new UE capability xx-1 for cross-PUCCH group CSI reporting,

* In column “Need for the gNB to know if the feature is supported”, it is “Yes”.
* In column “Applicable to the capability signalling exchange between UEs (Sidelink WI only)”, it is “N/A”.
* In column “Consequence if the feature is not supported by the UE”, it is “Cross-PUCCH group CSI reporting is not supported”.

Companies’ views are very welcome.

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### Question 1-6: If Per-UE is agreed in Question 1-2, then regarding the columns “Need of FDD/TDD differentiation”, “Need of FR1/FR2 differentiation” and “Capability interpretation for mixture of FDD/TDD and/or FR1/FR2”, whether the following contents are acceptable?

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| Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 |

**Proposal 1-6**: For the new UE capability xx-1 for cross-PUCCH group CSI reporting,

* In column “Need of FDD/TDD differentiation”, it is “No”.
* In column “Need of FR1/FR2 differentiation”, it is “No”.
* In column “Capability interpretation for mixture of FDD/TDD and/or FR1/FR2”, it is “N/A”.

Assuming type Per-UE in Question 1-2, companies’ views are very welcome.

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## Issue 2: CSI processing timeline

In the previous meeting, some company thought that CSI processing timeline might need some relaxation for supporting the new UE capability.

CSI processing timeline is illustrated below. $Z\_{ref}$ and $Z\_{ref}^{'}$ are defined to determine whether UE shall provide a valid CSI report.



### Question 2-1: Whether Rel-16 CSI processing timeline can be reused or CSI processing timeline relaxation is needed for UE reporting the new UE capability?

* **Option 1:** Rel-16 CSI processing timeline can be reused for UEs reporting the new UE capability of support cross-PUCCH group CSI report. [3]

*“However, processing time requirements for* $Z\_{ref}^{'}$ *in Table 5.4-1 and 5.4-2 in TS 38.214 do not differentiate which serving cell the CSI-RS resource is received on, i.e. the requirements are the same for all serving cells, and it seems not impacted by PUCCH group either.”*

* **Option 2:** CSI processing timeline relaxation is needed. (Detailed values of relaxation is still missing, need to be proposed).

Companies’ views are very welcome.

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## Other Issues

Issues or comments that do not fit in any of the previous sections of this document can be provided in this section.

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# Conclusions

TBD

# References

1. R1-2108704, “LS on beam information of PUCCH SCell in PUCCH SCell activation procedure”, TSG RAN WG1 #106bis-e, October 11th – 19th, 2021.
2. R1-2112858, “Reply LS on beam information of PUCCH SCell in PUCCH SCell activation procedure”, TSG RAN WG1 Meeting #107-e, November 11th – 19th, 2021.
3. R1-2202429, “Remaining issues on beam information of PUCCH SCell in PUCCH SCell activation procedure” Huawei February 21 – March 3, 2022.
4. R1-2201803, “Rel-17 UE features on cross PUCCH group CSI report” Apple February 21 – March 3, 2022.
5. R1-2202055, “On UE features for others” MediaTek February 21 – March 3, 2022.

# Appendix

On the UE capability, the RAN2 discussions and current situation can be referred to [R2-2201933](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2201933.zip):





