**3GPP TSG RAN WG1 #104bis-e R1-2103603**

**e-Meeting, April 12th – 20th, 2021**

**Agenda item:** 7.2.11

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** Summary on UE features related discussion

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the discussions and proposals in AI 7.2.11 regarding UE features for NR URLLC and IIoT, for MR-DC/CA and for FGs not dedicated to a specific Rel-16 WI/TEI.

Based on the discussions summarized in Section 2, followings are parts of the suggested email discussions/approvals for AI 7.2.11.

**FL proposal #1 of email discussion/approval:**

**[104b-e-NR-UEFeature-URLLCIIoT-01] Email discussion/approval on UE features for URLLC/IIoT**

* **For FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e, add “in the same subslot” to restrict the time granularity where the two PUCCH should be supported**
* **For FG 11-3d and FG 11-4e, add the restriction of “consecutive symbols” for supporting the two PUCCH**
* **For FG 11-3e and FG 11-3f, change the plural to singular**
* **For FG 11-4c, FG11-4d, FG 11-4f and FG 11-4h, add the restriction that they are for two codebooks where one of the two is sub-slot based codebook, and the other is slot-based codebook**
* **For 11-4f, clarify it is for “two” codebooks**
* **Correct that FG 11-4h is to cover the missing case in 11-4d and 11-4f**
* **Correct that FG 11-4i is to cover the missing case in 11-4e and 11-4g**

Companies are encouraged to check above FL proposal #1and to provide feedback if any in below.

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| Company | Comment |
| ZTE | In general, we are fine to further discuss these issues together, though some of them are not critical.* For the first bullet, the revisions is not necessary since it is already clear based on the descriptions in ‘Components’ column.
* For the second bullet, we are fine with the revisions which reflects the intention based on related FGs in Rel-15.
* For the fourth bullet, it is not necessary based on the prerequisite of the FGs.

For the other bullets, we are fine with the editorial corrections.  |
| OPPO | We are supportive of FL’s proposal. Some of them are necessary to describe UE feature accurately* For the second bullet, the restriction of “consecutive symbols” leads pretty different UE implementation, so restriction of “consecutive symbols” is necessary. In addition, without this restriction, it is logically wrong since there would be no missing case left for FG 11-3h and FG 11-4i which are supposed to support the non-consecutive case on top of FG 11-3d and FG 11-4e.
* For the sixth bullet, there is not any overlap between FG 11-4h and FG 11-4c/e, so it is logically wrong for FG 11-4h to cover the missing cases in FG 11-4c and 11-4e. To refect the intention based on related FGs in Rel-15, FG 11-4h is to cover the missing case in 1-4d and 11-4f.
* For the seventh bullet, similar as sixth bullet. It is logically wrong for FG 11-4i to cover the missing cases in FG 11-4d and 11-4f. To reflect the intention based on related FGs in Rel-15, FG 11-4i is to cover the missing case in 1-4e and 11-4g.

Some of them are editorial correction.* Although some editorial correction only intends to make up description from ‘Components’ column, it is benefit for RAN2 to capture our intention completely in TS38.306.
 |
| Nokia, NSB | We do not have a strong opinion on those issues as they are editorial corrections. Not all of them are needed in our view, but that might require some discussion to clarify anyway. |
| Apple | We support FL’s proposal. Based on past experiences, it is always good to have accurate descriptions of the FGs to avoid confusion, and to minimize the chance to revisit them at a later stage. |
| Ericsson | In general we are fine to discuss the bullets, even though they are all editorial or clarification in nature. This ensures that the editorial changes or clarifications can be made to 38.306 after RAN2 receives RAN1 input.One question is, to what extent should we worry about editorial/clarification issues? Do we need to check how RAN2 captured each UE feature in 38.306, which is what matters ultimately?  |
| Moderator (NTT DOCOMO) | Thanks for the feedbacks!It seems we can keep the FL proposal #1 as it is. Once we agreed some updates on descriptions in the UE features list, of course it will be sent to RAN2. RAN2 will consider such change will be reflected to 38.306 description or not and RAN2 will capture the UE features list in updated 38.822 anyway.  |
| Huawei, HiSilicon | We are fine to disucss these bullets for editoral corrections although we think some of them are not really necessary, e.g. * For the first bullet for FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e, we think “per subslot” in the components already make it clear on the granularity, thus actually the changes here seems not essential.
* For the fourth bullet for adding “one slot based HARQ-ACK codebook”, we think it is clear from the original description, since it mentions two HARQ-ACK codebooks with one sub-slot based, then for sure the other one is slot-based.

Of course, fine to make it clearer from RAN1 perspective, and can leave it to RAN2 on whether to make any change for it or not.  |

Based on the discussions summarized in Section 3, followings are parts of the suggested email discussions/approvals for AI 7.2.11.

**FL proposal #2 of email discussion/approval:**

**[104b-e-NR-UEFeature-MRDCCA-01] Email discussion/approval on UE features for MR-DC/CA enhancement**

* **Delete “X applies per span in a slot of scheduling CC” in FG 18-5c/d**

Companies are encouraged to check above FL proposal #2 and to provide feedback if any in below.

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| Company | Comment |
| ZTE | We support the first bullet.Regarding the second bullet, it seems the proposed new FG in R1-2103662 has the same function as FG22-10, which was agreed in last meeting. Is this the correct understanding, or did we miss anything? |
| Nokia, NSB | We support discussing the first bulletOn the second bullet, we do not see a need for discussion this meeting. We agree with ZTE that this seems to be the same issue that has already been discussed and agreed in last meeting in FG 22-10. Regarding the change to ‘per FS’, there is no need for that, as 3-5b is already ‘per FS’, and hence FG22-10 will only apply for those bands. This has been the understanding for various other Rel-16 FGs already. |
| Ericsson | We support discussing the first bullet. On 2nd bullet, indeed FG 22-10 agreed in last meeting addresses this issue already. So, there is no need to introduce another new FG and we do not prefer to change the reporting type granularity. |
| Moderator (NTT DOCOMO) | Thanks for the feedbacks!Based on the feedbacks, 2nd bullet can be deleted unless there are some companies (other than proponent) who want to discuss whether or not to change the type of FG to per FS as proposed in R1-2103770. |
| Huawei, HiSilicon | 1. We are fine to discuss the first bullet.
2. As to the second bullet, our original intention is to change the reporting type for the new Rel-16 capability to “FS” to align with the reporting type of FG 3-5b, which could provide more flexibility. However, we would like to hear views from other companies also and if all other companies prefer to keep it as it is, we can accept it also.
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Based on the discussions summarized in Section 4, followings are parts of the suggested email discussions/approvals for AI 7.2.11.

**FL proposal #3 of email discussion/approval:**

**[104b-e-NR-UEFeature-Others-01] Email discussion/approval on UE features that are not dedicated to specific Rel-16 WI/TEI**

* **Clarify FG3-1 as below.**
	+ **5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduling slot per scheduled CC for FDD scheduling cell**
	+ **6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per scheduling slot per scheduled CC for TDD scheduling cell**
* **Send an LS to RAN2 to add in the description of FG 22-5c and 22-5d the following note**
	+ **For simultaneously Ant.Sw . + Ant.Sw SRS in intra-band CA, or in inter-band CAs with bands whose UL are switched together according to the reported UE capability, the UE expects the same configuration of xTyR across the different CCs and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports.**
* **Introduce the following FGs**
	+ **FG22-Xa/Xb to address the missing 'cri-RI-CQI' report related UE capability**
	+ **Replicate FG 2-38, i.e., csi-ReportWithoutPMI, to address the NBC issue**

Companies are encouraged to check above FL proposal #3 and to provide feedback if any in below.

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| Company | Comment |
| Apple | We are supportive of the FL proposals* Regarding the first bullet, we are supportive of the clarification
* Regarding the second bullet, we are supportive of the LS and capturing the note in 38.306
* Regarding the third bullet, we truly hope that this issue can be resolved, or at least, discussed. The motivation is explained in our contribution R1-2103087
	+ non-PMI CSI is a LTE Rel-13 feature, however, the agreed non-PMI CSI, i.e. cri-RI-CQI, design in NR is so flexible that it is prohitively memory inefficient for UE to support due to the following two reasons
		- For UE supporting cri-RI-CQI, UE is mandated to support advanced *non-PMI-PortIndication* in which the RI to port mapping is configured by RRC independently for each RI and each NZP-CSI-RS resource
		- UE is mandated to support maximum 64 NZP-CSI-RS resources which requires unreasonably high memory
	+ Based on our knowledge, cri-RI-CQI is not actively deployed in the field. Therefore, there is no market fragmentation issue. In fact, in our view, the NR design makes it is very difficult for UE to support cri-RI-CQI and makes NR design less efficient than LTE.
	+ As results, we truly hope we can visit this issue since non-PMI CSI reporting could be useful for TDD deployment, even though we do also have port selection codebook.
 |
| ZTE | Regarding the first bullet, we are supportive to clarify this issue.Regarding the second bullet, we are fine to send an LS |
| Nokia, NSB | Regarding the first bullet, we are fine to discuss this issue. Regarding the LS, it looks like there is no need for separate LS on this particular point. In case any change is agreed on, it could be addressed as part of the usual LS RAN1 sends to update RAN2 on any changes to UE features.Regarding the third bullet, we do not support the discussion. We would like to note that there are already UE capabilities limiting the max number of configured CSI-RS/IM resources and ports, *maxConfigNumberNZP-CSI-RS-PerCC* and *maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC*, and they are provided per band (in *csi-RS-IM-ReceptionForFeedback*, i.e. FG 2-33). Hence, the UE already has the means to manage the number of configured resources, and there is no need for the new FGs.  |
| Ericsson | First bullet: OK to discuss.Second bullet: Ok to discuss. Agree the LS should be sent asking that the note be added to 38.306.We do not support discussing the third bullet. We have similar view as Nokia the the UE can use FG 2-33 to indicate the capability for the maximum # of configured NZP-CSI-RS resources per CC, maximum # of ports across all configured NZP-CSI-RS resources per CC, etc.  |
| Moderator (NTT DOCOMO) | Thanks for the feedbacks!Based on the feedbacks, 3rd bullet can be deleted unless there are some companies (other than proponent) who want to discuss whether or not to introduce new FGs as proposed in R1-2103087.Regarding the second bullet, I also agree with Nokia/NSB that our regular LS on updated UE features list can capture agreed changes and asking to RAN2 to reflect the change to 38.306 if any. |
| Huawei, HiSilicon | We agree the assessment from the moderator above.  |
| Apple | Regarding the third issue in others agenda that is removed in the latest FL summary, we have been raising this issue for at least three meetings. The issue is that the capability "maxConfigNumberNZP-CSI-RS-PerCC”, or “maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC” or any other related capability in FG2-33, for example, cannot be used for the UE to report its capability regarding the issue we raised. * The maximum number of NZP-CSI-RS resource that can be configured per CSI-ReportConfig with reportQuantity = "cri-RI-CQI” is 64
	+ UE needs to store the RI to port mapping for every single NZP-CSI-RS resource which is additional memory cost on top of storing the CSI-RS configurations. The FG2-33 is about the memory of storing CSI-RS configurations, not the RI to port mapping
	+ Strictly speaking, NW can configure the same NZP-CSI-RS resource multiple times in one or different CSI-ReportConfig.
	+ Therefore, truly from UE implementation perspective, the aforementioned UE capability cannot be used to report the UE memory related capability for cri-RI-CQI reporting with non-PMI-PortIndication
* In the current specification, if UE supports cri-RI-CQI (FG2-38), UE is mandated to support 64 NZP-CSI-RS-Resources per CSI-ReportConfig with reportQuantity = "cri-RI-CQI”
	+ We have the similar issue during Rel-16 BM capability discussion regarding the 64 SSBs. During which time, infra-vendor especially Ericsson has strong concern on how UE reports the capability for FG16-1g and FG16-1g-1. It is Ericsson opinion that UE should not add 64 SSBs as a constant to the capability reporting, which will restrict both the NW and UE operation.
	+ As results, we have a compromise to address infra-vendor concern. Now, for the same issue, when it affects UE capability, there is inconsistent treatment.
* If you check how CSI related capability is designed in Rel-15, it does not even follow the general design. Using LA-CSI as example
	+ We do have FG2-33 to cover the total memory/processing power for LA-CSI
	+ The LA-CSI contains many different CSI reporting modes, including but not limited to (1)FG2-38, cri-RI-CQI (2)FG-2-36: Type I SP (3)FG2-40, TypeI MP (4)FG2-41, TypeII (5)FG2-43, Type II PS
	+ If you check the other CSI codebook types, FG2-36/40/41/43, we do have individual resource related capability reporting (triplets) specified. The design is not to have one set of parameters in FG2-33 to cover all the reporting format, since UE may have different implementation and may not be able to share the processing or memory between all types of CSI reports.
	+ We can not use the argument that we already have FG2-33, for example, to remove the triplet in FG2-36/40/41/43. In fact, the triplet design is one of the most important UE capability reporting repeated discussed in Rel-16 TEI, Rel-16 eMIMO. If you check new FGs adopted for Rel-16 TEI/eMIMO, the triplet design is carried over.

With the above explanation, the reason provided by Nokia/Ericsson is not enough to prevent the discussing of this issue, in our view. We proposed this issue for three meetings because it is the issue we are facing when we are planning to support non-PMI based CSI reporting. If there is a solution, we would not struggle for three meetings to propose the same thing. In the end, we are discussing something in a UE feature agenda, and in this later stage, we only propose something that we feel is important since otherwise, the consequence is that we cannot support a feature that we feel might be useful. I would sincerely ask Nokia/Ericsson/Huawei to consider again our proposal, or may be provide some further explanation * If you stand in the shoes of some engineer that has to implement cri-RI-CQI reporting with non-PMI-PortIndication, with the above explanation I provided, how can FG2-33, i.e., "maxConfigNumberNZP-CSI-RS-PerCC” or “maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC”  be used to resolve the memory concern from the engineer.
	+ The additional memory cost of storing each individual RI to port mapping
	+ The additional memory cost of multiple CSI-ReportConfig and up to 64 NZP-CSI-RS-Resource per CSI-ReportConfig, and, for each NZP-CSI-RS-Resource in each CSI-ReportConfig, an independent RI to porting mapping for each RI
	+ Why NW needs to configure up to 64 NZP-CSI-RS-Resource per CSI-ReportConfig. If you have any plan to deploy the feature, what is the benefit for that, for example, in which frequency band we need this many NZP-CSI-RS resources?
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| Qualcomm | We are supportive of the third bullet. There are upto 128 resources per report config, and there can be a non-PMI-PortIndication for each of them. The number of bits for each non-PMI-PortIndication is upto 108bits, so 128 x 108 requires a huge memory cost. Network can order the ports in each resource so that non-PMI-PortIndication is not needed essentially. The tuple reported in 2-33 is a envelop for all codebooks and the non-PMI based CSI. We think it is also beneficial by having CSI-RS triplet for non-PMI based CSI, just as other codebooks. Alternative solution can be tying non-PMI based CSI capability to Type I capability, so there is no need of additional capability reporting. |
| Moderator (NTT DOCOMO) | Thanks for the additional feedbacks!As there is at least one company supporting the third bullet in addition to the proponent, it can be kept as one of discussion topics. However, we should be reminded that we are not in a phase for discussing new Rel-16 FGs proposal unless it is quite essential for majority. The bar to introduce new FGs for Rel-16 should be extremely high at this stage.  |

1. Discussion on Rel-16 NR UE features for URLLC/IIoT
	1. FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e

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| 11. NR\_L1enh\_URLLC | 11-3c | 2 PUCCH of format 0 or 2 for a single 7\*2-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR  | 11-3 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7” is replaced by “6” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-3d | 2 PUCCH of format 0 or 2 for a single 2\*7-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-3 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4e | 2 PUCCH of format 0 or 2 for two subslot based HARQ-ACK codebooks  | If the UE supports two subslot HARQ codebooks, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR   | 11-4a | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting. | Optional with capability signalling |

Following proposals are made in contributions.

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| [2] | **FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e**It did not mention in what time granularity where the two PUCCH should be supported.***Proposal 1: For FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e, add “in the same subslot” to restrict the time granularity where the two PUCCH should be supported.***

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| 11. NR\_L1enh\_URLLC | 11-3c | 2 PUCCH of format 0 or 2 in the same subslot for a single 7\*2-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR  | 11-3 |
| 11. NR\_L1enh\_URLLC | 11-3d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for a single 2\*7-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-3 |
| 11. NR\_L1enh\_URLLC | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-4 |
| 11. NR\_L1enh\_URLLC | 11-4e | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two subslot based HARQ-ACK codebooks  | If the UE supports two subslot HARQ codebooks, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR   | 11-4a |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #1**

* **For** **FG 11-3c, FG 11-3d, FG 11-4d and FG 11-4e, add “in the same subslot” to restrict the time granularity where the two PUCCH should be supported**
	1. FG 11-3d and FG 11-4e

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| 11. NR\_L1enh\_URLLC | 11-3d | 2 PUCCH of format 0 or 2 for a single 2\*7-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-3 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4e | 2 PUCCH of format 0 or 2 for two subslot based HARQ-ACK codebooks  | If the UE supports two subslot HARQ codebooks, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR   | 11-4a | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting. | Optional with capability signalling |

Following proposals are made in contributions.

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| [2] | **FG 11-3d and FG 11-4e:**It did not mention the “consecutive symbols” for supporting the two PUCCH. Without this restriction, it is logically wrong since there would be no missing case left for FG 11-3f and FG 11-4i which are supposed to support the non-consecutive case on top of FG 11-3d and FG 11-4e.***Proposal 2: For FG 11-3d and FG 11-4e, add the restriction of “consecutive symbols” for supporting the two PUCCH.***

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| 11. NR\_L1enh\_URLLC | 11-3d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for a single 2\*7-symbol subslot based HARQ-ACK codebook  | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-3 |
| 11. NR\_L1enh\_URLLC | 11-4e | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two subslot based HARQ-ACK codebooks  | If the UE supports two subslot HARQ codebooks, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR   | 11-4a |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #2**

* **For FG 11-3d and FG 11-4e, add the restriction of “consecutive symbols” for supporting the two PUCCH**
	1. FG 11-3e and FG 11-3f

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| 11. NR\_L1enh\_URLLC | 11-3e | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot | 11-3 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-3f | 2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks which are not covered by 11-3d and 11-3e  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks which are not covered by 11-3d and 11-3e  | 11-3 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |

Following proposals are made in contributions.

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| [2] | **FG 11-3e and FG 11-3f**It is wrong to use the plural, since it is for a single codebook.***Proposal 3: For FG 11-3e and FG 11-3f, change the plural to singular.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-3e | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for a single 2\*7-symbol HARQ-ACK codebook~~s~~  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot | 11-3 |
| 11. NR\_L1enh\_URLLC | 11-3f | 2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebook~~s~~ which are not covered by 11-3d and 11-3e  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks which are not covered by 11-3d and 11-3e  | 11-3 |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #3**

* **For FG 11-3e and FG 11-3f, change the plural to singular**
	1. FG 11-4c, FG11-4d, FG 11-4f and FG 11-4h

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 11. NR\_L1enh\_URLLC | 11-4c | 2 PUCCH of format 0 or 2 for two HARQ-ACK codebooks with one 7\*2-symbol sub-slot based HARQ-ACK codebook | If the UE supports a 7\*2-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR  | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting. For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2For ECP, “7” is replaced by “6” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |
| 11. NR\_L1enh\_URLLC | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot which are not covered by 11-4c and 11-4e  | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4c and 11-4e | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22aFor ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | **FG 11-4c, FG11-4d, FG 11-4f and FG 11-4h:**It is for two codebooks where one of the two is sub-slot based codebook, but did not mention the other codebook is slot or sub-slot based codebook. Considering that they are all dependent on 11-4, which is for “Two HARQ-ACK codebooks with up to one sub-slot based HARQ-ACK codebook (i.e. slot-based + slot-based, or slot-based + sub-slot based) simultaneously constructed for supporting HARQ-ACK codebooks with different priorities at a UE”, it can be derived that they are for slot-based + sub-slot-based case.***Proposal 4: For FG 11-4c, FG11-4d, FG 11-4f and FG 11-4h, add the restriction that they are for two codebooks where one of the two is sub-slot based codebook, and the other is slot-based codebook.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4c | 2 PUCCH of format 0 or 2 in the same subslot for two HARQ-ACK codebooks with one 7\*2-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 7\*2-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR  | 11-4 |
| 11. NR\_L1enh\_URLLC | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK, 2) 2 PUCCH format 0 in different symbols and once per subslot for SR   | 11-4 |
| 11. NR\_L1enh\_URLLC | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 |
| 11. NR\_L1enh\_URLLC | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot and one slot based HARQ-ACK codebook which are not covered by 11-4~~c~~d and 11-4~~e~~f  | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4~~c~~d and 11-4~~e~~f | 11-4 |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #4**

* **For FG 11-4c, FG11-4d, FG 11-4f and FG 11-4h, add the restriction that they are for two codebooks where one of the two is sub-slot based codebook, and the other is slot-based codebook**
	1. FG 11-4f

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook  | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [2] | **FG 11-4f: 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook.**It is for two codebooks, but the number “two” is missing.***Proposal 5: For 11-4f, clarify it is for “two” codebooks.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #5**

* **For 11-4f, clarify it is for “two” codebooks**
	1. FG 11-4h

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot which are not covered by 11-4c and 11-4e  | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4c and 11-4e | 11-4 | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22aFor ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [2] | **FG 11-4h: 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot which are not covered by 11-4c and 11-4e.**It is for the others cases not covered by FG 11-4c and 11-4e, but FG 11-4h is for 2\*7-symbol + 1 sub-slot based case or 2\*7-symbol + 1 slot-based codebook case, while FG 11-4c is for 7\*2-symbol case, and FG 11-4e is for two sub-slot based case, so there are no overlapping case. The case in FG 11-4h should be not cover by 11-4d and 11-4f.***Proposal 6: Correct that FG 11-4h is to cover the missing case in 1-4d and 11-4f.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot and one slot based HARQ-ACK codebook which are not covered by 11-4~~c~~d and 11-4~~e~~f  | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4~~c~~d and 11-4~~e~~f | 11-4 |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #6**

* **Correct that FG 11-4h is to cover the missing case in 11-4d and 11-4f**
	1. FG 11-4i

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4i | 2 PUCCH transmissions in the same subslot for two subslot based HARQ-ACK codebooks which are not covered by 11-4d and 11-4f  | If the UE supports two HARQ-ACK codebooks both with 2\*7-symbol configuration, the UE also supports:1) 2PUCCH transmissions in the same subslot of a codebook which are not covered by 11-4d and 11-4f | 11-4a | Yes | N/A |  | Per FSPer FS is selected because the processing power the UE has to spend on preparing PUCCH has a relation with PDSCH processing power and that is related to number of carriers on which the UE has to process PDSCH | N/A | N/A | N/A | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.For ECP, “7 symbols” is replaced by “6 symbols” | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| [2] | **FG 11-4i: 2 PUCCH transmissions in the same subslot for two subslot based HARQ-ACK codebooks which are not covered by 11-4d and 11-4f.**It is for the others cases not covered by FG 11-4d and 11-4f, but FG 11-4i is for 2 sub-slot based codebook case, while FG 11-4d and 11-4f are for 1 sub-slot based and 1 slot-based codebook, so no overlapping. The case in FG 11-4i should be not cover by 11-4e and 11-4g.***Proposal 7: Correct that FG 11-4i is to cover the missing case in 1-4e and 11-4g.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 11. NR\_L1enh\_URLLC | 11-4i | 2 PUCCH transmissions in the same subslot for two subslot based HARQ-ACK codebooks which are not covered by 11-4~~d~~e and 11-4~~f~~g  | If the UE supports two HARQ-ACK codebooks ~~both with 2\*7-symbol configuration~~, the UE also supports:1) 2PUCCH transmissions in the same subslot of a codebook which are not covered by 11-4~~d~~e and 11-4~~f~~g | 11-4a |

 |

Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #7**

* **Correct that FG 11-4i is to cover the missing case in 11-4e and 11-4g**
1. Discussion on Rel-16 NR UE features for MR-DC/CA enhancement
	1. FG 18-5c/5d

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18. MR-DC/CA enhancement | 18-5c | Processing up to X unicast DCI scheduling for DL per scheduled CC | Processing up to X unicast DCI scheduling for DL per scheduled CC * + X is based on pair of (scheduling CC SCS, scheduled CC SCS):
		- Candidate value(s) of X
			* X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)
		- X applies per span in a slot of scheduling CC
 | 18-5 | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5c is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell* If reported value of X in FG18-5c is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied.
 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5d | Processing up to X unicast DCI scheduling for UL per scheduled CC | Processing up to X unicast DCI scheduling for UL per scheduled CC * + X is based on pair of (scheduling CC SCS, scheduled CC SCS):
		- Candidate value(s) of X
			* X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)
		- X applies per span in a slot of scheduling CC
 | 18-5b | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5d is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell* If reported value of X in FG18-5d is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied.
 | Optional with capability signalling |

Following proposals are made in contributions.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [1] | According to the notes of FG 18-5c/d (yellow highlighted parts), they are only applicable to the basic PDCCH monitoring capability 3-1. However, in the components of them, it is clarified that “X applies per span in a slot of scheduling CC”. This seems to contradict with each other because there is no span definition for FG3-1. Thus, we propose to delete “X applies per span in a slot of scheduling CC” in FG 18-5c/d. ***Proposal-2****: Delete “X applies per span in a slot of scheduling CC” in FG 18-5c/d.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18. MR-DC/CA enhancement | 18-5c | Processing up to X unicast DCI scheduling for DL per scheduled CC | Processing up to X unicast DCI scheduling for DL per scheduled CC * X is based on pair of (scheduling CC SCS, scheduled CC SCS):
	+ Candidate value(s) of X

X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)* + X applies per span in a slot of scheduling CC
 | 18-5 | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5c is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell* If reported value of X in FG18-5c is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied.
 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5d | Processing up to X unicast DCI scheduling for UL per scheduled CC | Processing up to X unicast DCI scheduling for UL per scheduled CC * X is based on pair of (scheduling CC SCS, scheduled CC SCS):
	+ Candidate value(s) of X

X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)* + X applies per span in a slot of scheduling CC
 | 18-5b | Yes | N/A |  | Per FS | N/A | N/A | N/A | This FG is only applicable to the basic PDCCH monitoring capability 3-1Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5d is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell* If reported value of X in FG18-5d is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied.
 | Optional with capability signalling |

 |

Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #8**

* **Delete “X applies per span in a slot of scheduling CC” in FG 18-5c/d**
	1. New FG

Following proposals are made in contributions.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [8] | Below agreements were made in RAN1#104-e meeting. ***Agreement****Regarding the interpretation of UE capabilities in case of cross-carrier operation,* ***for cross-carrier scheduling with the same SCS in the scheduling cell and the scheduled cell****, RAN1 clarifies that support of* pdcch-MonitoringAnyOccasionsWithSpanGap *is based on both the support of this capability for the band of the scheduled/triggered/indicated cell and the support of this capability for the band of the scheduling/triggering/indicating cell.** *Note: For pdcch-MonitoringAnyOccasionsWithSpanGap, the supported set (set1, set2 or set 3) for cross-carrier scheduling with the same SCS in the scheduling cell and the scheduled cell is still based on the indicated value for the band of the scheduling cell.*

***Agreement******For cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell****, RAN1 introduces new Rel-16 UE capability to clarify the interpretation of* pdcch-MonitoringAnyOccasionsWithSpanGap *in case of cross-carrier operation.** *The detailed design of this new Rel-16 UE capability is to be discussed under Rel-16 UE feature session.*

***Agreement****LS to RAN2 on interpretation of UE features in case of cross-carrier operation is endorsed in* [*R1-2102085*](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_91e/Docs/R1-2102085.zip)For the new Rel-16 capability, we propose the following FG definition. **Proposal : Adopt below FG definition for the interpretation of pdcch-MonitoringAnyOccasionsWithSpanGap for cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 18. MR-DC/CA enhancement | 18-5e | Handling of pdcch-MonitoringAnyOccasionsWithSpanGap) for cross-carrier scheduling and with different numerology between scheduling cell and scheduled cell. | Indicates condition under which the UE supports pdcch-MonitoringAnyOccasionsWithSpanGap for cross-carrier scheduling with different SCS in the scheduling cell and the scheduled cells. Candidate values are {‘both’, ‘scheduling cell’}* When ‘both’ is reported,
	+ Condition is satisfied only when UE indicates support of pdcch-MonitoringAnyOccasionsWithSpanGap for the band of the scheduled/triggered/indicated cell and indicates support of pdcch-MonitoringAnyOccasionsWithSpanGap for the band of the scheduling/triggering/indicating cell.
* When ‘scheduling cell only’ is reported,
	+ Condition is satisfied when UE indicates support of pdcch-MonitoringAnyOccasionsWithSpanGap for the band of the scheduling/triggering/indicating cell.
 | 18-5/5b, 3-5b | Yes | N/A |  | Per UE | N/A | N/A | N/A | Note: For pdcch-MonitoringAnyOccasionsWithSpanGap, the supported set (set1, set2 or set 3) for cross-carrier scheduling with different SCS in the scheduling cell and the scheduled cell is still based on the indicated value for the band of the scheduling cell. | Optional with capability signalling |

 |
| [10] | In RAN1#104-e, FG22-10 was introduced for the interpretation of FG3-5b in case of cross-carrier scheduling with different SCSs in the scheduling cell and scheduled cell. It was also agreed that FG22-10 is a per UE capability. However, if UE indicates the support of band combination band A + band B + band C, if the UE indicates the support of FG3-5b on band A and interpretation 2 of FG22-10, the UE needs to support scheduling from band A to band B, band A to band C, band A to (band B + band C). Hence the number of scheduled cells depends on the band combination containing band A. However, not all band combinations needs FG3-5b for cross-carrier scheduling with different SCSs in the scheduling cell and scheduled cell, it is more proper if the granularity of FG22-10 is per FS and which will avoid unnecessary UE implementation complexity. Thus for band combination band A + band B +band C, if the band A supports FG3-5b and UE indicates support of interpretation2 of FG22-10 for band combination band A + band B, then UE supports cross-carrier scheduling from band A to band B using FG3-5b only, the scheduling from band A to band C, band A to (band B + band C) are not supported. Hence we propose to change the type of FG22-10 from per UE to per FS.***Proposal 1: The type of UE capability FG22-10 is changed to per FS.*** |

Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #9**

* **Adopt the FG definition for the interpretation of pdcch-MonitoringAnyOccasionsWithSpanGap for cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell as proposed in R1-2103662 or change the type of FG to per FS as proposed in R1-2103770**
1. Discussion on New FGs that are not dedicated to a specific Rel-16 work item/TEI
	1. FG 3-1

Following proposals are made in contributions.

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| [1] | In Rel-15 and Rel-16, RAN1 has defined some advanced UE features on PDCCH monitoring to support cross-carrier scheduling, especially cross-carrier scheduling with different numerologies, e.g., FG3-5b and FG18-5c/d. However, all these advanced UE features are optional. In case that UE only supports basic PDCCH monitoring UE capability, i.e., FG3-1, it is not clear how to interpret it for cross-carrier scheduling. The detailed description of FG3-1 is as below. Based on the yellow highlighted parts, UE is capable of processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD, and is capable of processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot per scheduled CC for TDD. It is not clear whether the “per slot” and “for FDD/TDD” refers to the scheduling cell or the scheduled cell.

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| 3-1 | Basic DL control channel | 1) One configured CORESET per BWP per cell in addition to CORESET0- CORESET resource allocation of 6RB bit-map and duration of 1 – 3 OFDM symbols for FR1- For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSSs, CORESET resource allocation of 6RB bit-map and duration 1-3 OFDM symbols for FR2- For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 1-2 OFDM symbols for FR2- REG-bundle sizes of 2/3 RBs or 6 RBs- Interleaved and non-interleaved CCE-to-REG mapping- Precoder-granularity of REG-bundle size - PDCCH DMRS scrambling determination- TCI state(s) for a CORESET configuration2) CSS and UE-SS configurations for unicast PDCCH transmission per BWP per cell- PDCCH aggregation levels 1, 2, 4, 8, 16- UP to 3 search space sets in a slot for a scheduled SCell per BWPThis search space limit is before applying all dropping rules. - For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot- For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot3) Monitoring DCI formats 0\_0, 1\_0, 0\_1, 1\_14) Number of PDCCH blind decodes per slot with a given SCS follows Case 1-1 table5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot per scheduled CC for TDD |

Based on our understanding, “per slot” refers to “per slot of the scheduling cell”. Otherwise, it may require UE to process 8 DCIs scheduling DL in one scheduling slot in case of 15KHz (scheduling cell) + 120KHz (scheduled cell) CA. Regarding “for FDD/TDD”, it refers to the duplex mode of the scheduling cell because the PDCCH limitation only occurs when the scheduling cell is TDD (i.e., the number of DL slots is limited). Thus, we propose to introduce the following clarification for FG3-1.***Proposal-1****:* *Clarify FG3-1 as below.**5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduling slot per scheduled CC for FDD scheduling cell**6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per scheduling slot per scheduled CC for TDD scheduling cell* |

Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #10**

* **Clarify FG3-1 as below.**
	+ **5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduling slot per scheduled CC for FDD scheduling cell**
	+ **6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per scheduling slot per scheduled CC for TDD scheduling cell**
	1. FG 22-5c/5d

Following proposals are made in contributions.

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| [5] | The following agreement was reached in RAN1 #102-e meeting with regards to the simultaneous transmission of SRS Ant. Sw. with other SRS resources.

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| **Agreement*** In UL CA, for SRS for antenna switching + SRS for CB/NCB /BM/antenna switching case, the simultaneous transmission of SRS on different CCs  is subject to UE FG 22-5a/22-5b/22-5c/22-5d
	+ New UE FG 22-5a/22-5b/22-5c/22-5d are introduced
	+ Note: For simultaneously Ant.Sw . + Ant.Sw SRS in intra-band CA, or in inter-band CAs with bands whose UL are switched together according to the reported UE capability, the UE expects the same configuration of xTyR across the different CCs  and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports.
* Note: In UL CA, for SRS for CB/NCB /BM + SRS for CB/NCB /BM case, the simultaneous transmission of SRS on different CCs are supported in the supported combinations subject to UE capability in Rel-15
	+ No spec impact for this
* Note: different spatial relation for SRS +SRS is a separate issue
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Even though the new FGs were added in the LS to RAN2 [2], the following Note from the above agreement was not captured in the 38.306 specification:* + Note: For simultaneously Ant.Sw . + Ant.Sw SRS in intra-band CA, or in inter-band CAs with bands whose UL are switched together according to the reported UE capability, the UE expects the same configuration of xTyR across the different CCs  and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports.

It should be noted that this Note is important for both UE and gNBs to have a common understanding on what is expected from a UE that supports this feature. Without the note, there is a risk of misconfiguring the UEs with Ant Switching configurations which are not compatible. ***Proposal 1:*** ***Send an LS to RAN2 to add in the description of FG 22-5c and 22-5d the following note:**** ***For simultaneously Ant.Sw . + Ant.Sw SRS in intra-band CA, or in inter-band CAs with bands whose UL are switched together according to the reported UE capability, the UE expects the same configuration of xTyR across the different CCs  and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports.***
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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #11**

* **Send an LS to RAN2 to add in the description of FG 22-5c and 22-5d the following note**
	+ **For simultaneously Ant.Sw . + Ant.Sw SRS in intra-band CA, or in inter-band CAs with bands whose UL are switched together according to the reported UE capability, the UE expects the same configuration of xTyR across the different CCs and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports.**
	1. New FGs

Following proposals are made in contributions.

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| [4] | In Rel-15, a special port selection CSI report is designed by configuring the UE with a CSI-ReportConfig with the higher layer parameter reportQuantity set to 'cri-RI-CQI'. The detailed UE behavior is specified in Clause 5.2.1.4.2 in 38.214. There are two modes of 'cri-RI-CQI' report summarized as below* Simpler mode, without *non-PMI-PortIndication*. In this mode, the port grouping for each rank is hardcoded in the specification
* More complicated mode, with *non-PMI-PortIndication*. In this mode, the port grouping for each rank is RRC configured independently for each CSI-RS resource.

Compared to the simpler mode, the mode with *non-PMI-PortIndication* requires UE to have more memory to store the RRC configuration of port grouping of each rank. This configuration is done per *CSI-ReportConfig* per CC, which may require large amount of UE memory to store the RRC configuration. Furthermore, it is not clear to us whether RRC configured port grouping can really provide meaningful performance benefit, since CSI-RS transmission is transparent such that gNB already has full flexibility to determine the beam forming applied to each CSI-RS ports. Therefore, it is reasonable to assume that a UE may only support 'cri-RI-CQI' report without *non-PMI-PortIndication*, but does not support 'cri-RI-CQI' report with *non-PMI-PortIndicatio.*In the current UE feature design, the above differentiation is not allowed. We only have a single FG, i.e. FG 2-38 *csi-ReportWithoutPMI*, to indicate whether UE supports 'cri-RI-CQI' report. UE has to support either both with and without *non-PMI-PortIndication*, or, neither of them. This limits the possibilities that a UE can support 'cri-RI-CQI' report and, also limits the potential gain that can be achieved in the field for reciprocity based MIMO operation especially in TDD frequency band.Furthermore, even for UE that supports 'cri-RI-CQI' report, currently the UE is not allowed to report the CSI-RS resource related capability, such as the maximum number of CSI-RS resources and the maximum number of ports of CSI-RS resource, unlike other codebook types such as FG2-36, FG2-40, FG2-41, FG2-43To address those issues, we propose the following new FGs **Proposal 1: Introduce the following FG and UE capability related to PUCCH group*** **FG22-7a/7b to address the missing 'cri-RI-CQI' report related UE capability**
* **Replicate FG 2-38, i.e., csi-ReportWithoutPMI, to address the NBC issue**

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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 (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 22. NR Others | 22-7a | Support of 'cri-RI-CQI' report with non-PMI-PortIndication | UE supports CSI-ReportConfig with the higher layer parameter reportQuantity set to 'cri-RI-CQI' and the higher layer parameter non-PMI-PortIndication configured | 2-38 | Yes | N/A |  | Per UE | N/A | N/A  | N/A |  | Optional with capability signalling |
| 22. NR Others | 22-7b | CSI-RS resource limitation on 'cri-RI-CQI' report | A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously.  | 2-38 | Yes | N/A |  | Per UE | N/A | N/A  | N/A |  | Optional with capability signallingMaximum size of the list is 16. the candidate values for the max # of Tx port in one resource is {2, 4, 8} The candidate value set of the max # of resources is: {from 1 to 64} The candidate value set of total # of ports (including both channel and NZP-CSI-RS based interference measurement) is: {from 2 to 256}  |

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Based on the above, following proposal can be discussed in RAN1#104bis-e meeting.

### **Discussion point #12**

* **Introduce the following FGs**
	+ **FG22-Xa/Xb to address the missing** **'cri-RI-CQI' report related UE capability**
	+ **Replicate FG 2-38, i.e., csi-ReportWithoutPMI, to address the NBC issue**

Reference

[1] R1-2102490 Discussion on NR Rel-16 UE Features ZTE

[2] R1-2102557 Discussion on NR Rel-16 UE Features OPPO

[3] R1-2102950 Remaining issues on Rel-16 eMIMO UE features. vivo

[4] R1-2103087 Discussions on NR Rel-16 UE features Apple

[5] R1-2103148 Discussion on NR Rel-16 UE features Qualcomm Incorporated

[6] R1-2103197 Remaining issues on NR Rel-16 UE features Nokia, Nokia Shanghai Bell

[7] R1-2103399 Remaining details of Rel-16 NR UE features Huawei, HiSilicon

[8] R1-2103662 Remaining details of Rel-16 NR UE features Ericsson

[9] R1-2102006 Updated RAN1 UE features list for Rel-16 NR after RAN1#104-e Moderators (AT&T, NTT DOCOMO, INC.)

[10] R1-2103770 Clarification on cross-carrier operation with different SCS Huawei, HiSilicon