3GPP TSG RAN WG1 #106-e Tdoc R1-210xxxx

e-Meeting, August 16th – 27th, 2021

Agenda Item: 7.2.5

Source: Moderator (Ericsson)

Title: Summary of email discussion [106-e-NR-L1enh-URLLC-02] Sub-slot Based HARQ-ACK Feedback for MAC CE Activation/deactivation

Document for: Discussion, Decision

# 1 Introduction

This contribution provides the summary for the following email discussion in RAN1#106-e:

[106-e-NR-L1enh-URLLC-02] Issue#6: Sub-slot Based HARQ-ACK Feedback for MAC CE Activation/deactivation by August 20 – Yufei (Ericsson)

In the following, the background information is provided in Section 2. Section 3 captures the detailed email discussions. Section 4 summarizes the outcome of the email discussion.

# 2 Background

R1-2106374 (TS38.213, Rel-16, CR#0244, Cat. F) was endorsed in RAN1#105-e for section 9 of 38.213 V16.5.0:

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| 9 UE procedure for reporting control informationIn the remaining of this Clause, if a UE is provided *subslotLength-ForPUCCH*, a slot for an associated PUCCH resource of a PUCCH transmission with HARQ-ACK information includes a number of symbols indicated by *subslotLength-ForPUCCH*. |

The intention of the above CR is to clarify that a slot is interpreted as sub-slot for a PUCCH transmission with HARQ-ACK when sub-slot is configured for the UE. This prevent a slot to be interpreted as a sub-slot for PUCCH carrying other types of UCI, e.g., SR and CSI.

The introduction of sub-slot based PUCCH transmission is not intended to change the effective time for MAC CE, even when sub-slot-based HARQ-ACK is reported for MAC CE. However, when an indicated PDSCH-to-HARQ\_feedback timing i in a DCI format scheduling a PDSCH reception with MAC CE commands is of granularity of sub-slot, the timing for applicability of MAC CE associated actions would be ambiguous due to mixture of parameters with slot-based granularity and sub-slot based granularity used in determining the timing.

The agreement below in RAN1#104-e resolved the above issue for MAC CE based SCell activation/deactivation (see Appendix for the endorsed text proposal):

**Agreement**

* The text proposal for 38.213 is endorsed in R1-2002104 (TS38.213, Rel-16, CR#0197, Cat. F).

However, the followng remaining cases need similar clarifications to ensure proper timing for associated actions:

* Spatial setting of PUCCH in clause 7.2.1 and 9.2.2 of TS38.213
* TCI state activation in clause 10.1 of TS38.213 and clause 5.1.5 of TS38.214
* Activation/deactivation of semi-persistent CSI RS and CSI reporting in clauses 5.2.1.5.2 and 5.2.4 of TS38.214.
* Activation/deactivation of semi-persistent SRS in clause 6.2.1 of TS38.214
* Selection of CSI trigger state for aperiodic CSI-RS or CSI reporitng in clause 5.2.1.5.1 of TS38.214

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| **TS38.213 - Clause 7.2.1**….- If the UE is provided *PUCCH-SpatialRelationInfo*, …. The UE applies the activation command in the first slot that is after slot  where  is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and  is the SCS configuration for the PUCCH …- If the UE is provided *pathlossReferenceRSs* and *PUCCH-SpatialRelationInfo*, …. The UE applies the activation command in the first slot that is after slot  where  is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and  is the SCS configuration for the PUCCH  |
| **TS38.213 - Clause 9.2.2**….A spatial setting for a PUCCH transmission is provided by *PUCCH-SpatialRelationInfo* …. The UE applies corresponding actions in [11, TS 38.321] and a corresponding setting for a spatial domain filter to transmit PUCCH in the first slot that is after slot  where  is the slot where the UE would transmit a PUCCH with HARQ-ACK information with ACK value corresponding to a PDSCH reception providing the *PUCCH-SpatialRelationInfo* and  is the SCS configuration for the PUCCH |
| **TS38.213 - Clause 10.1**….- if the UE receives a MAC CE activation command for one of the TCI states, the UE applies the activation command in the first slot that is after slot $k+3N\_{slot}^{subframe,μ}$ where $k$ is the slot where the UE would transmit a PUCCH with HARQ-ACK information for the PDSCH providing the activation command and $μ$ is the SCS configuration for the PUCCH. The active BWP is defined as the active BWP in the slot when the activation command is applied. |
| **TS38.214 - Clause 5.1.5**….When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, the indicated mapping between TCI states and codepoints of the DCI field *'Transmission Configuration Indication'* should be applied starting from the first slot that is after slot$ n+3N\_{slot}^{subframe,µ}$ where *m* is the SCS configuration for the PUCCH. |
| **TS38.214 - Clause 5.2.1.5.2**….For semi-persistent reporting on PUCCH, …. When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, the indicated semi-persistent Reporting Setting should be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH. …..- when a UE receives a deactivation command, as described in clause 6.1.3.12 of [10, TS 38.321], for activated CSI-RS/CSI-IM resource set(s) associated with configured CSI resource setting(s), and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of CSI-RS/CSI-IM transmission corresponding to the deactivated CSI-RS/CSI-IM resource set(s) shall apply starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH. |
| **TS38.214 – Clause 5.2.4**….A UE shall perform semi-persistent CSI reporting on the PUCCH applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command described in clause 6.1.3.16 of [10, TS 38.321]where ** is the SCS configuration for the PUCCH.  |
| **TS38.214 - Clause 6.2.1**….- when a UE receives an activation command, as described in clause 6.1.3.17 or 6.1.3.36 of [10, TS 38.321], for an SRS resource, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command is transmitted in slot *n*, the corresponding actions in [10, TS 38.321] and the UE assumptions on SRS transmission corresponding to the configured SRS resource set shall be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH. …..- when a UE receives a deactivation command [10, TS 38.321] for an activated SRS resource set, and when the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the deactivation command, the corresponding actions in [10, TS 38.321] and UE assumption on cessation of SRS transmission corresponding to the deactivated SRS resource set shall apply starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH. |
| **TS38.214 - Clause 5.2.1.5.1**….- When the number of configured CSI ….. When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the subselection indication, the corresponding action in [10, TS 38.321] and UE assumption on the mapping of the selected CSI trigger state(s) to the codepoint(s) of DCI CSI request field shall be applied starting from the first slot that is after slot $n+3N\_{slot}^{subframe,µ}$ where ** is the SCS configuration for the PUCCH. |

For example, for the issue in TS38.213 section 9.2.2, CATT [2] showed that there can be two understandings of ‘slot *k*’:

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| * Understanding 1: slot *k* is the sub-slot where the UE would transmit ACK
* Understanding 2: slot *k* is the slot composed of symbols where the UE would transmit ACK

As an example shown in Figure 1, assuming sub-slot of 7-symbol is configured, if a UE received a MAC CE for spatial setting for a PUCCH transmission in a PDSCH ending in slot *n* and the corresponding HARQ-ACK is transmitted in the first sub-slot in slot *n*+1, then the actions related to spatial setting for a PUCCH transmission should be applied from the second sub-slot in slot *n*+4 according to understanding 1 while from slot *n*+5 according to understanding 2.Figure 1 Ambiguous timing for spatial setting for a PUCCH transmission |

In [2][3][4], the issue in TS38.213 section 9.2.2 was addressed, and draft CR texts were provided. In [1] all MAC CE related issues were addressed with one umbrella change, instead of changing each section individually. All submitted CR texts [1][2][3][4] have the same intention, which is also aligned with the endorsed CR in R1-2102104:

* For the purpose of timing of applicability of MAC CE based associated actions, a slot with PUCCH transmission with HARQ-ACK information is considered as a slot with $N\_{symb}^{slot}$symbols as defined in [4, TS 38.211].

# 3 Email Discussions

## 3.1 First Round of Email Discussion

Since all submitted CR texts [1][2][3][4] share the same understanding, which is also aligned with the endorsed CR in R1-2102104, it seems that the following proposals can be agreeable:

**FL Proposal 3.1-1:**

For the purpose of determining the HARQ-ACK timing corresponding to a PDSCH carrying MAC commands [10, 38.321], a slot with PUCCH transmission carrying HARQ-ACK information is considered as a slot with $N\_{symb}^{slot}$symbols as defined in [4, TS 38.211], irrespective of presence or absence of *subslotLengthForPUCCH* configuration.

**Question 3.1-1.** Please indicate if you can support FL Proposal 3.1-1 above. Please explain your reasoning if you have strong concern of this proposal.

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| **Company** | **Support (Yes/No)** | **Comments** |
| **Apple** | Yes |  |
| **CATT** | Yes |  |
| **vivo** | Yes |  |
| **OPPO** | Yes |  |
| **HW/HiSi** | Yes |  |
| **Nokia, NSB** | Yes  |  |
| **Qualcomm** | Yes |  |
| **Intel** | Yes |  |
| **Samsung** | Yes |  |
| **ZTE** | Yes |  |

Regarding the manner of making specification change, [2][3][4] focused on one issue (*PUCCH-SpatialRelationInfo* in 38.213 Section 9.2.2) and provided the CR text for this section. On the other hand, [1] pointed out that there are at least five different MAC actions in the existing specifications (i.e., 38.213, 38.214) that share the same problem, and all need to be addressed. Hence [1] proposed to add umbrella sentence(s) to TS 38.213 section 9 to address all issues at the same time. It also covers all future MAC actions if introduced. In summary, there are two options to provide CR texts.

1. Umbrella sentence(s) are added in TS 38.213 section 9 to address the common issue related to HARQ-ACK timing for PDSCH carrying MAC commands when *subslotLengthForPUCCH* is configured.
2. Identify all affected specifications and sections, then provide CR texts for each section individually to address the issue related to HARQ-ACK timing for PDSCH carrying MAC commands when *subslotLengthForPUCCH* is configured.

Considering that numerous sections in at least two specifications (i.e., 38.213, 38.214) share a common problem, it seems to be more efficient to take Option 1, which is also future proof.

**FL Proposal 3.1-2:**

Umbrella sentence(s) are added in TS 38.213 section 9 to address the common issue related to HARQ-ACK timing for PDSCH carrying MAC commands when *subslotLengthForPUCCH* is configured.

**Question 3.1-2.** Please indicate if you can support FL Proposal 3.1-2 above. Please explain your reasoning if you have strong concern of this proposal.

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| **Company** | **Support (Yes/No)** | **Comments** |
| **Apple** | No | The umbrella sentence to replace slot by subslot is in TS 38.213 Clause 9: “In the remaining of this Clause, if a UE is provided subslotLengthForPUCCH, a slot for an associated PUCCH transmission includes a number of symbols indicated by subslotLengthForPUCCH.” It is clear from the sentence that it should be only applicable to the remaining of Clause 9, and should not apply to Clause 7.2.1 or 10.1. This means that the only place that requires clarification is Clause 9.2.2.Similarly, for TS 38.214, there is no umbrella sentence in 214 saying that “slot” becomes “sub-slot” when sub-slot is configured, which means “slot” is always a slot. Therefore, we do not see any issue with the current spec.Given that TS 38.213 Clause 9.2.2 is the only place that we need to address, we prefer Option 2 to directly clarify it.  |
| **CATT** | No | We share the same view with Apple that there is no confusion for other cases except the PUCCH spatial relationship setting in TS 38.213 Clause 9.2.2. Therefore, we prefer Option 2. |
| **vivo** | No | We share the same view with Apple and CATT. For the other places, the current spec is correct and clear. Clause 9.2.2 is the only place we need to address. |
| **OPPO** |  | We are ok with both of option 1 and option 2 to address the issue in Clause 9.2.2 and future MAC actions if introduced in section 9. Share similar view with other companies that there seems no confusion for other cases since they do not have quotation to 9.2.3. |
| **HW/HiSi** | No | Agree with Apple, CATT and vivo. |
| **Nokia, NSB** | No | We share the same view with Apple, CATT, vivo & HW/HiSi. |
| **Qualcomm** | Yes | We are fine with the proposal.  |
| **Intel** | No | Same view as Apple and others that only the case of PUCCH spatial relation info in 38.213, 9.2.2 needs to be addressed while there should not be an ambiguity for other cases outside of Section 9 of 38.213.  |
| **Samsung** |  | There is validity both in the proposal and in the comments made against it. A benefit of the proposal is that it is future proof and a “one stop”/“umbrella” solution (although it may need to be moved to another section).  |
| **ZTE** | No | Fine with views from Apple, CATT , vivo, HW, Intel |

Specifically, the umbrella sentence(s) provided in [1] for TS 38.213 section 9 is as follows.

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| 38.313, section 9If a UE would transmit a PUCCH with HARQ-ACK information in a slot corresponding to a PDSCH carrying MAC CE commands, the slot with the PUCCH transmission carrying HARQ-ACK information is assumed to consist of $N\_{symb}^{slot}$ symbols as defined in [4, TS 38.211] for the purpose of determining the timing where the corresponding MAC CE actions would be applicable, irrespective of presence or absence of *subslotLengthForPUCCH* configuration. |

For addressing the issue within 38.213 section 9.2.2, [2][3][4] provided the following text proposal.

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| 38.313, section 9.2.2A spatial setting for a PUCCH transmission is provided by *PUCCH-SpatialRelationInfo* if the UE is configured with a single value for *pucch-SpatialRelationInfoId*; otherwise, if the UE is provided multiple values for *PUCCH-SpatialRelationInfo*, the UE determines a spatial setting for the PUCCH transmission as described in [11, TS 38.321]. The UE applies corresponding actions in [11, TS 38.321] and a corresponding setting for a spatial domain filter to transmit PUCCH in the first slot that is after slot  where  is the slot consisting of  symbols as defined in [4, TS 38.211 where the UE would transmit a PUCCH with HARQ-ACK information with ACK value corresponding to a PDSCH reception providing the *PUCCH-SpatialRelationInfo* and  is the SCS configuration for the PUCCH |

**Question 3.1-3.** If you can support FL Proposal 3.1-2 above (i.e., Option 1), please indicate if you can support the text proposal in [1], or if you prefer an alternative text proposal (please provide). If you do not support FL Proposal 3.1-2 above (i.e., Option 2), please provide the list of specifications and sections where the HARQ-ACK timing corresponding to MAC CE need to be addressed, with the expectation to draft text proposals for each section individually, similar to the one shown above for 38.313 section 9.2.2.

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| **Company** | **Approach to write CR****(Option 1 vs Option 2)** | **Comments** |
| **Apple** | Option 2 | As explained above, we think only TS 38.213 Clause 9.2.2 needs to be addressed. |
| **CATT** | Option 2 | Same as Apple. |
| **Vivo** | Option 2 | Same as Apple and CATT. |
| **OPPO** |  | OK with both option 1 and option 2.If option 2 is adopted, we prefer to add the following change in section 9:**9. UE procedure for reporting control information**\*\*\* Unchanged text is omitted \*\*\*In the remaining of this clause, if a UE is provided *subslotLengthForPUCCH*, a slot for an associated PUCCH resource of a PUCCH transmission with HARQ-ACK information includes a number of symbols indicated by *subslotLengthForPUCCH*, unless stated otherwise.\*\*\* Unchanged text is omitted \*\*\* |
| **HW/HiSi** | Option 2 | Same as Apple, CATT and vivo. |
| **Nokia, NSB** | Option 2 | We are fine with Option 2, as also stated by Apple, vivo, CATT & HW/HiSi.  |
| **Qualcomm** | Option 1 | One generic statement applicable to all scenarios is sufficient.  |
| **Intel** | Option 1 | As suggested by Apple. |
| **Samsung** |  | OK with either option. |
| **ZTE** | Option 2 | Only change Clause 9.2.2 |

## 3.2 Second Round of Email Discussion

# 4 Outcome of the Email Discussion

# References

1. R1-2106674, [Sub-slot Based HARQ-ACK Feedback for MAC CE Activation deactivation](file:///C%3A%5C3GPP_RAN1%5CRAN1_106_e%5C7.2.5%5CR1-2106674%20Ericsson%20Sub-slot%20Based%20HARQ-ACK%20Feedback%20for%20MAC%20CE%20Activation%20deactivation.docx), Ericsson, RAN1#106-e, August 2021.
2. R1-2106931, Correction on MAC CE effective time for spatial setting for a PUCCH, CATT, RAN1#106-e, August 2021.
3. R1-2107263, Draft CR on PUCCH spatial setting when subslotLength-ForPUCCH is provided, OPPO, RAN1#106-e, August 2021.
4. R1-2107985, Draft CR on PUCCH spatial relation update, vivo, RAN1#106-e, August 2021.

# Appendix

**Agreement**

The text proposal for 38.213 is endorsed in R1-2102104 (TS38.213, Rel-16, CR#0197, Cat. F).

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| 38.213 V16.4.04.3 Timing for secondary cell activation / deactivationWith reference to slots for PUCCH transmissions each consisting of $N\_{symb}^{slot}$ symbols as defined in [4, TS 38.211], when a UE receives in a PDSCH an activation command [11, TS 38.321] for a secondary cell ending in slot *n*, the UE applies the corresponding actions in [11, TS 38.321] no later than the minimum requirement defined in [10, TS 38.133] and no earlier than slot , except for the following:- the actions related to CSI reporting on a serving cell that is active in slot - the actions related to the *sCellDeactivationTimer* associated with the secondary cell [11, TS 38.321] that the UE applies in slot - the actions related to CSI reporting on a serving cell which is not active in slot that the UE applies in the earliest slot after  in which the serving cell is active.The value of  is $\_{}^{}$ where slot *n*+*m* is a slot indicated for PUCCH transmission with HARQ-ACK information for the PDSCH reception as described in Clause 9.2.3 and  is a number of slots per subframe for the SCS configuration  of the PUCCH transmission as defined in [4, TS 38.211].With reference to slots for PUCCH transmissions each consisting of $N\_{symb}^{slot}$ symbols as defined in [4, TS 38.211], if a UE receives a deactivation command [11, TS 38.321] for a secondary cell ending in slot , the UE applies the corresponding actions in [11, TS 38.321] no later than the minimum requirement defined in [10, TS 38.133], except for the actions related to CSI reporting on an activated serving cell which the UE applies in slot *.*  |