3GPP TSG RAN WG1 #109-e R1-220xxxx

e-Meeting, May 9th – May 20th, 2022

Source: Moderator (ZTE)

Title: Summary of maintenance on scheduling and HARQ for NR NTN

Agenda Item: 8.4

**Document for: Discussion and Decision**

# **Introduction**

In RAN1#107e meeting, the Rel-17 NR-NTN has claimed to be completed. In this meeting, following topics are identified in the prepare phase in [109-e-Prep-AI8.4 R17 NR\_NTN\_solutions].

* Clarification on C-DAI and T-DAI definition
* HARQ-ACK codebook SPS PDSCH
* Other

Companies are encouraged to provide the inputs for corresponding topics in section 1, 2 and 3.

# **Issue-1 Clarification on C-DAI and T-DAI definition**

## **Company view (Round-1)**

Regarding the description of C-/T-DAI value for Type-2 codebook, as mentioned by [OPPO], the definition of C-DAI/T-DAI is not updated to reflect the previous agreement shown below.

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| Agreement:For Type-2 HARQ codebook in NTN, * For the DCI of PDSCH with feedback-enabled HARQ processes, the C-DAI and T-DAI are the count of only feedback-enabled processes
* FFS: Whether DCI for SPS release and any other DCIs are included in counting of C-DAI and T-DAI
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To capture the agreement, the following TP is proposed:

**TP from OPPO:**

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| --------------------TP#3: Start of TP for TS 38.213 V17.1.0 ---------------------------9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel<Unchanged parts are omitted>A value of the counter downlink assignment indicator (DAI) field in DCI formats denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pairs in which PDSCH receptions or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information bits that are not in response for PDSCH receptions, associated with the DCI formats, excluding the SPS activation DCI, is present up to the current serving cell and current PDCCH monitoring occasion, <Unchanged parts are omitted>The value of the total DAI, when present [5, TS 38.212], in a DCI format denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s) or PDSCH reception(s) with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information that does not correspond to PDSCH receptions, associated with DCI formats, excluding the SPS activation DCI, is present, up to the current PDCCH monitoring occasion $m$ and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. If, for an active DL BWP of a serving cell, the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode* = *joint*, the total DAI value counts the {serving cell, PDCCH monitoring occasion}-pair(s) for both the first CORESETs and the second CORESETs.--------------------End of TP for TS 38.213 V17.1.0 --------------------------------- |

In the preparation phase, 7 companies (Huawei, ZTE, Samsung, Ericsson, Thales, LG, Xiaomi) are fine to further discussion on C/T-DAI definition.

Meanwhile, 2 companies (Samsung, NTT DOCOMO) think current text is fine since the following is stated in 9.1.3 of TS 38.213 and the pseudo-code does not apply for TBs with disabled HARQ-ACK.

*“If a UE is provided HARQ-feedbackEnabling-disablingperHARQprocess indicating disabled HARQ-ACK information for a HARQ process associated with a transport block for PDCCH monitoring occasion* $m$ *or for SPS PDSCH receptions on serving cell* $c$*, the UE does not multiplex a HARQ-ACK information bit corresponding to the transport block in a Type-2 HARQ-ACK codebook and does not consider the transport block as received in the determination of* $N\_{m,c}^{received}$ *or of* $N\_{SPS,c}$ *in clause 9.1.3.1.”*

From FL’s perspective, the statement mentioned by [Samsung] highlight that the TB with disabled HARQ is not considered as received in the determination of $N\_{m,c}^{received}$ or of $N\_{SPS,c}$. Whether it is considered for DAI calculation is also not explicitly clarified. Therefore, updates on the definition of C/T-DAI are recommended to further clarify this issue.

Then, following proposal is recommended:

**[Initial Proposal 1.1-1]**

Adopt the following TP (38.213, Section 9.1.3):

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| ----------------------------------------Start of TP 38.213 V17.1.0 section 9.1.3 ---------------------------------------------<Unchanged parts are omitted>**9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**<Unchanged parts are omitted>A value of the counter downlink assignment indicator (DAI) field in DCI formats denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pairs in which PDSCH receptions or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information bits that are not in response for PDSCH receptions, associated with the DCI formats, excluding the SPS activation DCI, is present up to the current serving cell and current PDCCH monitoring occasion, <Unchanged parts are omitted>The value of the total DAI, when present [5, TS 38.212], in a DCI format denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s) or PDSCH reception(s) with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information that does not correspond to PDSCH receptions, associated with DCI formats, excluding the SPS activation DCI, is present, up to the current PDCCH monitoring occasion $m$ and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. If, for an active DL BWP of a serving cell, the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode* = *joint*, the total DAI value counts the {serving cell, PDCCH monitoring occasion}-pair(s) for both the first CORESETs and the second CORESETs.<Unchanged parts are omitted>----------------------------------------End of TP 38.213 V17.1.0 section 9.1.3 --------------------------------------------- |

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
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# **Issue-2 HARQ-ACK codebook SPS PDSCH**

## **Company view (Round-1)**

As mentioned by [Apple], HARQ feedback for SPS PDSCH can be disabled. However, the HARQ-ACK codebook construction for SPS PDSCH has not been captured in the specifications. Regarding this issue, the following TP is proposed:

**TP from Apple:**

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| TS 38.2139.1.2 Type-1 HARQ-ACK codebook determination \*\*\* < Unchanged parts are omitted> \*\*\*while $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if {a UE is configured to receive SPS PDSCHs providing a transport block for a HARQ process with enabled HARQ-ACK information from slot $n\_{D}-N\_{PDSCH}^{repeat}+1$ to slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, excluding SPS PDSCHs that are not required to be received in any slot among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated* where $N\_{PDSCH}^{repeat}$ is provided by *pdsch-AggregationFactor-r16* in *sps-Config* or, if *pdsch-AggregationFactor-r16* is not included in *sps-Config*, by *pdsch-AggregationFactor* in *pdsch-config*, andHARQ-ACK information for the SPS PDSCH is associated with the PUCCH}$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception $j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while |

In the preparation phase, 7 companies (Huawei, ZTE, Samsung, Ericsson, Thales, LG, Xiaomi) are fine to further discussion on this issue.

Meanwhile, [NTT DOCOMO] thinks this correction is not necessary since the text below captured in 9.1.3 of TS 38.213 covers the intention of this correction. In the pseudo-code, any PDSCH receptions via HARQ process with feedback-disabling configuration are not considered based on the text.

*“If a UE is provided HARQ-feedbackEnabling-disablingperHARQprocess indicating disabled HARQ-ACK information for a HARQ process associated with a transport block in PDSCH reception occasion on serving cell, the UE reports a NACK value for a HARQ-ACK information bit corresponding to the transport block in a Type-1 HARQ-ACK codebook and does not consider the transport block as received in the determination of* $N\_{m,c}^{received}$ *in clause 9.1.2.1.”*

Moreover, [Samsung] notes that the RAN1 agreement on Type-1 codebook is to report NACK for a TB with disabled HARQ-ACK, which has been specified as above text. The TP proposed by [Apple] is contradicted with current specification since it only considers TBs with enabled HARQ-ACK.

From FL’s perspective, HARQ-ACK disabling is agreed to be supported in SPS but the codebook design is not enhanced correspondingly. Thus, updates on SPS HARQ-ACK codebook is reasonable. However, as noted by [Samsung], RAN1 agreed to provide NACK to disabled HARQ process instead of ignoring them. The TP proposed by Apple seems contradictory to current specification so that needs to be updated.

Then, following proposal is recommended:

**[Initial Proposal 2.1-1]**

Adopt the following TP (38.213, Section 9.1.2):

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| ----------------------------------------Start of TP 38.213 V17.1.0 section 9.1.2 ---------------------------------------------<Unchanged parts are omitted>**9.1.2 Type-1 HARQ-ACK codebook determination**<Unchanged parts are omitted>while $c<N\_{cells}^{DL}$ Set $s=0$ – SPS PDSCH configuration index: lower indexes correspond to lower RRC indexes of corresponding SPS configurations while $s<N\_{c}^{SPS}$Set $n\_{D}=0$ – slot index while $n\_{D}<N\_{c}^{DL}$if {a UE is configured to receive SPS PDSCHs from slot $n\_{D}-N\_{PDSCH}^{repeat}+1$ to slot $n\_{D}$ for SPS PDSCH configuration $s$ on serving cell $c$, excluding SPS PDSCHs that are not required to be received in any slot among overlapping SPS PDSCHs, if any according to [6, TS 38.214], or based on a UE capability for a number of PDSCH receptions in a slot according to [6, TS 38.214], or due to overlapping with a set of symbols indicated as uplink by *tdd-UL-DL-ConfigurationCommon* or by *tdd-UL-DL-ConfigurationDedicated* where $N\_{PDSCH}^{repeat}$ is provided by *pdsch-AggregationFactor-r16* in *sps-Config* or, if *pdsch-AggregationFactor-r16* is not included in *sps-Config*, by *pdsch-AggregationFactor* in *pdsch-config*, andHARQ-ACK information for the SPS PDSCH is associated with the PUCCH}if the SPS PDSCH provides a transport block for a HARQ process with enabled HARQ-ACK information$\tilde{o}\_{j}^{ACK}$ = HARQ-ACK information bit for this SPS PDSCH reception else$\tilde{o}\_{j}^{ACK}$ = NACKend if$j=j+1$;end if$n\_{D}=n\_{D}+1$;end while$s=s+1$;end while$c=c+1$;end while<Unchanged parts are omitted>----------------------------------------End of TP 38.213 V17.1.0 section 9.1.2 --------------------------------------------- |

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
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# **Other**

In preparation phase, the following issue is not treated. And it’s captured below to check the group’s view.

## **Koffset and Type-1 Codebook construction**

### **3.1.1 Company view (Round-1)**

As mentioned by [Qualcomm], a summary statement made at beginning of Section 9 in TS 38.213 shown below was intended to be applied throughout Section 9, which illustrates how to apply Koffset.

*“For the remaining of this clause, if a UE is provided* $K\_{cell,offset}$ *by Koffset in ServingCellConfigCommon or* $K\_{UE,offset}$ *by a MAC CE command, reference to a slot* $n+k$ *for a PUCCH transmission or PUSCH transmission corresponds to a slot* $n+k+2^{μ}∙K\_{offset}$ *for the PUSCH or the PUCCH transmission, where* $μ$ *is the SCS configuration for the PUCCH transmission or PUSCH transmission.”*

However, for type-1 codebook construction procedure, following statement was made in Section 9.1.2 in TS 38.213.

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| while $k<C\left(K\_{1}\right)$ if $mod\left(n\_{U}-K\_{1,k}+1,max\left(2^{μ\_{UL}-μ\_{DL}},1\right)\right)=0$ or *subslotLengthForPUCCH* is provided for the HARQ-ACK codebookSet $n\_{D}=0$ – index of a DL slot overlapping with an UL slotSet $N\_{k}$ to a number of DL slots overlapping with UL slot $n\_{U}-K\_{1,k}$ if *subslotLengthForPUCCH* is provided for the HARQ-ACK codebook; otherwise, $N\_{k}=max\left(2^{μ\_{DL}-μ\_{UL}},1\right)$ |

When Koffset is provided, the $K\_{1,k} $above needs to be replaced by $K\_{1,k}+2^{μ}∙K\_{offset}$ to get the correct HARQ ACK bits for the PUCCH slot $n\_{U}$. The summary statement above cannot cover this case.

To handle this issue, the following TP is proposed:

**TP from Qualcomm:**

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| For the remaining of this clause, if a UE is provided $K\_{cell,offset}$ by *Koffset* in *ServingCellConfigCommon* or $K\_{UE,offset}$ by a MAC CE command, reference to a slot $n+k$ for a PUCCH transmission or PUSCH transmission corresponds to a slot $n+k+2^{μ}∙K\_{offset}$ for the PUSCH or the PUCCH transmission, and additionally, reference to a slot $n\_{U}-K\_{1,k}$ corresponds to $n\_{U}-K\_{1,k}-2^{μ}∙K\_{offset}$, where $μ$ is the SCS configuration for the PUCCH transmission or PUSCH transmission, …**Reasons of change:** current description of usage of Koffset does not cover all the cases.**Summary of change:** added a statement to cover a missing case.**Consequence if not approved:** incorrect Type-1 codebook construction when Koffset is configured |

From FL’s perspective, this clarification issue is reasonable since the unique expression in type-1 codebook construction cannot be covered by the general expression at start of Section 9 in TS 38.213.

Then, following proposal is recommended:

**[Initial Proposal 3.1.1-1]**

Adopt the following TP (38.213, Section 9):

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| ----------------------------------------Start of TP 38.213 V17.1.0 section 9 ---------------------------------------------<Unchanged parts are omitted>**9 UE procedure for reporting control information**<Unchanged parts are omitted>For the remaining of this clause, if a UE is provided $K\_{cell,offset}$ by *CellSpecific\_Koffset* or $K\_{UE,offset}$ by a MAC CE command, reference to a slot $n+k$ for a PUCCH transmission or PUSCH transmission corresponds to a slot $n+k+2^{μ-μ\_{K\_{offset}}}∙K\_{offset}$ for the PUSCH or the PUCCH transmission, and additionally, reference to a slot $n\_{U}-K\_{1,k}$ corresponds to $n\_{U}-K\_{1,k}-2^{μ-μ\_{K\_{offset}}}∙K\_{offset}$, where $μ$ is the SCS configuration for the PUCCH transmission or PUSCH transmission, $K\_{offset}$ is defined in clause 4.2, and $μ\_{K\_{offset}}=0$ in FR1.<Unchanged parts are omitted>----------------------------------------End of TP 38.213 V17.1.0 section 9 --------------------------------------------- |

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
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# **Appendix**

1. R1-2203088 Maintenance on solutions for NR to support NTN Huawei, HiSilicon
2. R1-2203231 Remaining issues on NR-NTN ZTE
3. R1-2203289 Maintenance on Solutions for NR to support non-terrestrial networks (NTN) PANASONIC R&D Center Germany
4. R1-2203306 Maintenance on Solutions for NR to support non-terrestrial networks (NTN) Spreadtrum Communications
5. R1-2203385 Maintenance on Solutions for NR to support NTN MediaTek Inc.
6. R1-2203721 Discussion on ambiguity of common TA calculation Sony
7. R1-2203756 Maintenance on NR NTN CATT
8. R1-2203770 Discussion on maintenance issues in NR-NTN xiaomi
9. R1-2203843 Maintenance aspects af Rel-17 NR over NTN Nokia, Nokia Shanghai Bell
10. R1-2203935 Discussion on the remaining issues in R17 NR NTN NEC
11. R1-2203990 Discussion on remaining issue for NTN-NR OPPO
12. R1-2204207 On remaining issues of NR NTN Apple
13. R1-2204345 Remaining issues on NR NTN NTT DOCOMO, INC.
14. R1-2204519 Remaining issues on UL time and frequency synchronization enhancements in NTN LG Electronics
15. R1-2204556 Maintenance on Release-17 NR NTN THALES
16. R1-2204660 On NR NTN maintenance issues Ericsson
17. R1-2204933 Enhancements on UL time and frequency synchronization Mavenir
18. R1-2204984 Maintenance on NR NTN Qualcomm Incorporated