**3GPP TSG RAN WG1 #110 R1-220xxxx**

**Toulouse, France, August 22nd – 26th, 2022**

**Source: Moderator(vivo)**

**Title: Summary of UE capability and SAI counting for DCI format 3\_0 issue in R1-2206716**

**Agenda item: 7.2.4**

**Document for:** **Discussion and Decision**

Introduction

In RAN1#110 meeting, one contribution [1, vivo] is submitted to clarify UE capability and SAI counting for DCI format 3\_0 reception. According to the chairman’s guidance, this document is to collect companies’ views on the issues of UE capability and SAI counting for DCI format 3\_0 reception discussed in R1-2206716.

Discussion

## Round 1

In [1], the following issue was identified:

According to 38.202, RRC connected UE supports downlink "Reception Type" combination (A + C0 + (B and/or (D0 or (m1\*D1+m2\*D2))) + E + F0 + n\*F1 + G + H + J0 + J1 + J2 + K + O + L0 + L1 + M + N + P) and m1\*D1 + m2\*D2 + E + n\*F1 + G + H + J0 + J1 + J2 + K + O + L0 + L1 + M + P, which means UE can monitor one DCI format 3-0 with CRC scrambled by SL-RNTI (denoted as L0) **PLUS** one DCI format 3-0 with CRC scrambled by SL-CS-RNTI (denoted as L1) simultaneously, where L1 may refer to a DCI format 3-0 scheduling retransmission corresponding to a SL CG or a DCI format 3-0 for SL CG activation/deactivation.

In TS 38.213, cSAI is defined as the accumulative number of PDCCH monitoring occasions with SL DG scheduling PSSCH with associated PSFCH, which means only one SL DG scheduling PSSCH with associated PSFCH is expected for cSAI counting per PDCCH monitoring occasion. However, this is contradictory to 38.202.

Additionally, if a gNB transmits a normal SL DG (L0) and a SL DG scheduling retransmission corresponding to a SL CG (L1) in the same monitoring occasion, UE should be able to decode both SL DCIs as specified in 38.202. However, it is not clear how the cSAI is indexed. Moreover, as only one HARQ-ACK bit is generated per monitoring occasion in a type2 HARQ-ACK codebook, it is also unclear how to determine the HARQ-ACK report in this case.

Observation 1: TS 38.202 allows simultaneous reception of one normal SL DG with CRC scrambled by SL-RNTI (denoted as L0) and one SL DG with CRC scrambled by SL-CS-RNTI (denoted as L1) for scheduling retransmission corresponding to a SL CG, which is contradictory to TS 38.213 where only 1 SL DCI scheduling PSSCH with associated PSFCH is expected for cSAI counting per monitoring occasion. Therefore, the type2 HARQ-ACK codebook would be broken if UE receives L0+L1 simultaneously in one monitoring occasion.

Table 6.2-2: Downlink "Reception Type" combinations

|  |  |
| --- | --- |
| Supported Combinations  | Comment |
| PCell | PSCell | SCell |
| 3. RRC\_CONNECTED |
| (A + C0 + (B and/or (D0 or (m1\*D1+m2\*D2))) + E + F0 + n\*F1 + G + H + J0 + J1 + J2 + K + O + L0 + L1 + M + N + P)  | (A + (D0 or (m1\*D1+m2\*D2)) + E + F0 + n\*F1 + G + H + J0 + J1 + J2 + K + O + N + P)  | m1\*D1 + m2\*D2 + E + n\*F1 + G + H + J0 + J1 + J2 + K + O + L0 + L1 + M + P | Note 2, Note 3, Note 4, Note 5, Note 6, Note 7, Note 8 |

Table 6.2-1: Downlink "Reception Types"

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| "Reception Type" | Physical Channel(s) | MonitoredRNTI | AssociatedTransport Channel | Comment |
| L0 | PDCCH | SL-RNTI | SL-SCH |  |
| L1 | PDCCH | SL-CS-RNTI | SL-SCH |  |

|  |
| --- |
| TS 38.213A value of a counter sidelink assignment indicator (SAI) field in DCI format 3\_0, excluding DCI format 3\_0 for the SL configured grant Type 2 activation, denotes an accumulative number of PDCCH monitoring occasions where PSSCH transmissions with associated PSFCH receptions are scheduled, up to a current PDCCH monitoring occasion, in ascending order of PDCCH monitoring occasion index $m$, where $0\leq m<M$.  |

The following options were proposed to address this issue in [1],

* Option 1. Clarify that simultaneous reception of one normal SL DCI with CRC scrambled by SL-RNTI(L0) and one SL DG with CRC scrambled by SL-CS-RNTI (L1) is not supported, change ‘L0 + L1’ to ‘( L0 or L1)’ in TS 38.202
* Option 2. No change to TS 38.202, but clarify in TS 38.213 that UE is not expected to receive one SL DCI with CRC scrambled by SL-RNTI and one SL DCI with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to a SL CG in the same monitoring occasion.
* Option 3. Define the ordering of SL DCIs received in the same monitoring occasion for cSAI counting, e.g., in the order of the start time of the corresponding scheduled PSSCH transmission occasion.

**Q1: Do you agree that the issue of the reception of multiple SL DCI as discussed in** [1] **should be addressed?**

|  |  |  |
| --- | --- | --- |
| **Company** | **agree or not** | **Comment** |
| vivo | agree | If this issue is not fixed, UE is forced to support the aforementioned combination of SL DCIs in the same monitoring occasion and gNB is also allowed to transmit two SL DCIs scheduling PSSCH with PSFCH in the same monitoring occasion according to 38.202, however, the corresponding behavior for cSAI counting and HARQ-ACK generation is not specified, and thus the codebook generation would be broken. |
| Intel | Comment | We are wondering the impact of this changed to already developed UEs. If this is changed as proposed, does that mean already developed implementation cannot be used any longer?[vivo 2022/8/22] Already developed UE is still feasible at least with option1/2. For a UE supporting multiple SL DCIs, there are two cases to consider: 1) the UE receives one DCI in one occasion: it assumes SAI +1 and generate 1 HARQ-ACK according to the current HARQ-ACK CB generation procedure, 2) the UE receives 2 DCIs in an occasion: according to SAI definition in 213, it should assume that the sSAI still increases by 1 for that occasion and determine a HARQ-ACK somehow by its implemention (but I doubt if there would be any developed UE implementing this case). With option1/option2, only one SL DCI is expected per occasion and the UE can always work properly as specified in 1) |
| DCM | agree |  |
| ZTE,Sanechips | Comment | Actually this does not have too much to do with 38.202. Even when multiple DCI format 3-0 scheduling PSSCH transmission in the same monitoring occasions occur, the proposed cSAI counting in option 3 is needed.  |
| OPPO | Comment | Similar comment as Intel on whether the current develoed UE is still feasible if there is such a problem.[vivo 2022/8/22] please check my reply to intel |
| Xiaomi | Comment | In TS 38.213 it has stated: “A UE determines monitoring occasions for PDCCH with DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH reception occasions on an active DL BWP of a serving cell , as described in clause 10.1, and for which the UE transmits HARQ-ACK information in a same PUCCH in slot based on...” So even if combination of SL DCIs are monitored simultaneously (e.g. L1+L0), there will be no issue if the corresponding HARQ-ACK information for different DCI is in different slots. We think gNB implementation can make sure this does not happen.[vivo 2022/8/22]Thank you for your comments. I think this is also a possible solution to address the issue. I can add this as option 4. |
| Qualcomm | Comment | We share the concerns about developed UEs. In particular, Option 3 requires changes to UE implementation, which might not be feasible at this stage. |

**Q2: If the answer to Q1 is yes, which option do you prefer? If you have concerns about the options, please further elaborate on your concerns or a different option to address this issue.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comment** |
| vivo | Option1 or option2 | We prefer not to change cSAI definition at this later stage, either option1 or option2 is fine. |
| DCM | Option 1 |  |
| ZTE,Sanechips | Option 3 |  |
| OPPO | Option 1 | If the issue has to be resolved, option 1 is preferred. |
| Qualcomm | Option 2 | It is backward compatible with UE implementation |

## Round 2

[vivo 2022/08/22]

@all, thank you all for the valuable inputs. 2 companies think the issue should be fixed. 2 company have concerns on the impacts on legacy UE. 1 companie think this issue can be avoided by allocating different PUCCH slots for the two SL DCIs in the same monitoring occasion. 3 companies are fine with option1 and 1 company supports option3.

Please check my responses marked in red in the table of Q1 and hopefully they can address your concerns. According to xiaomi’s comment, another option to fix this issue is added:

* Option 1. Clarify that simultaneous reception of one normal SL DCI with CRC scrambled by SL-RNTI(L0) and one SL DG with CRC scrambled by SL-CS-RNTI (L1) is not supported, change ‘L0 + L1’ to ‘( L0 or L1)’ in TS 38.202
* Option 2. No change to TS 38.202, but clarify in TS 38.213 that UE is not expected to receive one SL DCI with CRC scrambled by SL-RNTI and one SL DCI with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to a SL CG in the same monitoring occasion.
* Option 3. Define the ordering of SL DCIs received in the same monitoring occasion for cSAI counting, e.g., in the order of the start time of the corresponding scheduled PSSCH transmission occasion.
* Option 4. Reception of one SL DCI with CRC scrambled by SL-RNTI and one SL DG with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to one SL CG in the same monitoring occasion is supported, but need to clarify that UE is not expected to handle the case where SL HARQ-ACK bits corresponding to the two SL DCIs are multiplexed in the same HARQ-ACK codebook.

In my understanding, this issue should be fixed and we prefer not to leave it to NW implementation, but we also would like to hear more companies’ views. As a new option is added, I would like to check companies’ view for 2nd round. Please provide your views if you are ok to address the issue in [1], and which option is preferred.

**Q3: Do you agree the issue in [1] should be addressed? If yes, which option is preferred?**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Yes or no** | **option** | **Comment** |
| vivo | Yes  | Option1/2/4 |  |
| Qualcomm |  | Option 2 | If the issue needs to be addressed, the solution should be backwards compatible. |
| Intel |  | Option 2 | We share same view with QC and we believe at this stage backward compatibility is critical.  |
| Huawei, HiSilicon |  | Option 1 | This is the simple one, can avoid confusion that one spec allows one specific operation and however antoher spec disallows such operation. However, further question is whether to two seprate reception types, one contains L0 only and the other one contains L1 only. |
| Ericsson |  | Option 2 |  |
| ZTE, Sanechips |  | Option 3 | Following Uu logic is preferred, similar to the handling of taking the CG type 2 non-initial transmission. The change in option 3 is direct copy paste from Uu. Cross-WG impact that comes with option 1 should be avoided. |
| OPPO |  | Option 1/2 | We prefer Option 1, but we can also live with Option 2 by considering backward compatibility. |
| Sharp |  | Option 2 |  |
| Nokia, Nokia Shanghai Bell |  | Option 2/4 |  |
| Samsung |  | Option 4 |  |

Proposal for online session (Wednesday)

Based on the feedback in the first and second rounds, and further offline with some companies, companies that provided feedback all agree that the issue discussed in [1] is valid and should be addressed.

For the four options to slove this issue:

* Option 1. Clarify that simultaneous reception of one normal SL DCI with CRC scrambled by SL-RNTI(L0) and one SL DG with CRC scrambled by SL-CS-RNTI (L1) is not supported, change ‘L0 + L1’ to ‘( L0 or L1)’ in TS 38.202
	+ Supported by: vivo, DCM, Huawei, HiSilicon, OPPO—5 companies
	+ Concerns: this option also precludes another combination that has no feedback issues (i.e., SL DCI with CRC scrambled by SL-RNTI and one SL DG with CRC scrambled by SL-CS-RNTI for CG activation/deactivation)
* Option 2. No change to TS 38.202, but clarify in TS 38.213 that UE is not expected to receive one SL DCI with CRC scrambled by SL-RNTI and one SL DCI with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to a SL CG in the same monitoring occasion.
	+ Supported by: Qualcomm, vivo, Intel, Ericsson, OPPO, Sharp, Nokia, Nokia Shanghai Bell—8 companies
* Option 3. Define the ordering of SL DCIs received in the same monitoring occasion for cSAI counting, e.g., in the order of the start time of the corresponding scheduled PSSCH transmission occasion.
	+ Supported by: ZTE, Sanechips—2 companies
	+ Concerns: Option 3 requires changes to UE implementation
* Option 4. Reception of one SL DCI with CRC scrambled by SL-RNTI and one SL DG with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to one SL CG in the same monitoring occasion is supported, but need to clarify that UE is not expected to handle the case where SL HARQ-ACK bits corresponding to the two SL DCIs are multiplexed in the same HARQ-ACK codebook.
	+ Supported by: Nokia, Nokia Shanghai Bell, Samsung—3 companies

**Proposal1:** **clarify in TS 38.213 that UE is not expected to receive one SL DCI with CRC scrambled by SL-RNTI and one SL DCI with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to a SL CG in the same monitoring occasion.**

**===TP start===**

**16.5.2.1 Type-2 HARQ-ACK codebook in physical uplink control channel**

A UE determines monitoring occasions for PDCCH with DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH reception occasions on an active DL BWP of a serving cell $c$, as described in clause 10.1, and for which the UE transmits HARQ-ACK information in a same PUCCH in slot $n$ based on

- PSFCH-to-HARQ feedback timing indicator field values, or a value provided by *sl-PSFCH-ToPUCCH-CG-Type1*, for PUCCH transmission with HARQ-ACK information in slot $n$ in response to PSFCH receptions;

- time gap field in DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH receptions;

- time resource assignment in DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH receptions;

- a configured sidelink resource pool bitmap;

- a value of a period of PSFCH resources provided in *sl-PSFCH-Period*;

- a value of a minimum time gap provided in *sl-MinTimeGapPSFCH*.

The set of PDCCH monitoring occasions for DCI format 3\_0 for scheduling PSSCH transmissions with associated PSFCH reception occasions is defined as the PDCCH monitoring occasions in the active DL BWP of the configured serving cell, indexed in ascending order of start time of the associated search space sets. The cardinality of the set of PDCCH monitoring occasions defines a total number $M$ of PDCCH monitoring occasions. A UE is not expected to receive a DCI format 3-0 with CRC scrambled by SL-RNTI and a DCI format 3-0 with CRC scrambled by SL-CS-RNTI for scheduling retransmission corresponding to a SL configured grant Type 1 or a sidelink configured grant Type 2 simultaneously in a same monitoring occasion.

A value of a counter sidelink assignment indicator (SAI) field in DCI format 3\_0, excluding DCI format 3\_0 for the SL configured grant Type 2 activation, denotes an accumulative number of PDCCH monitoring occasions where PSSCH transmissions with associated PSFCH receptions are scheduled, up to a current PDCCH monitoring occasion, in ascending order of PDCCH monitoring occasion index $m$, where $0\leq m<M$.

**===TP end===**

Comments on CR

Please provide your comments on the draft CRs ([[draft]R1-2208001](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110/Inbox/drafts/7.2.4%285G_V2X_NRSL%29/R1-2206716%20UE%20capability%20and%20cSAI%20%28vivo%29-round2/%5Bdraft%20CR%5D/%5Bdraft%5DR1-2208001%20Correction%20on%20DCI%20format%203_0%20reception-R16.docx) CAT F for R16, [[draft]R1-2208002](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_110/Inbox/drafts/7.2.4%285G_V2X_NRSL%29/R1-2206716%20UE%20capability%20and%20cSAI%20%28vivo%29-round2/%5Bdraft%20CR%5D/%5Bdraft%5DR1-2208002%20Correction%20on%20DCI%20format%203_0%20reception-R17.docx)CAT A for R17) in the following table

|  |  |
| --- | --- |
| company | comments |
|  |  |
|  |  |

Summary

TBD

Reference

1. R1-2206716,‘Correction on UE capability and SAI counting for DCI format 3\_0 reception’, vivo