3GPP TSG-RAN WG1 Meeting #100bis-e R1-200xxx

e-Meeting, April 20th – 30th,2020

**Source: Moderator (ZTE)**

**Title: FL summary #2 of multiple TB scheduling for NB-IoT**

**Agenda item: 6.2.2.3**

**Document for:** **Discussion/Decision**

# Introduction

After RAN1#100-e meeting, it has been declared all the Rel-16 RAN1-led WIs as finished from RAN1 perspective. In RAN1 100 e-meeting, contribution were submitted for maintenance of Rel-16 NB.

In this contribution, summary of the issues regarding multiple TB scheduling for NB-IoT was discussed.

# Email discussion summary

Email discussion result is captured in the table below

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Issue | High | mid | low | Editorial | Support discussion |
| 1 | 2 | 7 |  |  |  |
| 2 | 3 | 4 | 2 |  | 2 |
| 3 | Included with #2 | | | | |
| 4 | 2 |  | 7 |  |  |
| 5 |  |  | 4 | 4 |  |
| 6 |  | 3 | 2 | 4 | 2 |

Based on the result, three email threads are suggested.

Discussion #1: Issue 1

Discussion #2: Issue 2(can include proposal from #3 as candidate solution)

Discussion #3: Issue 6 (include typo correction for TS213 section 16.5.1)

# Discussions

## Search space monitoring and scheduling

### Type2A-CSS monitoring during scheduling and processing gap

For SC-MTCH multiple TBs scheduling, the issue of type2A-CSS monitoring has not discussed in [1]. It is argued that since UE has received DCI scheduling multiple SC-MTCH TBs, there is no need to monitor Type2A-CSS during the scheduling gap or the processing gap while the other types of CSS (type1/1A/2) still need to be monitored.

It is noted that UE is not required to monitor Type2A-CSS (for SC-MTCH scheduling) while receiving NPDSCH carrying SC-MTCH. However, the purpose of scheduling gap is mainly for resource reservation and possibly backward compatible scheduling, the UE processing capability is not considered during the discussion. In fact the current timing constraint will ensure for most of scenario this monitoring is not required, except for the last scheduling gap. For processing gap, as the intention is to relieve UE processing burden for SC-MTCH decoding it is reasonable to assume no type2A-CSS monitoring is required.

Issue#1: Type2A-CSS monitoring during scheduling and processing gap

***Proposal 1: For SC-MTCH multiple TBs scheduling, UE is not required to monitor Type2A-CSS during a processing gap. Adopt TP in Appendix 5.4 .***

### DCI scheduling for SPS

In RAN1#99, the following agreement is achieved on how to handle multiple TBs scheduling for SPS transmission.

|  |
| --- |
| **Agreement**  A UE is not expected to receive a DCI scheduling more than one TB with CRC scrambled by SPS-C-RNTI |

However, it has not been captured yet in current spec. In Appendix 5.1, TP for capturing this agreement is proposed.

Issue#2: Capture the agreement of single TB scheduling for SPS-C-RNTI

***Proposal 2 : Explicitly capture the agreement of single TB scheduling for SPS-C-RNTI in the spec.***

In [3], it is proposed to use 1-bit indicator of “Number of scheduled TB for unicast” for NPDCCH validation for semi-persistent scheduling.

However, it seems without adding this indicator to the table 16.6.3-1/2 in 36.213, there is no misinterpretation.

Issue#3: Use 1-bit indicator of “Number of scheduled TB for unicast” for NPDCCH validation for semi-persistent scheduling.

***Proposal 3 : The issue can be discussed in RAN1 #100bis-e. FL propose no change in the specification.***

## Two HARQ process and multiple TB scheduling

Two HARQ processes are supported when two uplink HARQ processes are configured, or when multi-TB scheduling for unicast transmission is configured. The UE need to check both configuration as the precondition for further action. For most of the occurrence in the specification this rule is followed. There are still places where fix is needed.

Issue#4: Incorrect use of *twoHARQ-ProcessesConfig* .

***Proposal 4 : Adopt the proposed editorial changes in 5.2 and 5.3.***

## Editorial correction

**2.4.1 Clarification of DCI field description (36.212)**

The ‘Number of scheduled TB for Unicast’ field description for the DL DCI in 36.212 clause 6.4.3.2 looks like this, and the corresponding fields in the DL/UL DCIs for LTE-MTC use similar phrasing.

|  |
| --- |
| - Number of scheduled TB for Unicast – 1 bit, where value 0 indicates a single TB is scheduled and value 1 indicates multiple TB are scheduled. This field is only present if higher layer parameter *multi-TB-Unicast-config* is enabled and the corresponding DCI is mapped onto the UE specific search space given by the C-RNTI as defined in [3] |

The corresponding description for the UL DCI should be clarified and aligned in a similar way.

------------------------------------------------------------- Start -------------------------------------------------------------

- Number of scheduled TB for Unicast – 1 bit, where value 0 indicates a single TB is scheduled and value 1 indicates multiple TB are scheduled. This field is only present if higher layer parameter *multi-TB-Unicast-config* is enabled and the corresponding DCI is mapped onto the UE specific search space given by the C-RNTI as defined in [3].

-------------------------------------------------------------- End -------------------------------------------------------------

**2.4.2 Clarification of NPDCCH monitoring (36.213)**

Some of the new sentences in 36.213 are difficult to parse and has made the specification text for the legacy behaviour without the new feature somewhat obscure, increasing the risk for erroneous implementation. Many readers of the specification may only be interested in the important legacy single-TB case, so it is important that the description of the behaviour in the legacy single-TB case is still as well-defined as in earlier releases of the specification.

------------------------------------------------------------- Start -------------------------------------------------------------

For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *multi-TB-Unicast-config* and if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k,*

- if the corresponding NPDCCH with DCI format N0 with CRC scrambled by C-RNTI schedules two transport blocks as determined by the number of scheduled TB field if present, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+1* to subframe *n+k-1*, otherwise the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+k-2* to subframe *n+k-1*; and

* the UE does not expect to receive a DCI Format N0 before subframe *n*+*k*-2 for which the corresponding NPUSCH format 1 transmission ends later than subframe *n*+*k*+255 if the corresponding NPDCCH with DCI format N0 schedules one transport block.

- for TDD, and if the corresponding NPUSCH format1 transmission ends in subframe *n+m*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+ k* to subframe *n+m-1*.

otherwise

- if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission starts from *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-1*.

- for TDD, if the NB-IoT UE detects NPDCCH with DCI Format N0 ending in subframe *n* or receives a NPDSCH carrying a random access response grant ending in subframe *n*, and if the corresponding NPUSCH format 1 transmission ends in *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k*.

For a NPDCCH UE-specific search space, if a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig* or *multi-TB-Unicast-config*

- and if the NB-IoT UE detects NPDCCH with DCI Format N1 or N2 ending in subframe *n*, and if a NPDSCH transmission starts from *n+k*,

- if the corresponding NPDCCH with DCI format N1 with CRC scrambled by C-RNTI schedules two transport blocks as determined by the number of scheduled TB field if present, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+1* to subframe *n+k-1*;

- otherwise, the UE is not required to monitor an NPDCCH candidate in any subframe starting from subframe *n+k-2* to subframe *n+k-1*;

otherwise

- if the NB-IoT UE detects NPDCCH with DCI Format N1 or N2 ending in subframe *n*, and if the corresponding NPDSCH transmission starts from *n+k*, the UE is not required to monitor NPDCCH in any subframe starting from subframe *n+1* to subframe *n+k-1*.

-------------------------------------------------------------- End -------------------------------------------------------------

***Proposal 5 : Discuss the changes in RAN1#100bis-e.***

# Conclusion

In this contribution, the following pro.

***Proposal 1: The issue can be discussed in RAN1 #100bis-e. FL propose no change in the specification.***

***Proposal 2 : Explicitly capture the agreement of single TB scheduling for SPS-C-RNTI in the spec.***

***Proposal 3 : The issue can be discussed in RAN1 #100bis-e. FL propose no change in the specification.***

***Proposal 4 : Adopt the proposed editorial changes in 5.2 and 5.3.***

***Proposal 5 : Discuss the changes in RAN1#100bis-e.***

# Reference

1. R1-2001571, ‘Corrections on scheduling of multiple DL/UL transport blocks’, Huawei, HiSilicon
2. R1-2001853, ‘Remaining issues on scheduling enhancement for NB-IoT’, ZTE
3. R1-2002186, ‘Scheduling of multiple DL/UL transport blocks’, Qualcomm
4. R1-2002508, ‘Corrections for Multi-TB scheduling for NB-IoT’, Ericsson
5. R1-2002646, 'Remaining issues for scheduling of multiple TBs' Nokia, Nokia Shanghai Bell

# Appendix

## 

---------------------------------------------- Start of Text Proposal ------------------------------------------

-------------------------------------------- Unchanged parts omitted -----------------------------------------

16.5.1 UE procedure for transmitting format 1 narrowband physical uplink shared channel

-------------------------------------------- Unchanged parts omitted -----------------------------------------

- For ,

- if the UE is configured with higher layer parameter *multi-TB-UL-Unicast-Interleaving-config*, and NPUSCH corresponding to a NPDCCH with DCI CRC scrambled by C-RNTI, and  where  for ,  otherwise.

- NB-IoT UL slots  with  are associated with TB*r+*1 ,

- otherwise,

- NB-IoT UL slots  with  are associated with TB*r+*1 ,

- A UE may assume that a DCI with CRC scrambled by SPS-C-RNTI schedules a single TB.

**Table 16.5.1-1: for DCI format N0 for FDD.**

|  |  |
| --- | --- |
|  |  |
| 0 | 8 |
| 1 | 16 |
| 2 | 32 |
| 3 | 64 |

-------------------------------------------- Unchanged parts omitted -----------------------------------------

----------------------------------------------- End of Text Proposal ------------------------------------------

TP for 36.213 section 16.6:

**<Unchanged parts are omitted>**

If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig or multi-TB-Unicast-config*

- and if the UE has a NPUSCH transmission ending in subframe *n*,

- the UE is not required to receive transmissions in the Type B half-duplex guard periods as specified in [3]for FDD ; and

- the UE is not expected to receive an NPDCCH with DCI format N0/N1 for the same HARQ process ID as the NPUSCH transmission in any subframe starting from subframe n+1 to subframe n+3*;*

**<Unchanged parts are omitted>**

Similarly, another one need to be modified.

**<Unchanged parts are omitted>**

If a NB-IoT UE is configured with higher layer parameter *twoHARQ-ProcessesConfig or multi-TB-Unicast-config*

- the UE is not required to monitor an NPDCCH candidate of an NPDCCH search space if the candidate ends in subframe *n*, and if the UE is configured to monitor NPDCCH candidates of another NPDCCH search space having starting subframe k0 before subframe *n*+5

otherwise

- the UE is not required to monitor NPDCCH candidates of an NPDCCH search space if an NPDCCH candidate of the NPDCCH search space ends in subframe *n*, and if the UE is configured to monitor NPDCCH candidates of another NPDCCH search space having starting subframe k0 before subframe *n+5*.

**<Unchanged parts are omitted>**

**<TP, TS 36.213>**

16.6.3 NPDCCH validation for semi-persistent scheduling

A UE shall validate a Semi-Persistent Scheduling assignment NPDCCH only if all the following conditions are met:

- the CRC parity bits obtained for the NPDCCH payload are scrambled with the Semi-Persistent Scheduling C-RNTI

- the new data indicator field is set to '0'.

Validation is achieved if all the fields for the used DCI format N0 are set according to Table 16.6.3-1 or Table 16.6.3-2.

If validation is achieved, the UE shall consider the received DCI information accordingly as a valid semi-persistent activation or release.

If validation is not achieved, the received DCI format shall be considered by the UE as having been received with a non-matching CRC.

Table 16.6.3-1: Special fields for Semi-Persistent Scheduling Activation NPDCCH Validation

|  |  |
| --- | --- |
|  | **DCI format N0** |
| **HARQ process number (present if UE is configured with 2 uplink HARQ processes or higher layer parameter multi-TB-Unicast-config)** | set to '0' |
| **Redundancy version** | set to '0' |
| **Modulation and coding scheme** | set to '0000' |
| **Resource assignment** | set to '000' |

Table 16.6.3-2: Special fields for Semi-Persistent Scheduling Release NPDCCH Validation

|  |  |
| --- | --- |
|  | **DCI format N0** |
| **HARQ process number (present if UE is configured with 2 uplink HARQ processes or higher layer parameter multi-TB-Unicast-config)** | set to '0' |
| **Redundancy version** | set to '0' |
| **Repetition number** | set to '000' |
| **Modulation and coding scheme** | set to '1111' |
| **Subcarrier indication** | Set to all '1's |

**</TP>**

-------------------------------------------- Unchanged parts omitted -----------------------------------------

An NB-IoT UE is not required to monitor NPDCCH candidates of an NPDCCH search space during an NPUSCH UL gap.

An NB-IoT UE is not required to monitor NPDCCH candidates of a Type2A-NPDCCH common search space during the processing gap.

-------------------------------------------- Unchanged parts omitted -----------------------------------------

----------------------------------------------- End of Text Proposal ------------------------------------------