**3GPP TSG RAN WG1 Meeting #103-e R1-20xxxxx**

**E-Meeting, October 26 – November 13, 2020**

**Agenda Item: 6.1**

**Source: Moderator (Huawei)**

**Title: Summary on [103-e-LTE-6.1CRs-02] on interference randomization for NB-IoT SPS**

**Document for: Discussion and Decision**

# Introduction

This documents provides the summary of the following discussion regarding interference randomization for NB-IoT SPS [1].

[103-e-LTE-6.1CRs-02] Email discussion/approval on R1-2008341 (NB-IOT) by 10/29 – Jinhuan (Huawei)

# Discussion

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| ***Reason for change:*** | In RAN1#90, the following in R1-1714639 was agreed:   * *The interference randomization technique for NPDCCH is applied in the following cases:*   + *For Type-2 and Type1-CSS, in non-anchor carriers.*   + *For USS, is enabled by RRC configuration.*   + *For Type-1A and Type-2A, always.*   According to the agreement, the interference randomization is applied to NPDCCH in USS when enabled by RRC. The NPDCCH associated with SPS C-RNTI is mapped on USS, however, current spec omits it from interference randomization.  Besides, the cross reference of *interferenceRandomisationConfig* is wrong. |
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| ***Summary of change:*** | 1. Clarify that NPDCCH associated with SPS C-RNTI applies interference randomization if enabled by RRC configuration, i.e. *interferenceRandomisationConfig*. 2. Correct the cross reference of *interferenceRandomisationConfig* from [11] to [9]. |
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| ***Consequences if not approved:*** | The agreement is not captured completely. The performance of NPDCCH associated with SPS C-RNTI will be degraded. The number of NPDCCH blind decodes is increased if NPDCCH associated with C-RNTI is with interference randomization and SPS C-RNTI is not. |

The CR to TS 36.211:

< Unchanged parts are omitted >

10.2.3.4 Mapping to resource elements

< Unchanged parts are omitted >

For frame structure type 1, for NPDSCH associated with C-RNTI when *interferenceRandomisationConfig* is used according to [9],or NPDSCH associated with RA-RNTI, TC-RNTI or P-RNTI and transmitted in an NB-IoT carrier configured by *SystemInformationBlockType22-NB*, or NPDSCH associated with C-RNTI in an NB-IoT carrier configured by *SystemInformationBlockType22-NB* when *RadioResourceConfigDedicted-NB* is not configured by higher layer, or NPDSCH associated with G-RNTI or SC-RNTI, or for frame structure type 2, for NPDSCH not carrying the BCCH, define as the block of complex-valued symbols mapped to subframe number and radio frame number . Each complex-valued symbol  shall be multiplied with before its transmission, with



where the scrambling sequence is given by clause 7.2 and shall be initialized at the start of each subframe with .

< Unchanged parts are omitted >

< Unchanged parts are omitted >

10.2.5.5 Mapping to resource elements

The block of complex-valued symbols  shall be mapped in sequence starting with  to resource elements  on the associated antenna port which meet all of the following criteria:

- they are part of the NCCE(s) assigned for the NPDCCH transmission, and

- they are not used for transmission of NPBCH, NPSS, or NSSS , and

- except in a special subframe when NPDCCH is transmitted in more than one subframe, they are assumed by the UE not to be used for NRS, and

- they are not overlapping with resource elements used for CRS as defined in clause 6 (if any), and

- the index  in the first slot in a subframe fulfils  where is given by clause 16.6.1 of 3GPP TS 36.213 [4],

- in addition, for frame structure Type 2,

- in a special subframe where the NPDCCH is transmitted in one subframe, they are in DwPTS

- in a special subframe where the NPDCCH is transmitted in more than one subframe, they are not NRS locations when the subframe is not a special subframe..

The mapping to resource elements  on antenna port  meeting the criteria above shall be in increasing order of first the index  and then the index, starting with the first slot and ending with the second slot in a subframe. Denote  as the complex-valued symbols that are mapped to resource elements meeting the criteria above in subframe , with the insertion of <NIL> elements in the locations of resource elements which are not part of the NCCE(s) assigned for the NPDCCH transmission.

If the NPDCCH is transmitted in more than one subframe, the resource elements in a special subframe that are not part of DwPTS are counted but not used in the mapping. When , the resource elements in a special subframe assumed by the UE for NRSs are counted but not used in the mapping if the NPDCCH is transmitted in more than one subframe.

For frame structure type 1, for NPDCCH associated with RA-RNTI, TC-RNTI or P-RNTI and transmitted in an NB-IoT carrier configured by *SystemInformationBlockType22-NB,* or NPDCCH associated with C-RNTI in an NB-IoT carrier configured by *SystemInformationBlockType22-NB* when *RadioResourceConfigDedicted-NB* is not configured by higher layer, or NPDCCH associated with G-RNTI or SC-RNTI, or for NPDCCH associated with C-RNTI or SPS C-RNTI when *interferenceRandomisationConfig* is used according to [9], or for frame structure type 2, each complex-valued symbol , shall be multiplied with ,where



where the scrambling sequence  is given by clause 7.2, and shall be initialized at the start of each subframe with .

The NPDCCH transmission can be configured by higher layers with transmissions gaps where the NPDCCH transmission is postponed. The configuration is the same as described for NPDSCH in clause 10.2.3.4.

The UE shall not expect NPDCCH in subframe  if it is not a NB-IoT downlink subframe. In case of NPDCCH transmissions, in subframes that are not NB-IoT downlink subframes, the NPDCCH transmission is postponed until the next NB-IoT downlink subframe.

< Unchanged parts are omitted >

Please input your comments to the proposed CR:

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| Companies | Comments |
| Ericsson | We are OK with the CR. We just have the following editorial suggestions:   * In the “Consequences if not approved” field, it has been written “The agreement is not captured completely,” but is unclear to which agreement this field is referring to. Thus, in our view the wording should be replaced by:   “The agreement in R1-1714639 is incompletely captured, letting aside the case where NPDCCH is associated with SPS C-RNTI, which is also mapped on USS”   * In clause 10.2.5.5:   + The extra space after “NSSS” in the following sentence can be removed: “- they are not used for transmission of NPBCH, NPSS, or NSSS , and“   + The second dot after “subframe” in the following sentence can be removed: “- in a special subframe where the NPDCCH is transmitted in more than one subframe, they are not NRS locations when the subframe is not a special subframe..“ |
| Qualcomm | Regarding the comment from Ericsson on the cover page, we are fine either way – note that the agreement was made before SPS C-RNTI was introduced in NB-IoT. We are OK with adding the editorial changes, too, although they could be also changed in a separate CR to include Rel-14 (no strong view either way). |
| Nokia, NSB | We are fine with the CR. We are also OK with the editorial changes to 10.2.5.5 proposed by Ericsson. |
| ZTE | We are OK with the CR.  We are fine with the editorial changes proposed by Ericsson. |
| Huawei, HiSilicon | We support the CR.  On the proposed change to “Consequences if not approved”, although it’s already been clear combined with “reason for change”, we don’t have strong view on this. |
| Ericsson (v006)) | The need to explicitly write “SPS C-RNTI” has been questioned by one company in some other e-mail discussion:  “Even when the UE monitors SPS C-RNTI, the search space is given by the C-RNTI, as specified in 213:  ”  Based on the above, we wonder if the explicit mention of “SPS C-RNTI” is needed. |
| Huawei, HiSilicon 2 | Regarding the comments of Ericsson (v006), the wording are different that one is “search space by C-RNTI”, which by 36.213 can cover both C-RNTI and SPS C-RNTI. And the other in this CR is “associated with C-RNTI or SPS C-RNTI”, which in 36.211 has been used many places to mean C-RNTI and SPS C-RNTI separately, such as below:  *If subframeBitmap or slotBitmap in higher layer parameter ul-ResourceReservationConfig is configured, then in case of NPUSCH format 1 transmission associated with C-RNTI or SPS C-RNTI using UE-specific NPDCCH search space with the Resource reservation field in the DCI set to 1 including NPUSCH format 1 transmission without a corresponding NPDCCH, or in case of NPUSCH format 2 transmission associated with C-RNTI using UE-specific NPDCCH search space,*  *If subframeBitmap or slotBitmap in higher layer parameter ul-ResourceReservationConfig is configured, then in case of NPUSCH format 1 transmission associated with C-RNTI or SPS C-RNTI using UE-specific NPDCCH search space and the Resource reservation field in the DCI is set to 1 including NPUSCH format 1 transmission without a corresponding NPDCCH, or in case of NPUSCH format 2 transmission associated with C-RNTI using UE-specific NPDCCH search space,*  *If subframeBitmap or slotBitmap in higher layer parameter dl-ResourceReservationConfig is configured, then in case of NPDCCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific NPDCCH search space,* |
| Ericsson (v008) | The wording in this CR is aiming to say “NPDCCH associated with C-RNTI or SPS C-RNTI”, which might be argued that is different than “search space by C-RNTI”, but note that the title of Table 16.5.1-5 says “NPDCCH … configured by SPS C-RNTI” which covers what is intended to be added in this CR.  Aiming at being constructive, we do not have a strong view, especially if “SPS C-RNTI” has already been explicitly captured in the specification regardless of what one can infer from Table 16.5.1-5. But it would be to understand why for “NPDCCH associated with C-RNTI” and “search space by C-RNTI” a different criteria is followed if in both cases one can use Table 16.5.1-5. |
| Qualcomm | The way we followed to specify this is based on the NPDCCH + RNTI, instead of search space. If you read the Tables similar to 16.5.1-5, you can conclude that “NPDCCH configured with C-RNTI and NPDDCH configured with SPS C-RNTI are mapped onto the NPDCCH search space given by the C-RNTI”. Maybe it was a bad decision to make it based on RNTIs instead of search spaces, but that is the current status.  Thus, we think the change is still needed. |

# Summary

To be added.

# References

1. R1-2008341, Corrections on interference randomization for NB-IoT SPS, Huawei, HiSilicon, MediaTek, Qualcomm, RAN1#103-e, 2020.