**3GPP TSG RAN WG1 Meeting #102-e R1-20xxxxx**

**E-Meeting, August 17 – 28, 2020**

**Agenda Item: 6.2.2**

**Source: Moderator (Huawei)**

**Title: Feature summary on 102-e-LTE-NB\_IoTenh3-03**

**Document for: Discussion and Decision**

# Introduction

Agreements and conclusions in previous meeting for the coexistence of NB-IoT with NR are summarized in [1].

This documents provides the proposals and summary of discussions of the following second phase email discussion:

[102-e-LTE-NB\_IoTenh3-03] NB-IoT alignment with higher layer parameters and terms

* Issue #6: misalignment of terms and higher layer parameters names
* Issue #7: misalignment of configuration of multiTB-Gap
* Issue#8: PUR RNTI
* Issue #9: several editorial (typos)
* Discussions/Agreement by 8/21, TPs by 8/28

# Discussion

Issue 6: misalignment of terms and higher layer parameters names

* As explained in [2], there are some higher layer parameters not aligned with 36.331, as summarized as below

|  |  |  |
| --- | --- | --- |
|  | **Physical layer name** | **Higher layer name(36.331)** |
| **36.213** | *dl-ResourceReservationConfig* | *resourceReservationConfigDL* |
| *ul-ResourceReservationConfig* | *resourceReservationConfigUL* |
| *harq-ACK-Bundling* | *harq-AckBundling* |
| **36.212** | *valid-subframe-config-UL* | *subframeBitmap* |
| *slot-reserved-resource-config-UL* | *slotBitmap* |
| *valid-subframe-config-DL* | *subframeBitmap* |
| *slot-reserved-resource-config-DL* | *slotBitmap* |
| **36.211** | *dl-ResourceReservationConfig* | *resourceReservationConfigDL* |
| *ul-ResourceReservationConfig* | *resourceReservationConfigUL* |

* As explained in [4], the field for multi-TB scheduling is named as Number of scheduled TB for Unicast, which in 36.213, the number of scheduled TB field is used. Therefore, they should be aligned.
* Proposal: Endorse one of the following text proposal

---------------------------------------------- Start of Text Proposal to 36.213 ------------------------------

16.4 Narrowband physical downlink shared channel related procedures

<Unchanged parts omitted>

A NB-IoT UE shall determine whether a downlink subframe or a TDD special subframe configured for NB-IoT DL transmission is a NB-IoT DL subframe as follows

- If the UE determines that the subframe contains NPSS/NSSS/NPBCH/ *SystemInformationBlockType1-NB* transmission, then the subframe is not assumed as a NB-IoT subframe.

- Else if higher layer parameter *resourceReservationConfigDL* is configured

<Unchanged parts omitted>

**16.4.1 UE procedure for receiving the narrowband physical downlink shared channel**

<Unchanged parts omitted>

- , where the value of  is determined by the repetition number field in the corresponding DCI (see Subclause 16.4.1.3), the value of is determined by the resource assignment field in the corresponding DCI (see Subclause 16.4.1.3), and the value of is determined by the Number of scheduled TB for Unicast field, if present, in the corresponding DCI,  otherwise,

<Unchanged parts omitted>

**16.4.2 UE procedure for reporting ACK/NACK**

<Unchanged parts omitted>

- if the UE is configured with higher layer parameter *harq-ACK-Bundling* in *npdsch-MultiTB-Config*, then , otherwise , where the value of is determined by the Number of scheduled TB for Unicast field if present in the NPDCCH corresponding to the NPDSCH, otherwise ,

<Unchanged parts omitted>

16.4.2 UE procedure for reporting ACK/NACK

<Unchanged parts omitted>

- For 

- if the UE is configured with higher layer parameter *harq-AckBundling* in *npdsch-MultiTB-Config*, and the NPDSCH corresponding to a NPDCCH with DCI CRC scrambled by C-RNTI,

<Unchanged parts omitted>

16.5 Narrowband physical uplink shared channel related procedures

<Unchanged parts omitted>

A NB-IoT UE shall determine whether a subframe is a NB-IoT UL subframe as follows

- If higher layer parameter *resourceReservationConfigUL* is configured

<Unchanged parts omitted>

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

<Unchanged parts omitted>

- , where the value of is determined by the repetition number field in the corresponding DCI (see Subclause 16.5.1.1), the value of is determined by the resource assignment field in the corresponding DCI (see Subclause 16.5.1.1), the value of  is the number of NB-IoT UL slots of the resource unit (defined in clause 10.1.2.3 of [3]) corresponding to the  allocated number of subcarriers (as determined in Subclause 16.5.1.1) in the corresponding DCI, and the value of is determined by the Number of scheduled TB for Unicast field, if present, in the corresponding DCI,  otherwise

<Unchanged parts omitted>

**16.6 Narrowband physical downlink control channel related procedures**

<Unchanged parts omitted>

- 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 for Unicast 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

<Unchanged parts omitted>

- 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 for Unicast 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*;

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---------------------------------------------- Start of Text Proposal to 36.212 ------------------------------

6.4.3.1 DCI Format N0

<Unchanged parts omitted>

- Resource reservation – 1 bit as defined in clause 16.5 of [3]. This field is only present if *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigUL* is configured and the DCI is mapped onto the UE-specific search space given by C-RNTI as defined in [3].

<Unchanged parts omitted>

6.4.3.2 DCI Format N1

<Unchanged parts omitted>

- Resource reservation – 1 bit as defined in clause 16.4 of [3]. This field is only present if *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigDL* is configured and the DCI is mapped onto the UE-specific search space given by C-RNTI as defined in [3].

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---------------------------------------------- Start of Text Proposal to 36.211 ------------------------------

10.1.3.6 Mapping to physical resources

<Unchanged parts omitted>

If *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigUL* 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,

<Unchanged parts omitted>

10.1.4.2 Mapping to physical resources

<Unchanged parts omitted>

If *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigUL* 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,

<Unchanged parts omitted>

10.2.3.4 Mapping to resource elements

<Unchanged parts omitted>

If *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigDL* is configured, then in case of NPDSCH transmission associated with C-RNTI using UE-specific NPDCCH search space with the Resource reservation field in the DCI set to 1,

<Unchanged parts omitted>

10.2.5.5 Mapping to resource elements

<Unchanged parts omitted>

If *subframeBitmap* or *slotBitmap* in higher layer parameter *resourceReservationConfigDL* is configured, then in case of NPDCCH transmission associated with C-RNTI or SPS C-RNTI using UE-specific NPDCCH search space,

<Unchanged parts omitted>

----------------------------------------------- End of Text Proposal to 36.211 ------------------------------

Please input your comments in the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Lenovo&MotoM | How about simply using “*resourceReservationConfigDL*” aligned with 36.213, the same update to “*resourceReservationConfigUL*”.  If *~~subframeBitmap~~* ~~or~~ *~~slotBitmap~~* ~~in~~ higher layer parameter *resourceReservationConfigDL* is configured  ResourceReservationConfigUL-r16 ::= SEQUENCE {  periodicityStartPos-r16 PeriodicityStartPos-r16,  slotBitmap-r16 CHOICE {  slotPattern10ms BIT STRING (SIZE (20)),  slotPattern40ms BIT STRING (SIZE (80))  } OPTIONAL, -- Cond FDDandTDDnoDL  symbolBitmap1-r16 BIT STRING (SIZE (7)) OPTIONAL, -- Cond Bitmap1  symbolBitmap2-r16 BIT STRING (SIZE (7)) OPTIONAL, -- Cond Bitmap2  ...  } |
| Nokia, NSB | We are fine with the TP |
| Ericsson | We agree with Lenovo that it is enough to mention *resourceReservationConfigDL/UL* and leave out *subframeBitmap* and *slotBitmap*. We have done something similar in the LTE-MTC case. |
| ZTE,Sanechip | It seems it is possible that *subframeBitmap* or *slotBitmap* is not configured while *resourceReservationConfigDL/UL* is configured, right? If this understanding is correct then the original TP cannot be further optimized. |
| LG | We are okay with the TP with Lenovo’s suggested modifications. Do we need to mention *subframeBitmap* or *slotBitmap* in the condition? |
| Qualcomm | We think the approach by Lenovo is correct. Actually, for TDD it is possible that we don’t have “slotBitmap” or “symbolBitmap” in the UL grant:    So, I think we should just use *resourceReservationConfig(UL/DL)* as a condition. |

Issue 7: misalignment of configuration of multiTB-Gap

* As explained in [2][4], in 36.331, multiTB-Gap cannot be configured with 0 and when multiTB-Gap is not configured, there is no scheduling gap, i.e. gap is 0. While in 36.213, the current wording assumes the gap can be configured to 0.
* Proposal: Endorse one of the following text proposal

---------------------------------------------- Start of Text Proposal to 36.213 ------------------------------

<Unchanged parts omitted>

16.4.1 UE procedure for receiving the narrowband physical downlink shared channel

<Unchanged parts omitted>

- for  and NPDSCH corresponding to an NPDCCH with DCI CRC scrambled by G-RNTI,

- if *multiTB-Gap* is not configured and , a processing gap of 20ms is inserted after every 2 TBs

<Unchanged parts omitted>

----------------------------------------------- End of Text Proposal to 36.213 ------------------------------

Please input your comments in the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Lenovo&MotoM | Agree with the TP |
| Nokia, NSB | We are fine with the TP |
| Ericsson | Fine with TP |
| ZTE,Sanechips | OK |
| LG | We are okay with the TP |
| Qualcomm | Agree with the TP |

Issue 8: PUR RNTI

* As explained in [4], RAN1 and RAN2 specifications are not following a common terminology with respect to the PUR RNTI. RAN1 specifications are using “PUR C-RNTI” while RAN2 specifications are using “PUR-RNTI” (e.g. see TS 36.302).
* Proposal: Endorse one of the following text proposal

----------------------------------------------- Start of Text Proposal to 36.212 -----------------------------

6.4.3.1 DCI Format N0

DCI format N0 is used for the scheduling of NPUSCH and operation on preconfigured UL resources in one UL cell.

The following information is transmitted by means of the DCI format N0:

- Flag for format N0/format N1 differentiation – 1 bit, where value 0 indicates format N0 and value 1 indicates format N1

- Modulation and coding scheme – 4 bits as defined in clause 16.5.1.2 of [3]. This field is only present if format N0 CRC is scrambled by PUR RNTI.

If format N0 CRC is scrambled by PUR RNTI and Modulation and coding scheme is set to '1110', the remaining fields are set as follows:

- ACK or Fallback indicator – 1 bit, where value 0 indicates ACK and value 1 indicates fallback as defined in clause 16.6.4 of [3]

- NPUSCH repetition adjustment – 3 bits as defined in clause 16.5.1.1 of [3]

- Timing advance adjustment – 6 bits as defined in clause 16.1.2 of [3]. The field is only present if ACK or Fallback indicator is set to 0.

- All the remaining bits in format N0 are set to one

Otherwise

- Subcarrier indication – 6 bits as defined in clause 16.5.1.1 of [3]

- Resource assignment – 3 bits as defined in clause 16.5.1.1 of [3]

- Scheduling delay – 2 bits as defined in clause 16.5.1 of [3]

- Modulation and coding scheme – 4 bits as defined in clause 16.5.1.2 of [3]. This field is not present if format N0 CRC is scrambled by PUR RNTI.

- Redundancy version – 1 bit as defined in clause 16.5.1.2 of [3]

- Repetition number – 3 bits as defined in clause 16.5.1.1 of [3]

- New data indicator – 1 bit

- DCI subframe repetition number – 2 bits as defined in clause 16.6 in [3]

- 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 *npusch-MultiTB-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 field is set to 0 if the CRC of the DCI is scrambled by SPS C-RNTI.

- HARQ process number – 1 bit. This field is only present if 2 HARQ processes are configured and the corresponding DCI format is mapped onto the UE specific search space given by the C-RNTI as defined in [3], or if Number of scheduled TB for Unicast is present. If multiple TB are scheduled, it functions as New data indicator for the second TB.

- Resource reservation – 1 bit as defined in clause 16.5 of [3]. This field is only present if higher layer parameter *valid-subframe-config-UL* or *slot-reserved-resource-config-UL* is configured and the DCI is mapped onto the UE-specific search space given by C-RNTI as defined in [3].

If the number of information bits in format N0 mapped onto the UE specific search space given by the C-RNTI as defined in [3] is less than that of format N1 in the same search space, zeros shall be appended to format N0 until the payload size equals that of format N1.

6.4.3.2 DCI Format N1

DCI format N1 is used for the scheduling of one NPDSCH codeword per TTI in one cell, random access procedure initiated by a NPDCCH order, notifying SC-MCCH change, and operation on preconfigured UL resources. The DCI corresponding to a NPDCCH order is carried by NPDCCH.

The following information is transmitted by means of the DCI format N1:

- If the format N1 CRC is scrambled by C-RNTI or RA-RNTI or PUR RNTI:

- Flag for format N0/format N1 differentiation – 1 bit, where value 0 indicates format N0 and value 1 indicates format N1

- NPDCCH order indicator – 1 bit

- Else if the format N1 CRC is scrambled by a G-RNTI:

- Information for SC-MCCH change notification – 2 bits as defined in clause 5.8a of [6]

----------------------------------------------- End of Text Proposal to 36.212 ------------------------------

----------------------------------------------- Start of Text Proposal to 36.213 -----------------------------

### 16.4.1 UE procedure for receiving the narrowband physical downlink shared channel

<Unchanged parts omitted>

If a UE is configured by higher layers to decode NPDCCH with CRC scrambled by the PUR RNTI, the UE shall decode the NPDCCH and the corresponding NPDSCH according to any of the combination defined in Table 16.4.1-9. The scrambling initialization of the NPDSCH corresponding to these NPDCCHs is by PUR RNTI.

Table 16.4.1-9: NPDCCH and NPDSCH configured by PUR RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format N1 | UE specific by PUR RNTI |

<Unchanged parts omitted>

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

<Unchanged parts omitted>

A UE may transmit NPUSCH on preconfigured uplink resources as configured by higher layers. The scrambling initialization of NPUSCH transmission using preconfigured uplink resource is by PUR RNTI.

If a UE is configured by higher layers to decode NPDCCHs with the CRC scrambled by the PUR RNTI, the UE shall decode the NPDCCH according to the combination defined in Table 16.5.1-6 and in case the indication in the DCI corresponds to the retransmission of a transport block transmitted using preconfigured uplink resource, transmit a corresponding NPUSCH. The scrambling initialization of this NPUSCH corresponding to these NPDCCHs and the NPUSCH retransmission for the same transport block is by PUR RNTI.

Table 16.5.1-6: NPDCCH and NPUSCH configured by PUR RNTI

|  |  |
| --- | --- |
| DCI format | Search Space |
| DCI format N0 | UE specific by PUR RNTI |

#### 16.5.1.1 Resource allocation

The resource allocation information in uplink DCI format N0 for NPUSCH transmission or configured by higher layers for NPUSCH transmission using preconfigured uplink resource indicates to a scheduled UE

* a set of contiguously allocated subcarriers () of a resource unit determined by the Subcarrier indication field,
* a number of resource units () determined by the resource assignment field according to Table 16.5.1.1-2,
* a repetition number () determined by the repetition number field according to Table 16.5.1.1-3. For a NPUSCH transmission using preconfigured uplink resource, the UE shall use the repetition number determined by the NPUSCH repetition adjustment field according to Table 16.5.1.1-3 from the most recent NPDCCH DCI format N0 with CRC scrambled by PUR RNTI with the value of "modulation and coding scheme" field () set to '14' if detected, configured by higher layers otherwise.

<Unchanged parts omitted>

## 16.6 Narrowband physical downlink control channel related procedures

<Unchanged parts omitted>

For NPDCCH UE-specific search space, the aggregation and repetition levels defining the search spaces and the corresponding NPDCCH candidates are listed in Table 16.6-1 by substituting the value of with the higher layer configured parameter *npdcch-NumRepetitions*, except for NPDCCH candidates associated with PUR RNTI in which case it is given by higher layer parameter *npdcch-NumRepetition­s* in *PUR-Config-NB*.

<Unchanged parts omitted>

- for NPDCCH UE-specific search space,

- is given by the higher layer parameter *npdcch-StartSF-USS*, except for NPDCCH candidates associated with PUR RNTI in which case it is given by higher layer parameter *npdcch-StartSF-USS* in *PUR-Config-NB*,

- is given by the higher layer parameter *npdcch-Offset-USS*, except for NPDCCH candidates associated with PUR RNTI in which case it is given by higher layer parameter *npdcch-Offset-USS* in *PUR-Config-NB*,

<Unchanged parts omitted>

If the UE has initiated a NPUSCH transmission using preconfigured uplink resource ending in subframe *n*, the UE shall monitor the NPDCCH UE-specific search space in a search space window starting in subframe *n+4* with duration given by higher layer parameter *pur-SS-window-duration*. Upon detection of a NPDCCH with DCI format N0 with CRC scrambled by PUR RNTI intended for the UE within the search space window and the value of "modulation and coding scheme" field () in the corresponding DCI is set to '14', the UE is not required to monitor the NPDCCH UE-specific search space for the remaining search space window duration.

----------------------------------------------- End of Text Proposal to 36.213 ------------------------------

Please input your comments in the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Lenovo&MotoM | Agree with the TP if the naming of PUR RNTI is stable in RAN2, otherwise postpone to next meeting |
| Nokia, NSB | We are fine with the TP |
| Ericsson | Fine with TP |
| ZTE,Sanechips | OK |
| LG | We are okay with the TP |
| Qualcomm | Agree with the TP |

Issue 9: Correction of editorial typos

* As explained in [2], there are some typos that need to be corrected.
* Proposal: Endorse one of the following text proposal

---------------------------------------------- Start of Text Proposal to 36.211 ------------------------------

<Unchanged parts omitted>

3.1 Symbols

<Unchanged parts omitted>

 Periodicity for NPDSCH/NPDCCH gaps

 Duration for NPDSCH/NPDCCH gaps

 Threshold for applying NPDSCH/NPDCCH gaps

<Unchanged parts omitted>

10.2.3.4 Mapping to resource elements

<Unchanged parts omitted>

The NPDSCH transmission can be configured by higher layers with transmission gaps where the NPDSCH transmission is postponed. There are no gaps in the NPDSCH transmission if where  is given by the higher layer parameter *dl-GapThreshold* and  is given by [4]. The gap starting frame and subframe is given by  where the gap periodicity,, is given by the higher layer parameter *dl-GapPeriodicity*. The gap duration in number of subframes is given by , where  is given by the higher layer parameter *dl-GapDurationCoeff*. For NPDSCH carrying the BCCH there are no gaps in the transmission.

<Unchanged parts omitted>

----------------------------------------------- End of Text Proposal to 36.211 ------------------------------

Please input your comments in the following table:

|  |  |
| --- | --- |
| Companies | Comments |
| Lenovo&MotoM | Agree with the TP |
| Nokia, NSB | We are fine with the TP |
| Ericsson | Fine with TP |
| ZTE,Sanechips | OK |
| LG | We are okay with the TP |
| Qualcomm | Agree with the TP |

# Summary

To be added.

# References

1. R1-1913595, “RAN1 agreements for Rel-16 Additional Enhancements for NB-IoT”, Futurewei, Reno, USA, November 2019.
2. R1-2006420, Corrections on higher layer parameters for additional NB-IoT enhancements, Huawei, HiSilicon
3. R1-2005472 Remaining issues on scheduling enhancement for NB-IoT        ZTE
4. R1-2006189, Maintenance on PUR, Qualcomm Incorporated