**3GPP TSG RAN WG1 Meeting #101-e R1-2004534**

**E-meeting, May 25 – June 5, 2020**

**Agenda Item: 6.2.2.2**

**Source: Moderator (Huawei)**

**Title: Feature lead summary #2 on transmission in pre-configured UL resources for NB-IoT**

**Document for: Discussion and Decision**

# Introduction

This contribution summarizes NB-IoT Rel-16 PUR related discussions and proposals. According to the guidance of the chairman below, the intention of this contribution is to provide a list of issues/proposals and identify the set of email threads.

* May 18th – 22nd: preparation phase
	+ May 18th – 19th: FLs to prepare summary
	+ May 20th – 22nd: FLs to lead the discussion identifying the set of email threads

Section 2 lists all the issues discussed in the contributions, and FL’s view on the priority of each issue is summarized in Section 3.

# Issues

## Issue#1: Clarification on subcarrier spacing

**Description**: Regarding subcarrier spacing for PUR, Huawei/HiSilicon [1] identified several problems of the current TS 36.213:

* **P1**: After PUR transmission, the eNB may send RRC messages to the UE, and the UE needs to send NPUSCH F2 upon receiving such RRC messages. However, the subcarrier spacing of such NPUSCH F2 is undefined
	+ Note that in legacy NB-IoT, the subcarrier spacing of NPUSCH F1 and F2 are the same and are given by RAR
	+ So similarly, it is proposed that for PUR, the subcarrier spacing of such NPUSCH F2 is the same as NPUSCH F1
* **P2**: TS 36.331 uses “*npusch-SubCarrierSetIndex*” instead of “*Delta\_f^PUR*”, so the parameter name should be updated for alignment
* **P3**: There might be multiple retransmissions for the PUR transmission or RRC message, so suggest to add “(s)” to “subsequent retransmission” and “NPUSCH format 2 transmission”

TP provided by Huawei/HiSilicon [1] is:

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| ------------------------------------- Start of Text Proposal for TS 36.213-------------------------------------------------------------------------- Unchanged parts omitted --------------------------------------16.5.1.1 Resource allocation…The subcarrier spacing  of NPUSCH transmission is determined by - the higher layer parameter *npusch-SubCarrierSetIndex*, in the case of NPUSCH transmission using preconfigured uplink resources and subsequent retransmission(s) of transport blocks transmitted using preconfigured uplink resource, scheduled by an NPDCCH with DCI format N0, and the corresponding NPUSCH format 2 transmission(s)- the uplink subcarrier spacing field in the Narrowband Random Access Response Grant according to Subclause 16.3.3 otherwise.-------------------------------------------- Unchanged parts omitted ----------------------------------------------------------------------------------- End of Text Proposal ---------------------------------------- |

## Issue#2: Clarification on timing advance adjustment

**Description**: For PUR, TA can be updated in two ways: TA command from MAC CE (legacy way), or TA adjustment from dedicated PUR ACK DCI (newly introduced in Rel-16 PUR). Huawei/HiSilicon [1] points out the description in TS 36.213, i.e., “a 6-bit timing advance command [8]”, is not accurate enough since timing advance command refers to MAC CE, so it does not consider timing advance adjustment from dedicated PUR ACK DCI.

TP provided by Huawei/HiSilicon [1] is:

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| ------------------------------------- Start of Text Proposal for TS 36.213-------------------------------------------------------------------------- Unchanged parts omitted --------------------------------------16.1.2 Timing synchronization…In other cases, a 6-bit timing advance command [8] or timing advance adjustment in DCI format N0 if present, *TA*, indicates adjustment of the current *NTA* value, *NTA,old*, to the new *NTA* value, *NTA,new*, by index values of *TA* = 0, 1, 2,..., 63, where *NTA,new* = *NTA,old* + (*TA* −31)×16. Here, adjustment of *NTA* value by a positive or a negative amount indicates advancing or delaying the uplink transmission timing by a given amount respectively.-------------------------------------------- Unchanged parts omitted ----------------------------------------------------------------------------------- End of Text Proposal ---------------------------------------- |

## Issue#3: TP for PUR collision handling

**Description**: Regarding PUR collision handling, the following WA was made in RAN1#100bis-e, and an LS was sent to RAN2 for confirmation. To accelerate the discussion, Huawei/HiSilicon [1] proposed the corresponding TP.

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| Working Assumption* When PUR transmission overlaps with WUS, PUR transmission is prioritized
	+ For eMTC, this applies only to HD-FDD UEs
* When PUR SS monitoring overlaps with Paging CSS, PUR SS monitoring is prioritized
* When PUR SS monitoring overlaps with WUS, PUR SS monitoring is prioritized

If it is concluded by RAN2 that the working assumption is feasible, the working assumption will be automatically confirmed.[**R1-2002944**](file:///D%3A%5CMix-Local%5C001-Mix%20Working%20Folder%5C202005-RAN1%23101-Greece-Athens%20%28e-Meeting%29%5CDocs%5CR1-2002944.zip) **LS on PUR working assumption for NB-IoT and eMTC RAN1, Huawei**AgreementThe LS to RAN2 on PUR working assumption for NB-IoT and eMTC is approved. |

**FL’s comment**: Since RAN2#110-e is one week later than RAN1#101-e, it might be too late to wait for RAN2’s response and then initiates the discussion on TP in RAN1. To accelerate the discussion, the FL suggests to discuss on the TP based on the WA directly.

TP provided by Huawei/HiSilicon [1] is:

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| ------------------------------------- Start of Text Proposal for TS 36.213-------------------------------------------------------------------------- Unchanged parts omitted --------------------------------------16.6 Narrowband physical downlink control channel related procedures…Until UE receives higher layer configuration of NPDCCH UE-specific search space, the UE monitors NPDCCH according to the same configuration of NPDCCH search space as that for NPDCCH scheduling Msg4.A UE is not required to monitor Type1-NPDCCH common search space or NWUS if the set of subframes comprising the NPDCCH candidates or NWUS include any subframes in which the UE has initiated an NPUSCH transmission using preconfigured uplink resource on a given serving cell.…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 *n+4* subframewith duration given by higher layer parameter *pur-SS-window-duration*. Upon detection of a NPDCCH with DCI format N0 with CRC scrambled by PUR C-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. The UE is not required to monitor Type1-NPDCCH common search space or NWUS if it overlaps with the NPDCCH UE-specific search space within the search space window.-------------------------------------------- Unchanged parts omitted ----------------------------------------------------------------------------------- End of Text Proposal ---------------------------------------- |

## Issue#4: TP for L1 adjustment on the NPUSCH repetition number

**Description**: Regarding L1 adjustment on the (N)PUSCH repetition number, RAN1 replied LS (R1-2002846) to RAN2 in RAN1#100bis-e. The major content of the LS is copied below for reference.

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| *… (Copied from R1-2002846)…*RAN1 considers that the answers to the questions above are covered through the following response:* The L1 adjustment on the (N)PUSCH repetition number is intended to apply for future PUR UL transmissions until a new L1 adjustment or RRC reconfiguration is received, i.e. the UE uses the information from the most recently received L1 adjustment or RRC (re)configuration.
* The decision on whether the L1 adjustment on the (N)PUSCH repetition number is intended to update the higher layer (i.e. RRC) configuration or to be used instead of the configuration provided by higher layers can be made in RAN2, and then RAN1 will update the RAN1 specifications in accordance with the RAN2 decision if needed.
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Qualcomm [2] proposed two alternative modifications to TS 36.213 to capture this, depending on whether the “storing” behavior is described in RAN1 (TP1-PHY) specifications or RAN2 (TP1-RRC) specifications.

**FL’s comment**: Since RAN2#110-e is one week later than RAN1#101-e, it might be too late to wait for RAN2’s response and then initiates the discussion on TP in RAN1. The FL suggests to discuss on the TP based on RAN1’s reply LS (R1-2002846) directly (maybe two alternatives for the TP as Qualcomm pointed out), and the final alternative for the TP depends on the outcome from RAN2’s discussion.

“TP1-PHY” provided by Qualcomm [2] is:

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| **<TP1-PHY, TS 36.213, Subclause 16.5.1.1>**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 C-RNTI with the value of "modulation and coding scheme" field () set to '14' if detected, or from the most recent reception of *PUR-Config-NB* containing *pur-PhysicalConfig*, whichever was received later.

**</TP1-PHY>** |

“TP1-RRC” provided by Qualcomm [2] is:

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| **<TP1-RRC, TS 36.213, Subclause 16.5.1.1>**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 configured by higher layers.

**</TP1-RRC>** |

## Issue#5: Clarification on “after the UE has initiated a NPUSCH transmission using preconfigured uplink resource” in TS 36.213

**Description**: Ericsson [4] points out “after the UE has initiated a NPUSCH transmission using preconfigured uplink resource” is not very clear due to the following reasons:

1. It does not clarify how long this “after” lasts.
2. It does not restrict whatever comes next to a particular search space or RNTI
3. The legacy text (which is of the highest interest to most readers) have been made less clear or even obscure

So Ericsson [4] proposes to replace the formulation with “in case of NPDCCH transmission associated with PUR C-RNTI using NPDCCH UE-specific search space” and rearrange some of the sentences.

TP provided by Ericsson [4] is:

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| ------------------------------------- Start of Text Proposal for TS 36.213---------------------------------------------------------------------------- Unchanged parts omitted --------------------------------------16.6 Narrowband physical downlink control channel related procedures…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 in case of NPDCCH transmission associated with PUR C-RNTI using NPDCCH UE-specific search space in which case it is given by higher layer parameter *npdcch-NumRepetition­s-PUR*. …The locations of starting subframe  are given by where is the th consecutive NB-IoT DL subframe from subframe , excluding subframes used for transmission of SI messages, and , and , and where - subframe  is a subframe satisfying the condition , where , *T*≥4.- for NPDCCH UE-specific search space, - is given by the higher layer parameter *npdcch-StartSF-USS,* except in case of NPDCCH transmission associated with PUR C-RNTI using NPDCCH UE-specific search space in which case it is given by higher layer parameter *npdcch-StartSF-USS-PUR*, - is given by the higher layer parameter *npdcch-Offset-USS,* except in case of NPDCCH transmission associated with PUR C-RNTI using NPDCCH UE-specific search space in which case it is given by higher layer parameter *npdcch-Offset-USS-PUR*,- for NPDCCH Type2-NPDCCH common search space, - is given by the higher layer parameter *npdcch-StartSF-CSS-RA*, - is given by the higher layer parameter *npdcch-Offset-RA*, -------------------------------------------- Unchanged parts omitted ------------------------------------------------------------------------------------ End of Text Proposal ---------------------------------------- |

## Issue#6: Clarification on PUR power control

**Description**: During Rel-16 discussion, the following agreement was made respect to PUR power control:

**Agreement**

Open loop power control is used as power control mechanism for PUR.

* The power for PUR transmission is calculated based on pathloss regardless of the number of repetitions.

PUR power control is captured in TS 36.213 as follows:

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| *…(Copied from TS 36.213)…*16.2.1.1.1 UE behaviour…The UE transmit power  for NPUSCH transmission in NB-IoT UL slot *i* for the serving cell is given by:For NPUSCH (re)transmissions corresponding to the random access response grant if enhanced random access power control is not applied, and for all other NPUSCH transmissions except for NPUSCH transmission using preconfigured uplink resource, when the number of repetitions of the allocated NPUSCH RUs is greater than 2:[dBm]otherwise [dBm] |

ZTE [3] points out based on the current TS 36.213, power control for PUR initial transmission and retransmission are specified as follows:

* PUR initial transmission, i.e., NPUSCH transmission using preconfigured uplink resource, will only follow the formula listed in “otherwise”
* PUR retransmission, will follow both the formula listed in “… greater than 2:” and the formula listed in “otherwise”

ZTE [3] points out the UE transmit power  of PUR retransmission is incorrectly captured, i.e.,  of PUR retransmission should only follow the formula listed in “otherwise”, i.e., same as PUR initial transmission.

TP provided by ZTE [3] is:

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| ------------------------------------- Start of Text Proposal for TS 36.213---------------------------------------------------------------------------- Unchanged parts omitted --------------------------------------**16.2.1.1.1 UE behaviour**…The UE transmit power  for NPUSCH transmission in NB-IoT UL slot *i* for the serving cell is given by:For NPUSCH (re)transmissions corresponding to the random access response grant if enhanced random access power control is not applied, and for all other NPUSCH transmissions except for NPUSCH transmission using preconfigured uplink resource and NPUSCH transmission scheduled by DCI format N0 with CRC scrambled by PUR-RNTI, when the number of repetitions of the allocated NPUSCH RUs is greater than 2:[dBm]otherwise [dBm]-------------------------------------------- Unchanged parts omitted ------------------------------------------------------------------------------------ End of Text Proposal ---------------------------------------- |

## Issue#7: Support of NPDCCH order for PUR

**Description**: Support of NPDCCH order for PUR was discussed in previous meetings, but there was no consensus. ZTE [3] proposes to support NPDCCH order for PUR considering the benefits of contention-free, less signaling overhead, larger max TBS size than EDT, etc.

TP provided by ZTE [3] is:

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| **TS36.212****6.4.3.2 DCI Format N1****<Unchanged parts are omitted>**Format N1 is used for random access procedure initiated by a NPDCCH order only if NPDCCH order indicator is set to '1', format N1 CRC is scrambled with C-RNTI or PUR-RNTI, and all the remaining fields are set as follows: - Preamble format indicator – 1 bit, where value 0 indicates preamble format 0/1 and value 1 indicates preamble format 2. This field is only present if *SystemInformationBlockType2-NB* or *SystemInformationBlockType23-NB* is configured and the UE indicates the *nprach-Format2* capability.- Starting number of NPRACH repetitions – 2 bits as defined in subclause 16.3.2 of [3]- Subcarrier indication of NPRACH – 6 or 8 bits, this field is 8 bits only if Preamble format indicator is present and set to 1, as defined in subclause 16.3.2 of [3] - Carrier indication of NPRACH – 4 bits as defined in subclause 16.3.2 of [3]. This field is only present if *ul-ConfigList* is configured and the UE indicates the *multiCarrier-NPRACH* capability. - All the remaining bits in format N1 are set to one**<Unchanged parts are omitted>** |

# Summary of preparation phase (May 18th – 22nd)

During the preparation phase, companies provided their views on each issue, which are collected in Annex A. Based on these, FL’s view on the priority of each issue in given in Table 1 below.

The following email discussions are suggested:

* **Email discussion#1: Clarification on subcarrier spacing and timing advance adjustment**
	+ Refer to Issue#1 and Issue#2
* **Email discussion#2: Clarification on PUR power control and “after the UE has initiated a NPUSCH transmission using preconfigured uplink resource”**
	+ Refer to Issue#6 and Issue#5
* **Email discussion#3: TP for PUR collision handling and L1 adjustment on the NPUSCH repetition number**
	+ Refer to Issue#3 and Issue#4

Table 1 FL’s view on the priority of each issue

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| --- | --- | --- |
| **Issue** | **FL’s view on priority** | **Summary of company view** |
| Issue#1: Clarification on subcarrier spacing | High | High: 6 |
| Issue#2: Clarification on timing advance adjustment | Medium | High: 3Medium: 2Low/Editorial: 1 |
| Issue#3: TP for PUR collision handling | Medium | High: 3Low: 3 |
| Issue#4: TP for L1 adjustment on the NPUSCH repetition number | Medium | High: 3Medium: 1Low: 2 |
| Issue#5: Clarification on “after the UE has initiated a NPUSCH transmission using preconfigured uplink resource” in TS 36.213 | Low (jointly discussed with #6) | Medium: 2Low/Editorial: 4 3 companies suggest piggybacking |
| Issue#6: Clarification on PUR power control | High | High: 6 |
| Issue#7: Support of NPDCCH order for PUR | Low | Medium: 2Low: 4 |

# Reference

1. R1-2003536 Corrections on transmission in preconfigured UL resources Huawei, HiSilicon

1. R1-2003783 Support for transmission in preconfigured UL resources Qualcomm Incorporated

1. R1-2003796 Remaining issues for transmission in preconfigured UL resources for NB-IoT ZTE

1. R1-2004659 Corrections for Preconfigured UL resources for NB-IoT Ericsson

# Annex A. Company’s view during preparation phase (May 18th – 22nd)

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| --- | --- | --- |
| **Issue** | **FL’s initial view on priority** | **Company’s view on priority and comments** |
| Issue#1: Clarification on subcarrier spacing | High | QC: OKLenovo&MotoM: High(need to clarify)Ericsson: HighSierra Wireless: HighHuawei/HiSilicon: HighZTE/Sanechips: High |
| Issue#2: Clarification on timing advance adjustment | Medium | QC: OKLenovo&MotoM: Low, editorial issue if no objectionEricsson: HighSierra Wireless: HighHuawei/HiSilicon: HighZTE/Sanechips: Medium |
| Issue#3: TP for PUR collision handling | High | QC: See Issue #4Lenovo&MotoM: HighEricsson: Low, it seems that the farthest we can go here is a Working Assumption (WA), but we will end up having a WA on a WA. Thus, we think is better to wait for the RAN2 response in this case.Sierra Wireless: Low – Easy if we wait for RAN2Huawei/HiSilicon: High. Since RAN2 is one week later than RAN1, it might be too late to wait for RAN2 and then initiates the discussion on TP. Ok to merge Issue#3/#4 in the same email thread since both are related to RAN2’s outcome.ZTE/Sanechips:   It's better to wait for ran2 since we don't know what new information ran2 may give and our discussion result could depend on these new information. |
| Issue#4: TP for L1 adjustment on the NPUSCH repetition number | High | QC: Maybe we can merge issue3/4 in the same email discussion, since both are related to LS response from RAN2.Lenovo&MotoM: HighEricsson: Medium, although we prefer to wait for the RAN2 response, we are open to discuss the two possible outcomes. This, under the understanding that the farthest we can go is a WA, the difference here is that there is no other WA preceding this issue.Sierra Wireless: Low – Easier if we wait for RAN2Huawei/HiSilicon: High, same view as Issue#3.ZTE/Sanechips:   It's better to wait for ran2 since we don't know what new information ran2 may give and our discussion result could depend on these new information. |
| Issue#5: Clarification on “after the UE has initiated a NPUSCH transmission using preconfigured uplink resource” in TS 36.213 | Medium | QC: To us this is an editorial change, propose low priority – but OK to discuss if piggyback with a different discussion.Lenovo&MotoM: LowEricsson: Medium, we are fine if it seen as an editorial issue piggybacked to e.g., Issue #6.Sierra Wireless: Low Huawei/HiSilicon: Medium, suggests to merge with other issue, e.g., Issue#6ZTE/Sanechips:  Editorial. |
| Issue#6: Clarification on PUR power control | High | QC: OKLenovo&MotoM: High (need to clarify)Ericsson: HighSierra Wireless: HighHuawei/HiSilicon: HighZTE/Sanechips: High |
| Issue#7: Support of NPDCCH order for PUR | Low | QC: We think there may be some useful use case of supporting PDCCH order during PUR – we propose to have “medium” priority here at least.Lenovo&MotoM: LowEricsson: LowSierra Wireless: Low Huawei/HiSilicon: Low, not essentialZTE/Sanechips:  Medium.  This is not new feature but try to keep the legacy feature PUR should support. |