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

e-Meeting, October 26th – November 13th, 2020

**Agenda item:** 6.2.1 Maintenance of Additional MTC Enhancements

**Source:** Moderator **(**Sierra Wireless)

**Title:** FL summary for PUR issues for Rel-16 LTE-MTC

**Document for**: Discussion

# Introduction

This contribution includes a summary for the email discussion:

[103-e-LTE-eMTC5-01] PUR issues – Gus (Sierra Wireless)

* Issue #1: TM1/TM2 configuration issue ([R1-2008800](https://protect2.fireeye.com/v1/url?k=414a0303-1c98140a-414b884c-0cc47a31cdf8-c78687a922ee16fa&q=1&e=31cac414-d755-4f05-8fc7-d03d4bb99eda&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_103-e%2FDocs%2FR1-2008800.zip))
* Issue #2: TM6/TM9 support issue ([R1-2008583](https://protect2.fireeye.com/v1/url?k=c40bed42-99d9fa4b-c40a660d-0cc47a31cdf8-8e662925567a5aee&q=1&e=31cac414-d755-4f05-8fc7-d03d4bb99eda&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_103-e%2FDocs%2FR1-2008583.zip), [R1-2008800](https://protect2.fireeye.com/v1/url?k=66896cba-3b5b7bb3-6688e7f5-0cc47a31cdf8-7bddb7075a541129&q=1&e=31cac414-d755-4f05-8fc7-d03d4bb99eda&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_103-e%2FDocs%2FR1-2008800.zip))
* Issue #3: Repetition number delivery to higher layers ([R1-2008583](https://protect2.fireeye.com/v1/url?k=9bddc1cd-c60fd6c4-9bdc4a82-0cc47a31cdf8-e3c0d20e4287dc83&q=1&e=31cac414-d755-4f05-8fc7-d03d4bb99eda&u=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG1_RL1%2FTSGR1_103-e%2FDocs%2FR1-2008583.zip))
* Discussion and decision by 10/29, TPs by 11/5

# Issue #2: TM6/TM9 support issue

## Issue Description

Ericsson in [1] points out that there have been no agreements on which transmission modes PUR should support.

## Discussion

Possible options for consideration:

* Option 1: PUR Support only TM 1,2, 6 and 9 (current specification)
* Option 2: PUR supports only TM 1 and 2 (supported by [1] and [2])

## Company Views

Please indicate which option your company can supports:

|  |  |
| --- | --- |
| **Company** | **Comments on Proposal** |
| Ericsson | In principle we support Option 2, but as pointed out in [2] “since there is no RRC configuration of TM, it is unclear how the TM is configured for PUR”. For that reason, perhaps only “Single-antenna port, port 0 (see Subclause 7.1.1)” should be supported for PUR without referring to any Mode.  ------------------------- Text start (TS 36.213 Clause 7.1)---------------------------------  If a BL/CE UE is configured by higher layers to decode MPDCCH with CRC scrambled by the PUR-RNTI, the UE shall decode the MPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-9. The scrambling initialization of PDSCH corresponding to these MPDCCHs is by PUR-RNTI.  Table 7.1-9: MPDCCH and PDSCH configured by PUR-RNTI   |  |  |  |  | | --- | --- | --- | --- | |  | DCI format | Search Space | Transmission scheme of PDSCH corresponding to MPDCCH | |  | 6-1A or 6-1B | UE specific by PUR-RNTI | Single-antenna port, port 0 (see Subclause 7.1.1) | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |   ------------------------- Text end (TS 36.213 Clause 7.1)---------------------------------- |
| Qualcomm | We think both transmission schemes “single antenna port” and “TxDiv” have to be supported. Since there is no unicast RRC configuration for the TM in PUR, we should follow the same procedure as other RNTIs in IDLE as follows:  ------------------------- Text start (TS 36.213 Clause 7.1) V-QC------------------------  If a BL/CE UE is configured by higher layers to decode MPDCCH with CRC scrambled by the PUR-RNTI, the UE shall decode the MPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-9. The scrambling initialization of PDSCH corresponding to these MPDCCHs is by PUR-RNTI.  Table 7.1-9: MPDCCH and PDSCH configured by PUR-RNTI   |  |  |  |  | | --- | --- | --- | --- | |  | DCI format | Search Space | Transmission scheme of PDSCH corresponding to MPDCCH | |  | 6-1A or 6-1B | UE specific by PUR-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise Transmit diversity (see Subclause 7.1.2). | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |   ------------------------- Text end (TS 36.213 Clause 7.1) V-QC ---------------------------------- |
| Sierra wireless | Sierra Wireless prefers option 2 |
| Lenovo&MotoM | We prefer option 2 and agree with QC’s update except minor update to align with current Table content.  Table 7.1-9: MPDCCH and PDSCH configured by PUR-RNTI   |  |  |  |  | | --- | --- | --- | --- | | Transmission mode | DCI format | Search Space | Transmission scheme of PDSCH corresponding to MPDCCH | | **Mode 1 or 2** | 6-1A or 6-1B | UE specific by PUR-RNTI | If the number of PBCH antenna ports is one, single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise transmit diversity (see Subclause 7.1.2). | |
| Nokia | We prefer option 2 |
| ZTE | We prefer option 2. |
| Huawei/HiSilicon | Support Option 2 and agree with QC’s update. We think both single-antenna port and Tx diversity should be supported to follow legacy. |

# Issue #1: TM configuration issue

## Issue Description

Huawei [2] point out that since there is no RRC configuration of TM, it is unclear how the TM is configured for PUR. Note: this issue is linked to the choice for issue #2 on which TM are supported.

## Text Proposal

If option 1 (from above) is chosen where only TM 1 and 2 are supported, Huawei [2] recommends TM 1 or 2 is determined by the number of PBCH antenna ports. Huawei [2] provided the following TP:

-------------------------------------------------- Text start (TS 36.213 Clause 7.1) ----------------------------------------------

If a BL/CE UE is configured by higher layers to decode MPDCCH with CRC scrambled by the PUR C-RNTI, the UE shall decode the MPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-9. The scrambling initialization of PDSCH corresponding to these MPDCCHs is by PUR C-RNTI.

**Table 7.1-9: MPDCCH and PDSCH configured by PUR C-RNTI**

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| --- | --- | --- | --- |
|  | **DCI format** | **Search Space** | **Transmission scheme of PDSCH corresponding to MPDCCH** |
|  | 6-1A or 6-1B | UE specific by PUR C-RNTI | If the number of PBCH antenna port is one, Single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise Transmit diversity is used (see Subclause 7.1.2) |
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-------------------------------------------------- Text ends (TS 36.213 Clause 7.1) ---------------------------------------------

If option 2 (from above) is chosen where TM 1,2, 6 and 9 are supported, it is unclear how the TM would be determined. Companies may provide solutions.

## Company Views

Please indicate your company view on the above options, TP and provide other proposals if TM 6 and 9 are supported:

|  |  |
| --- | --- |
| **Company** | **Comments on Proposal** |
| Ericsson | See our previous comment in section 2.3. |
| Qualcomm | Agree with Huawei’s proposal. |
| Sierra wireless | Sierra Wireless prefers option 1 (same view as Qualcomm and Ericsson) |
| Lenovo&MotoM | OK with Huawei’s proposal in general and please refer above comments 2.3. |
| Nokia | OK with Huawei’s proposal |
| ZTE | We are OK with TP |
| Huawei/HiSilicon | Agree with Huawei’s proposal. |
| Ericsson (v010) | As we said in section 2.3, in principle we also would like to support both “Single-antenna port” and “Transmit diversity”. We just wonder if we have to be more specific in terms of the antenna port number if we are going to support “Transmit diversity”. The current wording is “If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise Transmit diversity (see Subclause 7.1.2)”, the otherwise part will encompass the case where there are two antenna ports and four antenna ports. In our understanding the Transmit diversity we are referring to is applied in the case of two antenna ports, whereas the four antenna ports case is for FSTD. |
| QC | To Ericsson: No, “Transmit diversity” refers to the scheme for both 2 and 4 antenna ports. See 211: |
| Ericsson (v012) | Thanks for the clarification, given that the two and four antenna ports are covered in clause 6.3.4.3 which is referred by clause 7.1.2, we are fine with the TP as per V-QC in section 2.3. For the final TP consider adding “is used” as follows: “…), otherwise Transmit diversity is used (see Subclause 7.1.2)”,” |

## Conclusion

There is consensus on option 1 and the following TP based on Qualcomm suggestion with the added “is used” suggestion from Ericsson in phase 1 is agreeable:

------------------------- Text start (TS 36.213 Clause 7.1) ------------------------

If a BL/CE UE is configured by higher layers to decode MPDCCH with CRC scrambled by the PUR-RNTI, the UE shall decode the MPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-9. The scrambling initialization of PDSCH corresponding to these MPDCCHs is by PUR-RNTI.

Table 7.1-9: MPDCCH and PDSCH configured by PUR-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format | Search Space | Transmission scheme of PDSCH corresponding to MPDCCH |
|  | 6-1A or 6-1B | UE specific by PUR-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise Transmit diversity is used (see Subclause 7.1.2). |
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------------------------- Text end (TS 36.213 Clause 7.1) ----------------------------------

# Issue #3: Repetition number delivery to higher layers

## Issue Description

Ericsson in [1] points out that in the current specification, the UE only delivers the 3-bit *PUSCH repetition adjustment* from the PUR ACK/fallback indication to the higher layers and does not deliver the *Repetition Number* from the UL grant for retransmission.

## Discussion

At least, the following two options are possible:

**Option 1: Only the PUSCH repetition adjustment from the PUR ACK/fallback indication is delivered**

This is what is currently defined in the specification, so no TP is needed. A conclusion such as could be made:

Possible Conclusion:

* The UE does not deliver the *Repetition Number* from the UL grant for PUR retransmissions to the higher layers.

**Option 2: The *Repetition Number* field from the UL grant for PUR retransmission is delivered**

For this option, a TP is provided by Ericsson in [1]:

---------------------------------------------- Text start (TS 36.213 Clause 9.1.5.3)------------------------------------

9.1.5.3 Preconfigured Uplink Resource ACK/fallback and retransmission procedure

If a UE has initiated a PUSCH transmission using preconfigured uplink resource on a given serving cell, and upon detection of a MPDCCH with DCI format 6-0A/6-0B with CRC scrambled by PUR-RNTI intended for the UE within the PUR search space window as defined in Subclause 9.1.5, and the corresponding DCI is for PUR ACK/fallback indication or an uplink grant for retransmission (as defined in [4]):

- the UE shall deliver the PUR ACK/fallback indication or an uplink grant for retransmission, as signalled on the MPDCCH, to the higher layers, and

- the UE shall deliver to higher layers a 3-bit PUSCH repetition adjustment or a 3-bit repetition number according to Table 8-2b for CEModeA or Table 8-2c for CEModeB as signalled on the MPDCCH, where a bit with a value of 0 shall be prepended to the DCI field if the DCI field has a size of 2 bits.

----------------------------------------------- Text end (TS 36.213 Clause 9.1.5.3)-------------------------------------

## Company Views

Please indicate your company views on the above options, conclusions, and TP:

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| --- | --- |
| **Company** | **Comments on Proposal** |
| Ericsson | Option 2 is expected to improve the feature’s performance for example in case the PUSCH transmission at the upcoming PUR transmission opportunity had been preceded by a retransmission that adjusted the number of repeats.  If Option 2 were not adopted, then it needs to be clarified why for the 2-bit “PUSCH repetition adjustment” field a zero-bit padding is applied, and why the same solution is not applied for 2-bit “Repetition number” field. The clarification will be needed to understand how the 2-bit “Repetition number” is handled in PUR. |
| Qualcomm | We don’t think we need to discuss any of this. It should be obvious that Option 1 is the one that RAN1 agreed on.  About Ericsson’s question on what would happen if Option 2 is not adopted, let us try to explain the difference between “repetition adjustment” and “repetition number”:   * “Repetition number” is internal to PHY/MAC, it doesn’t go to RRC. RAN1 specifications cover how to translate between the 2/3 bits and the number of repetitions. The UE uses the number of repetitions in that particular grant, then forgets about it. * For “Repetition adjustment”, unfortunately RAN1/RAN2 decided that the DCI content will update RRC, and then we spent some time coming up with an overspecified behavior to make it logically consistent. RRC has a 3-bit field, so when PHY “stores” the value it needs to zero pad it to match 3 bits. Again, I still think we are overspecifying the UE behavior, since it should be obvious what the UE should do (and it shouldn’t matter too much if the UE stores the value in PHY / RRC, or how many bits it uses). |
| Ericsson (v004) | Through L1 signalling, PUR makes use of two different fields “PUSCH repetition adjustment” and “Repetition number” to change the number PUSCH repetitions. In the comment above, QC explained that in the case of the “Repetition number” field “The UE uses the number of repetitions in that particular grant, then forgets about it”. That is what needs to be confirmed as common understanding.  We see a technical benefit for the PUR feature if Option 2 is adopted, but if companies prefer do not apply the padding for the 2-bit “Repetition number” field, then we at least would like to have a conclusion that can reflect the common understanding about the handling of the 2-bit “Repetition number” in PUR. |
| Sierra Wireless | We do not see the benefit of updating the PUR repeats using the 2-bit “Repetition number” from the retransmission. In fact, as we explained last meeting, we think this may degrade performance thus we prefer option 1 (current spec). We do not have a strong view if we need a conclusion or not. |
| Lenovo &MotoM | We prefer option 1 and believe the current spec is clear. |
| Nokia | We prefer option 1 |
| ZTE | We prefer option 1  There has no agreement to deliver repetition number in UL grant for Retransmission to higher layers. Since *ce-pdsch-puschEnhancement-config* is not supported for PUR, Repetition number field in DCI is 2 bits. For PUR retransmission, the 2-bit Repetition number field can be used for indicating of repetition number of PUR retransmission. |
| Huawei/HiSilicon | We support Option 1. And we think the specification is clear and correct, no need for any conclusion.  Option 2 is not an essential issue, so we should not discuss Option 2 at such late maintenance phase.  In general, we agree with QC that we do not need to discuss any of this. |
| Ericsson (v010) | About the comment “we think the specification is clear”, can you please tell us from where it can be read why a zero-bit padding is applied on the 2-bit “PUSCH repetition adjustment” field and not on the 2-bit “Repetition number” field given that both fields can adjust the number of repetition using L1-signaling? We are not insisting on Option 2, we just think is important to have a conclusion that reflects the common understanding about the handling of the 2-bit “Repetition number” in PUR. To have Option 1 (common understanding) is important as a reference, it will help to avoid having to have exactly the same discussion in the future. |
| Qualcomm | To Ericsson:  *can you please tell us from where it can be read why a zero-bit padding is applied on the 2-bit “PUSCH repetition adjustment” field and not on the 2-bit “Repetition number”*  In the text you have in your CR is exactly what you ask for:  *the UE shall deliver to higher layers a 3-bit PUSCH repetition adjustment according to Table 8-2b for CEModeA or Table 8-2c for CEModeB as signalled on the MPDCCH, where a bit with a value of 0 shall be prepended to the DCI field if the DCI field has a size of 2 bits.*  Of course, the text doesn’t say anything about the “repetition number”, because this number is not delivered to higher layers.  And just to be clear, the “repetition number” does not adjust the number of repetitions for PUR, it just determines the number of repetitions for the dynamic retransmission. There is no need to pad it, since the PHY has tables for 2 bit and 3 bit. |
| Ericsson (v012) | About “the “repetition number” does not adjust the number of repetitions for PUR, it just determines the number of repetitions for the dynamic retransmission.” Yes, but such a retransmission corresponds to PUR transmission that failed using a certain number of repetitions, the retransmission may use a different number of repetitions using the “Repetition number” field, and even if the retransmission is successful upon the adjustment, the upcoming PUR transmission won’t go along with the adjustment of repetitions but will rather use the other value. With Option 1, we just want to make clear that this is the intentional behaviour and avoid a future misinterpretation that is not there because it was missed. |

# Phase 2

## Issue #2: TM6/TM9 support issue

The FL concludes that there is consensus on option 2.

* Option 2: PUR supports only TM 1 and 2

This issue is closed.

## Issue #1: TM1/TM2 configuration issue Phase 2

The following TP to TS 36.213 based on Qualcomm’s suggested TP and with the added “is used” suggestion from Ericsson should be agreeable:

------------------------- Text start (TS 36.213 Clause 7.1) ------------------------

If a BL/CE UE is configured by higher layers to decode MPDCCH with CRC scrambled by the PUR-RNTI, the UE shall decode the MPDCCH and any corresponding PDSCH according to the respective combinations defined in Table 7.1-9. The scrambling initialization of PDSCH corresponding to these MPDCCHs is by PUR-RNTI.

Table 7.1-9: MPDCCH and PDSCH configured by PUR-RNTI

|  |  |  |  |
| --- | --- | --- | --- |
|  | DCI format | Search Space | Transmission scheme of PDSCH corresponding to MPDCCH |
|  | 6-1A or 6-1B | UE specific by PUR-RNTI | If the number of PBCH antenna ports is one, Single-antenna port, port 0 is used (see Subclause 7.1.1), otherwise Transmit diversity is used (see Subclause 7.1.2). |
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------------------------- Text end (TS 36.213 Clause 7.1) ----------------------------------

Please indicate your company views on the above TP:

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| --- | --- |
| **Company** | **Comments on Proposal** |
| Ericsson | We are fine with the above TP. |
| Qualcomm | We are mostly OK with the TP. Regarding the addition of “is used”, while it is correct (I think), that sentence appears at least 20 times in TS 36.213 without the “is used”. My personal preference would be to keep it without “is used” (e.g. to be able to do consistent textual search, and to not confuse the reader wondering why a different expression is used), but it is not very strong. Up to the majority view / feature lead. |
| Lenovo, MotoM | We agree to remove the two “is used” to align the spec and hope to delete blank cells of table. |
|  |  |
|  |  |

## Issue #3: Repetition number delivery to higher layers Phase 2

The majority of companies prefer option 1:

**Option 1: Only the PUSCH repetition adjustment from the PUR ACK/fallback indication is delivered**

Further discussion is needed to determine if a “Conclusion” is needed and what it should be.

Possible Conclusion:

* The *Repetition Number* field from the UL grant for PUR retransmission is NOT delivered to higher layers.

Please add your views if the following “Conclusion” is needed or needs modification

|  |  |
| --- | --- |
| **Company** | **Comments on Proposal** |
| Ericsson | We are fine with the possible conclusion. It will make clear that this is the intentional behavior and I will avoid the future misinterpretation that the padding for the “Repetition Number” field is not there because it was missed. |
| Qualcomm | We don’t think the conclusion is needed, but if writing the conclusion down is the way to close this topic faster, we are OK with it. |
| Lenovo, MotoM | We are OK to have the conclusion to clarify the issue. |
|  |  |
|  |  |

# Summary

# References

1. R1-2008583, “PUR maintenance issues for Rel-16 LTE-MTC”, Ericsson
2. R1-2008800, “Corrections on transmission modes for PUR”, Huawei, HiSilicon