3GPP TSG-RAN WG1 Meeting #105-e R1-21xxxxx

e-Meeting, 19th – 27th May 2021

Agenda Item: 6.2.1

Source: Moderator (Ericsson)

Title: FL summary on clarification of UE procedure for UL multi-TB scheduling in TDD for Rel-16 LTE-MTC

Document for: Discussion, Decision

# 1 Introduction

This document provides a summary of the following RAN1 email discussion.

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| [105-e-LTE-eMTC5-02] Clarification of UE procedure for UL multi-TB scheduling in TDD for LTE-MTC – Johan (Ericsson)   * Discuss and decide on the potential clarification in 36.213 discussed in these contributions:   + [R1-2105267](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2105267.zip), “Clarification on UE procedure for uplink MTB scheduling in TDD”, ZTE   + [R1-2105268](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2105268.zip), “Discussion on UE procedure for uplink MTB scheduling in TDD”, ZTE * Discussion and decision by May 24, TPs by May 27 |

# 2 Discussion

Contribution [2] discusses a potential need to clarify the UE procedure for UL multi-TB scheduling in CE mode A in TDD UL/DL configuration 0. In this TDD UL/DL configuration, the ‘UL index’ field in the DCI achieves dual-TB scheduling already since Rel-13. Section 2.1 in [2] makes the following observations and proposal:

*Observation 1: For TDD configuration 0, when repetition number N = 1 and UL index = ‘11’, the corresponding HARQ process number for the two scheduled TBs are consecutive.*

*Observation 2: When 2 TBs are scheduled, the HARQ process number determined by ‘UL index’ and ‘Scheduling TBs for Unicast’ field are conflicted.*

*Observation 3: When more than 2 TBs are scheduled, the 2 HARQ process number determined by UL index is conflicted with the HARQ process number indicated by ‘Scheduling TBs for Unicast’ field if multi-TB scheduling feature is configured.*

*Proposal 1: When ce-PUSCH-MultiTB-Config is configured and ‘UL index’ in DCI format 6-0A is set as ‘11’, if multiple TBs are scheduled, further clarification is needed on how to determine the HARQ process number for each TB.*

**Question 1: Companies are invited to comment on the observations and proposal listed above.**

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| **Company** | **Comments** |
| Lenovo, MotoM | We agree the observation 1-3  For the proposal part:  When *ce-PUSCH-MultiTB-Config* is configured, no matter how many TBs are scheduled, even only one TB is scheduled, the UL index in DCI format 6-0A should not set as “11”.  If one TB is scheduled by ‘Scheduling TBs for Unicast’ field, and we use “UL index = ‘11’” to schedule 2 TB, this is another confliction. |
| Qualcomm | We agree with the analysis. We think the simplest way would be to disallow ‘11’ when multiple TBs are scheduled. |
| FL (Ericsson) | Companies are invited to comment on the statement in Lenovo’s response above that even scheduling of a single TB will be problematic when *ce-PUSCH-MultiTB-Config* is configured and ‘UL index’ is set to ‘11’. |
| Lenovo, MotoM | Let me clarify more  If *ce-PUSCH-MultiTB-Config* is configured, eNB can use ‘Scheduling TBs for Unicast’ field to schedule 2TB without HARQ process number restriction, do we still need to use legacy Rel.13 method to use UL index=11 to schedule 2TB in subframe n+k and n+7 with HARQ process number restriction?  If ‘Scheduling TBs for Unicast’ field indicate one TB is scheduled, and UL index=11, 2TB in subframe n+k and n+7 are scheduled. Although this can work well, and all procedure should follow N\_TB=1 case (e.g., uplink power control, adopted to 1 TB or 2 TB), which seems not a good understanding.  If so, we hope to remove “*if multiple TBs are scheduled,*” in the proposal. |
| Qualcomm | Although we do not have a terribly strong view, we think we can allow ‘11’ with HARQ process restriction to be kept. One potential advantage is that, if one of the two subframes are invalid, ‘11’ allows to override the invalid subframe mask (although there may be a mistake in 36.213, the condition shouldn’t be “N>1”, but “N N\_TB > 1”). |
| ZTE, Sanechips | We are OK to remove “*if multiple TBs are scheduled,*” in the proposal to obtain a better understanding. In this case, when multi-TB is configured, 2TB scheduling with the full scheduling flexibility can be provided.  Regarding N>1, this condition is set for the repetition case. So, maybe we can keep it there. |
| FL (Ericsson) | Qualcomm has proposed the following TP above. From Lenovo’s comments above, it seems that this solution might have some problems. Companies are invited to comment further.  - for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *NTBN>1*. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A |
| FL (Ericsson) | Correction of the latest FL comment above:  Qualcomm has proposed the following TP in their response to Question 2 below. From Lenovo’s comments above, it seems that this solution might have some problems. Companies are invited to comment further.  - for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1* or *NTB>1*. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A |
| Lenovo,MotoM | We still have some concern about If ‘Scheduling TBs for Unicast’ field indicate one TB is scheduled, and UL index=11, 2TB in subframe n+k and n+7 are scheduled.  However, the uplink power of subframe n+k and n+7 for legacy Rel.13 eMTC.  For the closed loop part, the uplink power is indicated by DCI format 6-0A 7 subframes ago.   * If the subframe-PUSCH transmission in subframe 2 or 7 is scheduled with a PDCCH/EPDCCH of DCI format 0/4 or a MPDCCH of DCI format 6-0A in which the LSB of the UL index is set to 1, = 7   However, I am wondering the open loop part, the Path loss is changing all the time, especially there is Downlink subframe between n+k and n+7 (DSUUU DSUUU). So the uplink power of n+k and n+7 can be different. Right?  In Rel.16, with the introduction of multiple TB scheduling, the following CR is captured in TS36.213  For the uplink power control, if PUSCH transmission is scheduled by one DCI, the power is the same.  For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by    It seems the two spec are not aligned, right? Which one should UE follow? If I am wrong, please let me know. Thanks. |
| QC | Per our understanding, it would work as follows:   1. Legacy index ‘11’ will follow legacy spec. I.e.: Do not postpone if invalid, follow legacy power control, etc. 2. Multi-TB: Postpone if invalid, follow multi-TB power control.   Is this an issue? |
| Lenovo, MotoM | If we want to keep the possibility of DCI format 6-0A to schedule 2TB to override the invalid subframe, we don’t have strong view on that and can accept the TP from FL.  What I want to clarify is:  For Rel.13 uplink control, when UL index=11, the power of subframe n+k and n+7 may be different.  However, with Rel.16 CR, the legacy behavior has been changed. PUSCH transmission scheduled by One DCI (subframe n+k, n+7 transmission scheduled by one DCI), the power is the same.   * For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by |
| Huawei, HiSilicon | The motivation of UL index is to handle the case that there’s more UL subframes than downlink subframes. When multi-TB scheduling is configured, it will not be a problem. So we prefer to separate the features of multi-TB scheduling and UL index, by not allowing UL index=11 when multi-TB scheduling is configured. But if majority view prefers, we can be fine with FL’s TP above. |
| FL (Ericsson) | Could the following paragraph in 36.213 in conflict with the UL index ‘11’ case already, regardless of whether the Rel-16 multi-TB feature is configured or not?  For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by    If so, what potential updates would be needed? |
| ZTE, Sanechips | From our understanding, the legacy behavior is based on single PUSCH as following in R15   |  | | --- | | For a BL/CE UE configured with CEModeA, if the PUSCH is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by    For a BL/CE UE configured with CEModeB, the PUSCH transmit power in subframe *ik* is determined by |   And this paragraph is used to describe the PUSCH transmit power with repetition. *N* indicates the repetition number. In this case, ‘UL index=11’ would not be set when repetition number N>1 and for each PUSCH, the transmit power may be different.  However, for multi-TB scheduling in R16,it is agreed that the TPC across different TBs are the same. After the corresponding CR, the case for UL index=11 is also introduced when solve the same TPC issue for multi-TB by introducing ‘scheduled by one DCI’ .  A simple solution is excluding the case of ‘UL index=11’ and the following revision can be considered for reference.   |  | | --- | | For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI without both the MSB and LSB of the UL index set to 1, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by |   Additionally, if we have the consensus that ‘the PUSCH’ is for single PUSCH and multiple PUSCHs, then the legacy description means that the PUSCH transmit power should be the same regardless of whether UL index is ‘11’ or not. In this case, no update is needed. |
| Ericsson | We agree in principle with ZTE’s proposal above, but perhaps some rephrasing can be considered to make the paragraph easier to read, e.g.:   |  | | --- | | For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by    except in case the DCI contains an UL index set to ‘11’. |   Some clarification of this paragraph regarding how to handle the UL index ‘11’ case could also be considered in the Rel-13/14/15 specifications, but that seems less critical than this clarification of the Rel-16 specification. |
| Qualcomm | The proposal from Ericsson looks OK to us. |
| Lenovo, MotoM | We fully agree with the analysis from ZTE.  The proposal from E/// excludes the case UL index set to “11”, which seems OK to solve the problem, because when UL index set to “11”, no repetition at all.  We support the update from E///. |
| FL (Ericsson) | Based on the responses, Proposal 1 below can be considered. |

Section 2.2 in [2] lists the following potential solutions and proposes to adopt Option 1. A draft 36.213 CR corresponding to Option 1 has been provided in [1].

* *Option 1: UE is not expected to receive DCI format 6-0A with both the MSB and LSB of ‘UL index’ set to 1 if multiple TBs are scheduled when ce-PUSCH-MultiTB-Config is configured.*
* *Option 2: When ce-PUSCH-MultiTB-Config is configured, the ‘UL index’ field is ignored.*
* *Option 3: The multi-TB scheduling feature is not supported for TDD configuration 0.*
* *Option 4: When UL index = 11 and ce-PUSCH-MultiTB-Config is configured, only single TB scheduling is supported.*

**Question 2: Please comment on the options listed above and express your preference, if any.**

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| **Company** | **Comments** |
| Lenovo, MotoM | Based on the observation, if we want to down select from the 4 options above, we prefer option 1 in general. |
| Qualcomm | We think Option 1 is preferred (it is not clear to us what is the difference with Option 4, though). We think the CR can be simplified as follows:  with both the MSB and LSB of the UL index set to 1 when *N>1* or . |
| FL (Ericsson) | Companies are invited to comment on the options listed above in the light of the statement in Lenovo’s response to Question 1 above that even scheduling of a single TB will be problematic when *ce-PUSCH-MultiTB-Config* is configured and ‘UL index’ is set to ‘11’. |
| Lenovo, MotoM | We agree with the CR by [1] removing the following part.  The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1* or ~~multiple TBs are scheduled when~~ *ce-PUSCH-MultiTB-Config* isconfigured. |
| ZTE, Sanechips | The modification from Lenovo is fine with us, which corresponds to option1.  The revision from Qualcomm is similar with the original version since the formula can be described as “multiple TBs are scheduled when *ce-PUSCH-MultiTB-Config* isconfigured”. |
| FL (Ericsson) | Are there any further comments on the following TP?  - for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1* or *ce-PUSCH-MultiTB-Config* isconfigured. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A |
| QC | If the previous TP is accepted, this TP is not needed. |
| Huawei, HiSilicon | As commented to Q1, we prefer to separate the features of multi-TB scheduling and UL index, by not allowing UL index=11 when multi-TB scheduling is configured. If option 1 is the majority view, we can also accept it. |
| FL (Ericsson) | A majority seems to prefer to adopt the following 36.213 TP. If there are no further comments, the FL proposal will be to adopt the following 36.213 TP.  - for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1* or *ce-PUSCH-MultiTB-Config* isconfigured. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A |
| ZTE, Sanechips | Above TP is slightly preferred. It is convenient to avoid the explanation for the case that UL=11 and one TB is scheduled for multi-TB scheduling. Also original CR or revision from Qualcomm () are also workable. |
| Ericsson | We are fine with the latest TP above. |
| Qualcomm | Our preference would be to still support ‘11’ when the multi-TB indicates a single TB (as explained above), but if the majority view prefers this option we would also be OK. |
| Lenovo, MotoM | We are fine with the latest TP above. |
| FL (Ericsson) | Based on the responses, Proposal 1 below can be considered. |

# 3 Conclusion

Based on the discussion, the following is proposed.

**Proposal 1: Agree the following 36.213 TP for clarification of UE procedure for UL multi-TB scheduling in TDD for Rel-16 LTE-MTC.**

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| 5.1.1.1 UE behaviour **<Unchanged parts are omitted>**  For a BL/CE UE configured with CEModeA, if the PUSCH transmission, scheduled by one DCI, is transmitted in more than one subframe *i0*, *i1*, …, *iN-1* where *i0*< *i1*< …< *iN-1*, the PUSCH transmit power in subframe *ik* , *k*=0, 1, …, *N*-1, is determined by    except in case the DCI contains an UL index set to ‘11’.  For a BL/CE UE configured with CEModeB, the PUSCH transmit power in subframe *ik* is determined by    **<Unchanged parts are omitted>** 8.0 UE procedure for transmitting the physical uplink shared channel **<Unchanged parts are omitted>**  - for TDD UL/DL configuration 0 and a BL/CE UE in CEModeA, if the MSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, the value of *x* isgiven as the value of *k* in Table 8-2 for the corresponding TDD UL/DL configuration; if the LSB of the UL index in the MPDCCH with DCI format 6-0A is set to 1, *x = 7.* The UE is not expected to receive DCI format 6-0A with both the MSB and LSB of the UL index set to 1 when *N>1* or *ce-PUSCH-MultiTB-Config* isconfigured. In case both the MSB and LSB of the UL index are set to 1, the HARQ process number of the PUSCH corresponding the MSB of the UL index is  and the HARQ process number of the PUSCH corresponding the LSB of the UL index is , where  is determined according to the *HARQ process number* field in DCI format 6-0A  **<Unchanged parts are omitted>** |

# References

1. [R1-2105267](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2105267.zip), “Clarification on UE procedure for uplink MTB scheduling in TDD”, ZTE

1. [R1-2105268](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_105-e/Docs/R1-2105268.zip), “Discussion on UE procedure for uplink MTB scheduling in TDD”, ZTE