**3GPP TSG RAN WG1 #106-e R1-** **21xxxxx**

**e-Meeting, August 16th – 27th, 2021**

**Agenda Item: 8.8**

**Source: Moderator (China Telecom)**

**Title: [Post-106-e-Rel17-RRC-08] NR coverage enhancement**

**Document for: Discussion**

1. Introduction

As per Chair’s guidance, there are a number of email threads on Rel-17 RRC parameters. The email discussions on RRC parameters start from September 1 until September 10 (excluding the weekend). The purpose of these email discussions is to initiate preparations to send the first LS to RAN2 on Rel-17 RRC parameters in October (e.g. tabulate agreed RRC parameters so far and identify ones that RAN1 should discuss whether or not to define). Please note that RAN1 will NOT be making any decision with regards to the Rel-17 RRC parameters during the email discussions. The intention is to provide initial assessment on RRC parameters and collect company views.

This contribution is a summary of the following email discussion:

[Post-106-e-Rel17-RRC-08] NR coverage enhancement – to be moderated by Jianchi (China Telecom)

1. Email discussion (1st round)

Companies are encouraged to provide comments on RRC parameters for enhancements on PUSCH repetition type A.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Huawei, HiSilicon | //Comment #1Row#2:Suggest to add parent IE *PUSCH-Allocation-r17* to row#2, |
| Samsung | A clarification for **row 7** (can be added in the comment column).For *PUSCH-Allocation-r17* (row 7) only the field *numberOfRepetitions-r16* is changed to *numberOfRepetitions-r17*. Other fields (*mappingType, startSymbolAndLength, startSymbol, length*) would be same as in Rel-16.  |
| ZTE | 1. General comment#1: Suggest to add parent IE for each row,
2. General comment#2: Suggest to add value range for each row. This can address the comments from Samsung and also the two detailed comments 3) and 4) below.
3. On row#6, we are not sure whether we can simply reuse the same way as defined for PUSCH-TimeDomainResourceAllocation-r16, where it can also indicate the resource allocation for multiple PUSCHs (by maxNrofMultiplePUSCHs-r16) that is introduced in Rel-16 NR-U.
4. Should we introduce another RRC parameter maxNrofUL-Allocations-r17 to indicate the maximum number of rows of the TDRA table? Or is intention here to reuse the Rel-16 one?
5. On row#8, one minor comment that RepetitionCountingType-R17 should be changed to RepetitionCountingType-~~R~~r17 or directly delete ‘-R17’ as there is no similar parameter in Rel-15/16.
 |
| Nokia/NSB | We share similar views with other companies that adding parent IE and value range may help for clarification. For row#8: Although we are fine with having this parameter in general, the name “RepetitionCountingType” seems to imply a selection of more than one counting type (e.g., available & consecutive). However, this parameter just has two values “enabled/disabled”, which aim to enable/disable the counting on available slots. |
| Intel | We share similar view as Nokia that the name of “RepetitionCountingType” may need to be updated, which may cause some confusion. It may be good to add parent IE in the excel sheet.  |
| Panasonic | We share the similar views with other companies that adding parent IE could help for clarification.For row#7, we agree to Samsung’s view that for *PUSCH-Allocation-r17*, only the field *numberOfRepetitions-r16* is changed to *numberOfRepetitions-r17*. Other fields would be same as in Rel-16. |
| Lenovo, Motorola Mobility | General comment: Same view as others to add a column for parent IE for all the rowsComment on Row#7: *PUSCH-Allocation-r17*Right now, the description for row#7 only indicates that the configuration for TDRA of each TDRA list entry include numberOfRepetitions-17.Shouldn’t the description be updated to include the parameters related to TBoMS including “*numberOfSlotsTBoMS-r17*” and “*numberOfRepetitionsTBoMS-r17*”? |
| Ericsson | For enhanced Type A PUSCH repetitions: * To indicate the number of repetitions, following 2 TDRA list should be enough according to current agreement (we only agreed on DCI format 0\_1 and DCI format 0\_2):

*pusch-TimeDomainAllocationListDCI-0-1-r17**pusch-TimeDomainAllocationListDCI-0-2-r17*To indicate the repetition type, since we haven’t discussed how to configure the 2 types of enhancements, we propose to delay this discussion till we made some agreements in next RAN1 meeting. Therefore RepetitionCountingType-R17 should be deleted for now.Regarding adding parent IEs such as PUSCH-TimeDomainResourceAllocationList-r17, PUSCH-TimeDomainResourceAllocation-r17, and PUSCH-Allocation-r17, we think the discussion here may be straying into RAN2’s work. It’s not clear to us why a parent IE should be added if that parent itself is not modified, that is, parameters can be extended. On the other hand, there may be reasons to modify the parent from a RAN2 perspective. So we prefer that these 3 parameters are not included for now in the spreadsheet, and we focus on parameters changes needed to reflect the behavior we specify in RAN1, rather than how ASN.1 is structured.Lastly, we think that numberOfRepetitions-17, pusch-TimeDomainAllocationListDCI-0-1-r17, and pusch-TimeDomainAllocationListDCI-0-2-r17, are existing parameters that are extended, so should be ‘existing’ in the spreadsheet.**We have provided a** [**revised spreadsheet**](https://www.3gpp.org/ftp/tsg_ran/wg1_rl1/TSGR1_106-e/Inbox/drafts/8.8/%5BPost-106-e-Rel17-RRC-08%5D/Post_RAN1%23106-e_Rel-17_RRC%20-%20CovEnh%20-%20v001%20FL_Ericsson.xlsx) **to illustrate our suggested changes for this and the other topics in this email discussion.** |
| Qualcomm | Looks good to us. Agree with comment by Intel/Nokia. |
| Apple | For the row 7 *PUSCH-Allocation-r17*, we have similar comment as ZTE. This *PUSCH-Allocation-r16* was introduced for NR-U to scheduling multiple PUSCH. According to our understanding, it’s still under discussion whether support multiple PUSCH scheduling with the repetition even in Rel.16. We have no related discussion in Rel.17 coverage enhancement as well. In addition, if we follow Rel.16 ASN.1 design structure, the field of *stratSymobl* and *length* are not needed, due to these two field is repetition type B specific. Rel.17 repetition enhancement is only focusing repetition type A.In short, the simple way is to follow Rel.15 ASN.1 structure, only introduce field of *numberofrepetition* without*PUSCH-Allocation-r17.* PUSCH-TimeDomainResourceAllocation-r17 ::= SEQUENCE { k2 INTEGER(0..32) OPTIONAL, -- Need S mappingType ENUMERATED {typeA, typeB}, startSymbolAndLength INTEGER (0..127) numberofrepetition-r17 ENUMERATED} |

Companies are encouraged to provide comments on RRC parameters for TBoMS.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Huawei, HiSilicon | //Comment #1**General issue:**To better shape the structure of RRC parameters, suggest to also discuss the parent IEs (column #E) for each parameters. For example, the parent IE for **row#9** is *PUSCH-Allocation-r17*, so are for **row#10 and row#2**.**//Comment#2**Row#10:Suggest to capture the following agreement into column#J as “the product of numberOfRepetitionsTBoMS and numberOfSlotsTBoMS is expected to be no larger than 32.” “*Note: M\*N is no more than the max number of repetitions agreed for repetition Type A enhancement in agenda 8.8.1.1*” |
| Samsung | For “*numberOfRepetitionsTBoMS-r17*”, this may not be needed for TBoMS as it could simply reuse that for normal TDRA repetition configuration for Type A repetition. |
| ZTE | We are in general fine, and it could be better to add the parent IE for each row. |
| Sharp | As suggested by Samsung, *numberOfRepetitionsTBoMS-r17* should be removed from the list. Whether such a parameter should be introduced or not should be discussed in the next meeting. |
| Nokia/NSB | We share similar views with other companies that adding parent IE may help for clarification. |
| Intel | It may be good to add parent IE in the excel sheet.We are fine to keep number of slots and number of repetitions for TBoMS in the list.  |
| Panasonic | We agree to Huawei’s comment#2. |
| Ericsson | Similar comment to Samsung. We think that a parameter numberOfSlotsTBoMS-r17 can be optionally configured in existing TDRA table for supporting TBoMS. The existing repetition factor numberOfRepetitions in the exiting TDRA table can be reused by TBoMS, Also, similar to Huawei’s comment: when numberOfSlotsTBoMS-r17 is present, numberOfSlotsTBoMS-r17\*numberOfRepetitions cannot be larger than 32. |
| Qualcomm  | If the intention is to have a separate/dedicated TDRA list for TBoMS, the suggested parameters look fine to us. If the intention is to let a TDRA list be shared between classical PUSCH and TBoMS, then reinterpretation of “numberOfRepetitions” may suffice. We should first establish clarity on this aspect before finalizing the RRC parameters. |
| Apple  | We share the similar view as Qualcomm, it needs to clarify first whether only one Rel.17 TDRA list is defined, or separate TDRA lists are defined for Rel.17 repetition and TboMS. |

Companies are encouraged to provide comments on RRC parameters for joint channel estimation for PUSCH.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Huawei, HiSilicon | **//Comment#1**Row#11,:Since window length L is taken as a WA, a RRC parameter for it should be added. If this parameter is configured, then time domain window has been indicated as enabled. Additionally, it is fresh new parameter without any precedent, a postfix “-r17” is not necessary at least in RAN1. Therefore, changes are suggested as,PUSCH-TimeDomainWindow-r17 => PUSCH-TimeDomainWindowLengthENUMERATED {enabled, disable } => FFS IntegerSimilarly, a length L is expected to be configured for PUCCH as well, above changes are suggested to row#13 |
| Samsung | For the length of the configured time domain window, *PUSCH-TimeDomainWindow-r17* can indicate the integer value for the length of TDW. Agree also with previous comment that ‘-*r17*’ may not be needed. |
| ZTE | We share similar view as Huawei.  |
| Nokia/NSB | We share similar view with other companies that a parameter for the “configured TDW” length L is needed. Whether the enabling/disabling of JCE and TDW for PUSCH should be configured in a separate RRC parameter or it can be interpreted from the availability of L can be FFS (e.g. depending on which method is more convenient for RRC update). |
| Intel | It may be good to add DMRS bundling in “*PUSCH-TimeDomainWindow-r17*” to avoid some confusion. Time domain window seems very broad. We are also fine to add configured window duration in the parameter for both PUSCH and PUCCH enhancement. A single parameter may be good to cover both PUSCH and PUCCH.  |
| Ericsson | Similar comments as the above. The parameter to jointly enable TDW and DMRS bundling is ambiguously named as ‘PUSCH-TimeDomainWindow-r17’, since there should also be a length ‘L’ for the window. Suggest naming this as ‘PUSCH-DMRS-Bundling-r17’, and then creating a parameter ‘PUSCH-WindowLength-r17’; details are in the spreadsheet. We would also be OK with creating only PUSCH-WindowLength-r17, and leaving it FFS if a separate parameter to enable/disable DMRS bundling is defined. |
| Qualcomm | Agree with Ericsson --- PUSCH-DMRS-Bundling-r17 may be more appropriate, taking values enable/disable. Window length may need to be separately indicated with the range of values TBD. |

Companies are encouraged to provide comments on RRC parameters for PUCCH enhancements.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Huawei, HiSilicon | **//Comment#1**Similar to our comment#1 for PUSCH, a length L is expected to be configured for PUCCH as well, similar changes are suggested to row#13**//Comment#2**Row#12:Parent IE can be PUCCH-ResourceSet where a list of repetition number per resource id is configured, i.e. each entry corresponds to the entry in *resourceList* of *PUCCH-ResourceSet*. It can provide better resource sharing between different resource sets comparing to the repetition number configured within IE *PUCCH-Resource*. For example, PUCCH-Resource#1 is shared by two resource-sets, set#1 and set#2. In set#2, the repetition number can be 4 for the PUCCH-Resource#1 while it can be 8 in set#1. |
| Samsung  | A clarification is added at the end of the description of **row 12**. Description: A new repetition parameter corresponding to Rel-17 dynamic PUCCH repetition factor indication. The new repetition parameter is configured per PUCCH resource **and should be in *PUCCH-Resource*.** |
| ZTE | We are Ok to introduce a separate RRC parameter for TDW indication for PUCCH on top of the one for PUSCH in row#11. Then, similar changes are needed as also commented by Huawei above.  |
| Nokia/NSB | We are fine to have separate RRC parameters for PUSCH and PUCCH. Similar comment as for PUSCH applies for PUCCH. |
| Intel | Based on the agreement, the repetition factor needs to be configured per PUCCH resource. It is not clear whether we need to extend this to PUCCH resource set. It may be good to add DMRS bundling in “*PUSCH-TimeDomainWindow-r17*” to avoid some confusion. Time domain window seems very broad. We are fine to have a separate parameter for enabling/disabling DMRS bundling for PUSCH and PUCCH.  |
| Panasonic | For row#12, in our view, Parent IE of *PUCCH-nrofSlots-r17* should be PUCCH-Resource in order to allow configuration of PUCCH repetition factor per PUCCH resource. |
| Ericsson | Similar to ‘PUSCH-TimeDomainWindow-r17’, suggest to rename as ‘PUCCH-DMRS-Bundling-r17’. |
| Qualcomm | Similar comment as PUSCH DMRS bundling parameters. |

For Msg3 repetition, it seems we haven’t identified any parameters needed at this moment based on the agreements so far.

Any other comments?

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Ericsson | For Msg3 repetition, given that there’re no stable RRC parameters for Msg2, we’re fine to discuss this after next RAN1 meeting. |
|  |  |
|  |  |

1. Email discussion (2nd round)

**FL comments:**

**For enhancements on PUSCH repetition type A, as commented by ZTE and Apple, *PUSCH-Allocation-r17* includes features for NR-U. It seems not appropriate to directly extend *PUSCH-Allocation-r16*. Suggest to remove this IE at present. Based on comments, parent IE is added, *maxNrofUL-Allocations-r17* is added, *RepetitionCountingType-R17* is changed to *AvailableSlotCounting*. *PUSCH-TimeDomainResourceAllocationList-r17* and *PUSCH-TimeDomainResourceAllocation-r17* are put in brackets. Whether these two IEs are necessary is FFS.**

**For TBoMS, as commented by some companies, *numberOfRepetitionsTBoMS-r17* may not be needed. Suggest to remove this IE at present.**

**For DMRS bundling, separate RRC parameters are listed for PUSCH and PUCCH respectively. *PUSCH-TimeDomainWindow-r17*/*PUCCH-TimeDomainWindow-r17* is changed to *PUSCH-DMRS-Bundling*/*PUCCH-DMRS-Bundling*. *PUSCH-TimeDomainWindowLength* and *PUCCH-TimeDomainWindowLength* are added.**

Companies are encouraged to provide comments on updated RRC parameters for enhancements on PUSCH repetition type A.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Sharp | We are fine to remove "PUSCH-Allocation-r17" but in this case the value range of "PUSCH-TimeDomainResourceAllocation-r17" should be "SEQUENCE {k2, startSymbolAndLength-r17, numberOfRepetitions-r17, ...}", and also "defined in the same way as for PUSCH-TimeDomainResourceAllocation-r16" should be removed from the Description. |
| Samsung | Keeping “PUSCH-Allocation-r17” seems the most straightforward way to introduce *numberOfRepetitions-17*, with *mappingType* to be restricted to TypeA*startSymbolAndLength, startSymbol, length* – same as in Rel-16. row#6 – Remove. TDRA table size is not increased respect to Rel-16. |
| Nokia/NSB | One question for clarification, concerning “***PUSCH-Allocation-r17* includes features for NR-U. It seems not appropriate to directly extend *PUSCH-Allocation-r16*. Suggest to remove this IE at present.”,** if we don’t introduce PUSCH-Allocation-r17 and we also don’t extend PUSCH-Allocation-r16 then how and where to do we configure the numberOfRepetitions-r17? Is it still in PUSCH-TimeDomainResourceAllocation-r17, but outside of PUSCH-Allocation-r17? |
| ZTE | We have similar understanding with Sharp.  |
| Intel | In our view, it may not be good to reuse the PUSCH-Allocation-r16. The IE structure in Rel-17 may be different compared to the one introduced in NR-U.  |
| Apple | We share the same views as Sharp and ZTE. |

Companies are encouraged to provide comments on updated RRC parameters for TBoMS and whether only one Rel-17 TDRA list is defined, or separate TDRA lists are defined for Rel-17 repetition and TBoMS.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Sharp | We prefer defining only one Rel-17 TDRA list which covers both Rel-17 PUSCH repetition type-A enhancement and TBoMS. On the other hand, we don’t think there is common understanding so far. Therefore, we think Parent IE for *numberOfSlotsTBoMS-r17* should be FFS for now. |
| CATT | Agree with former companies’ view to capture ‘*numberOfRepetitions* \* *numberOfSlotsTBoMS-r17* is no larger than 32’ in the description column according to the previous RAN1#106-e agreement:

|  |
| --- |
| **Agreement**Repetitions of a single TBoMS are supported, where:* The number of ~~configured~~ repetitions is denoted by M, i.e., the total number of allocated slots for TBoMS repetition is M\*N.
	+ Note: M\*N is no more than the max number of repetitions agreed for repetition Type A enhancement in agenda 8.8.1.1

… |

 |
| Samsung | Reuse of *numberOfRepetitions-r17* of normal TDRA repetition configuration for Type A repetition for TBoMS seems to be sufficient. |
| ZTE | Given TBoMS with repetition have been agreed, our understanding is a TDRA table with two separate columns (one for M and another for N) can be introduced, and only one of the two columns is configured if only repetition type A or single TBoMS is enabled. In this sense, we are fine to introduce numberOfSlotsTBoMS-r17.  |
| Intel | Based on current agreements, we are open to introduce both number of slots for single TBoMS transmission and number of repetitions for TBoMS. We can further discuss this in the upcoming meetings.  |
| Apple | Only one Rel.17 TDRA list could make the specification clearer. The repetition parameters and TBoMS parameters can be configured independently. Considering current agreement, the IE *numberOfSlotsTBoMS-r17* and *numberOfRepetitionsTBoMS-r17* are needed. Currently introducing one or two separate TDRA list for repetition and TBoMS is not clear, so *numberOfRepetitionsTBoMS-r17* can be in bracket. |

Companies are encouraged to provide comments on updated RRC parameters for joint channel estimation for PUSCH.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| CATT | According to the following RAN1#106-e agreement, one IE (i.e. *PUSCH-TimeDomainWindowLength*) should be enough to indicate the enabling of JCE and also the length of configured TDW. Seems no need to introduce *PUSCH-DMRS-Bundling*. For example, one value of the *PUSCH-TimeDomainWindowLength* may be used to represent ‘disable’ (Or simply state that if JCE is disabled this field is absent).

|  |
| --- |
| **Agreement*** Joint channel estimation for PUSCH transmissions and the time domain window are jointly enabled or disabled via RRC configuration for a UE.
	+ Note: Enabling/disabling of joint channel estimation for PUSCH transmissions means enabling/disabling of DMRS bundling for PUSCH transmissions under the condition of power consistency and phase continuity.
 |

In addition, it is desirable to have a unified design for PUSCH and PUCCH. In AI 8.8.2, it was discussing whether the RRC configuration for (PUCCH) DMRS bundling is per BWP configured (also with other alternatives). If JCE (PUCCH) is per BWP configured, it seems enough to use only one ‘L’ of configured TDW length for both PUSCH and PUCCH. If common parameter is used for PUSCH and PUCCH, there is no need to introduce both *PUSCH-TimeDomainWindowLength and PUCCH-TimeDomainWindowLength.* A unified parameter like *UL-TimeDomainWindowLength* should be enough. In this case, the parent IE may be *BWP-UplinkDedicated*.Given that the above discussion is still on-going, we are open to keep the parameters separate for PUSCH and PUCCH respectively for now. We can comeback in the later phase. |
| Samsung | Ok to keep both PUSCH and PUCCH parameters for now. |
| ZTE | No need to introduce PUSCH-DMRS-Bundling. We are ok to reflect DMRS bundling in the name of PUSCH-TimeDomainWindowLength as commented by companies in the first round.  |
| InterDigital | We are also supportive of the proposal from CATT about using one IE (e.g., *PUSCH-TimeDomainWindowLength*) to indicate whether DMRS bundling is enabled or not. |
| Intel | We are fine to use one parameter to indicate both enabling/disabling and TDW duration. If this parameter is not configured, this indicates that TDW for DMRS bundling is disabled. We are fine to keep separate parameters for PUSCH and PUCCH. |
| Apple | We also think the IE *PUSCH-DMRS-Bundling* is not needed. *PUSCH-TimeDomainWindowLength* could indicate the DMRS bundling is enabled/disabled. |

Companies are encouraged to provide comments on updated RRC parameters for PUCCH enhancements.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| Sharp | RAN2 parent IE for *PUCCH-nrofSlots-r17* should be *PUCCH-Resource*. |
| CATT | Regarding to the repetition number, we agree with Sharp. Dynamic number of repetition for PUCCH should be per PUCCH-resource configured.Regarding to the JCE parameters, we have the same comment in PUSCH JCE. |
| Samsung | Agree with above comments - RAN2 parent IE to be *PUCCH-Resource*. |
| Nokia/NSB | Agreed with the above comments.One question for clarification, if PUCCH-nrofSlots-r17 takes only value {2, 4, 8} (i.e., 1 is not included) how can PUCCH without repetition be indicated? Is it so that PUCCH without repetition only applies if both PUCCH-nrofSlots-r17 and nrofSlots are not configured? |
| ZTE | Agree above comments to change the parent IE as *PUCCH-Resource*.Similar as PUSCH, there is no need to introduce PUCCH-DMRS-Bundling. |
| Intel | Agree above comments that parent IE should be PUCCH-resource |