3GPP TSG RAN WG1 #101 R1-200xxxx

e-Meeting, May 20th – June 5th, 2020

Source: Moderator (OPPO)

Title: Discussion on Issue#b-2 in Email Thread 2

Agenda Item: 7.2.6.2

Document for: Discussion and Decision

1. Introduction

Rel-16 enhancement on MIMO WID includes objectives of enhancing multi-TRP/Panel transmission with ideal and non-ideal backhaul. During the work of rel-16, designs for multiple-PDCCH based and single-PDCCH based multi-TRP/Panel transmission were discussed and specified. This document provides the discussion for Issue #b-2 in multi-TRP email thread 2:

* The issue# b-2 to Clarify the relationship between *RepetitionNumber-r16*/*RepSchemeEnabler* and *pdsch-AggregationFactor*, and also clarify the repetitions are in *RepNum16* consecutive slots in Scheme 4.

# Issue#b-2

**Background**:

Companies [4], [12], [17], [18] discuss the issue of relationship between the *RepNumR16* of scheme 4 and the parameter *pdsch-AggregationFactor* that was specified in rel15. They all propose that the *RepNumR16* of scheme 4 and parameter *pdsch-AggregationFactor*  can not be used simultaneously. But their proposal has some difference:

* [4] proposed that *pdsch-AggregationFactor* should be overwritten whenever Rel-16 repetition number *RepetitionNumber-r16* is indicated by DCI.
* [12] proposed that when at least one entry in *pdsch-TimeDomainAllocationList* contains RepNumR16, the UE will ignore the *AggregationFactor*.
* [17] proposed that *pdsch-AggregationFactor* should be overwritten when Rel-16 repetition number *RepetitionNumber-r16* is indicated by DCI.
* [18] proposed that when at least one entry in *pdsch-TimeDomainAllocationList* contains RepNumR16, the UE does not expect to be configured with *AggregationFactor*.

[18] also discussed the issue of simultaneous configuration of scheme 2a/2b/3 and *pdsch-AggregationFactor* and proposed that simultaneous configuration of scheme 2a/2b/3 and *pdsch-AggregationFactor* is not allowed.

[12], [17] and [19] proposed to clarify that in scheme 4, the PDSCH is repeated in in RepNumR16 consecutive slots.

**Proposal 1: Regarding the *RepetitionNumber-r16* of scheme 4 and *AggregationFactor*, down-select from:**

* **Alt1: *pdsch-AggregationFactor* is applied only when the Rel-16 repetition number *RepetitionNumber-r16* is not indicated by a DCI.**
* **Alt2: *AggregationFactor* is applied only when the Rel-16 repetition number *RepetitionNumber-r16* is not included in any entry in *pdsch-TimeDomainAllocationList.***
* **Alt3: When at least one entry in *pdsch-TimeDomainAllocationList* contains *RepetitionNumber-r16*, the UE does not expect to be configured with *AggregationFactor***

**Proposal 2: When a UE is configured by *repetitionSchemeConfig-r16* set to one of '*FDMSchemeA*', '*FDMSchemeB*' and '*TDMSchemeA*', the UE does not expect to be configured with AggregationFactor.**

**Proposal 3: Clarify that in scheme 4, PDSCH is repeated in *RepNumR16* consecutive slots**

Please input your views and comments on these 3 proposals:

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| Company | Views and comments |
| Apple | Since all the parameters are provided by RRC, gNB should provide the correct parameters. Such “ignore” or “overwritten” are not typical ways we used. It seems Alt3 in proposal 1 and proposal 2 & 3 should be fine. |
| MediaTek | We support Alt 3 in Proposal 1, and also support Proposal 2 and Proposal 3.  |
| OPPO(updated) | For proposal 1, regarding Apple’s comments, I modify the wording since we only need to clarify in 38.214 when to apply *pdsch-AggregationFactor****.*** The application of *RepetitionNumber-r16* has been clearly described in spec. It should be noticed that it is possible that *RepetitionNumber-r16* is configured in *pdsch-TimeDomainAllocationList-ForDCIFormat1\_2* but not in *pdsch-TimeDomainAllocationList* considering it is mainly applied for URLLC. In this case, if DCI format 1\_0 or DCI format 1\_1 is used to schedule PDSCH, it is not reasonable to forbid gNB to use *pdsch-AggregationFactor* for PDSCH (which is actually Rel-15 UE behavior). Hence, **considering a unified design for *pdsch-TimeDomainAllocationList-ForDCIFormat1\_2* and *pdsch-TimeDomainAllocationList*, Alt.1 or Alt.2 is fine to us**. Otherwise, we may need another conclusion to clarify if *pdsch-AggregationFactor* can be configured if *RepetitionNumber-r16* is only configured in *pdsch-TimeDomainAllocationList-ForDCIFormat1\_2.*We also support proposal 2 and 3. |
| ZTE | Support **Proposal 1 with Alt3**, proposal 2 and proposal 3. The reason is that, Alt.1 is not flexible since it doesn’t support repetition number =1 if *pdsch-AggregationFactor* is configured. Alt.2 causes unnecessary configuration, the benefit is unclear. |
| CMCC | Support Proposal 1 with Alt2, proposal 2 and proposal 3.For proposal 1, in 38.214, the number of repetitions *K* for PUSCH has been specified as follows. Similar principle can be reused for PDSCH.For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as- if *numberofrepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberofrepetitions*;- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*; - otherwise *K=1*. |
| Spreadtrum | Support Alt.3 in Proposal 1 for its flexibility, proposal 2, and proposal 3. |
| vivo | Support Alt.2 in Proposal 1 which works the same way as UL PUSCH in TS 38.214:=============================================For PUSCH repetition Type A, when transmitting PUSCH scheduled by DCI format 0\_1 or 0\_2 in PDCCH with CRC scrambled with C-RNTI, MCS-C-RNTI, or CS-RNTI with NDI=1, the number of repetitions *K* is determined as- if *numberofrepetitions* is present in the resource allocation table, the number of repetitions K is equal to *numberofrepetitions*;- elseif the UE is configured with *pusch-AggregationFactor*, the number of repetitions *K* is equal to *pusch-AggregationFactor*; - otherwise *K=1*.For PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot. The redundancy version to be applied on the *n*th transmission occasion of the TB, where n = 0, 1, … *K*-1, is determined according to table 6.1.2.1-2. ===============================================For a UE supporting both DCI format 1-1 and 1-2, two TDRA tables are configured, each applies the same rule as Alt.2.We also support Proposal 3. |
| QC | Support Alt3 in Proposal 1, and proposals 2 and 3. Note that for semi-static HARQ-Ack, we agreed on the following in Feb e-Meeting, which means that Alt1 is not allowed. Also, Alt2 is a configuration error case, which should be avoided by the network. For the case of different TDRA tables for DCI formats 1-1 and 1-2 (if this is agreed), still Alt 3 should be followed (if at least one entry of any of the two TDRA tables is configured with RepetitionNumber-r16, AggregationFactor should not be configured/used). Otherwise, Type-1 HARQ-Ack codebook determination requires additional specification efforts. Note that such an impact does not exists for the case of PUSCH in eURLLC (as it does not impact the HARQ-Ack).If the UE is provided *pdsch-AggregationFactor* and no entry in *pdsch-TimeDomainAllocationList* includes *RepNumR16* in *PDSCH-TimeDomainResourceAllocation*, $N\_{PDSCH}^{repeat}$ is a value of *pdsch-AggregationFactor*; otherwise $N\_{PDSCH}^{repeat}=1$. The UE reports HARQ-ACK information for a PDSCH reception- from slot $n-N\_{PDSCH}^{repeat}+1$ to slot $n$, if $N\_{PDSCH}^{repeat}>1$, or - from slot $n-RepNumR16+1$ to slot $n$, if the Time domain resource assignment field in the DCI format scheduling the PDSCH reception indicates an entry in *pdsch-TimeDomainAllocationList* containing *RepNumR16,* or - in slot $n$, otherwise  |
| Ericsson | We have similar comments as QC with regards to Proposal 1. Hence, we support Alt 3 of Proposal 1. We also support Proposals 2 and 3. |
| Huawei | Support Proposal 1 with Alt1 or Alt 3, and slightly prefer Alt 1 due to avoid potential reconfiguration if the NW does not want to use dynamic repetition and prefer that Rel-15 can be sufficient. We are fine with proposal 2, and proposal 3 which shall be aligned with Rel-15 repetition mechanism.  |
| Nokia | On Proposal 1: Alt.2Alt.1 is not matching with the existing specification text as highlighted by QC. On other alternatives, it is not clear why there are two variants as Alt.2 and Alt.3 as the outcome suggest there is the same. Alt.2 refer to the case where *RepetitionNumber-r16* is not configured (for any entry) and *AggregationFactor* is configured. As alt.2 behaviour is already captured in HARQ-Ack codebook (mentioned by several companies above), we do not see a strong need on using Alt.3 wording. Proposal 2 & 3: Fine. |
| LG | Support Alt 3 for Proposal 1 and support Proposal 2 and 3.Regarding Proposal 1, Alt 1 and 2 introduce unnecessary priority when both aggregation factor and repetition number are configured. Such configuration can be avoided by capturing “UE does not expect …” as Alt 3 and it is well aligned with Proposal 2 as well. |
| OPPO1 | Regarding QC’s comments, we don’t think any modification is needed for Type-1 HARQ-ACK codebook determination in 38.213. Even when *pdsch-AggregationFactor* and *RepNumR16* are both configured, there is no issue with $N\_{PDSCH}^{repeat}=1$ according to the rules in 38.213. And I don’t know why we need to restrict configuration of *pdsch-AggregationFactor* for DCI format 1\_0 and 1\_1, when gNB configures *RepNumR16* for URLLC for DCI format 1\_2. Alt3 actually introduces additional scheduling restriction. |
| Samsung | Support Proposal 1 with Alt3, proposal 2, and proposal 3.In RAN1#99, we already discussed whether simultaneous configuration of *RepetitionNumber-r16* and *AggregationFactor* is allowed or not. We concluded to not support any additional cases except the rows in the following agreement. So Alt3 is exactly what we’ve agreed for Proposal 1.

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|  |  TCI states | CDM groups | URLLCRepNum | URLLCSchemeEnabler | UE Behavior  |
| 0 (in spec draft) | 1 | >=1 | Not applicable | Not applicable | Rel 15  |
| A (one scheme) | 1 | 1 | Condition 1 | Configured or not configured  | "Scheme 4" with repetition from the same TRPLimitations agreed for Scheme 4 apply |
| A’ (one scheme) | 1 | >=1 | Condition 2 | Not configured  | Rel 15  |
| B (in spec draft) | 2 | 1 | Condition 1 | Not configured  | Scheme 4 |
| C (in spec draft) | 2 | 2 | Condition 2 | Not configured  | 1a/NCJT |
| E (in spec draft) | 2 | 2 | Condition 4 | Not configured  | 1a/NCJT |
| F (in spec draft) | 2 | 1 | Condition 4 | Configured  | Scheme 2a/2b/3 |
| D’’ (one scheme) | 2 | 2 | Condition 4 | Configured  | 1a/NCJT |
| G’ (one scheme) | 1 | >=1 | Condition 2 | Configured  | Rel 15  |
| G (one scheme) | 1 | >=1 | Condition 4 | Configured  | Rel 15  |

**Agreement**Following TCI state and joint schemes are supportedNote:* Condition 1: indicates ~~at least~~ one entry in *pdsch-TimeDomainAllocationList* containing *URLLCRepNum* (>1) in *TDRA by DCI*
* Condition 2: indicates one entry in *pdsch-TimeDomainAllocationList* having no *URLLCRepNum by DCI*, but at least one entry having URLLCRepNum
* Condition 4: None of entry in TDRA contains *URLLCRepNum*
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Support Proposal 2 for the same reason. |
| NTT DOCOMO | Support Alt.2 in proposal 1, and also support proposal 2 and proposal 3.From NW perspective, we don’t see the need to restrict the configuration of *pdsch-AggregationFactor*.What we can do is to clarify the UE behavior when such configuration happens. For Alt.1, we have similar view as ZTE, it doesn’t support repetition number =1 if *pdsch-AggregationFactor* is configured. For Alt.2 and Alt.3, Alt.2 is preferred to have flexible NW configuration.  |

1. Reference
2. R1-2003397 On remaining issues on M-TRP vivo
3. R1-2003469 Maintenance of multi-TRP enhancements ZTE
4. R1-2003531 Remaining issues on multi-TRP in R16 Huawei, HiSilicon
5. R1-2003627 Discussion on remaining issues of multi-TRP/panel transmission CATT
6. R1-2003660 Remaining issues on multi-TRP transmission MediaTek Inc.
7. R1-2003742 Corrections to multi-TRP Intel Corporation
8. R1-2003819 Remaining issues on multi-TRP/panel transmission Lenovo, Motorola Mobility
9. R1-2003881 On Rel.16 multi-TRP/panel transmission Samsung
10. R1-2003928 Text proposals on enhancements on multi-TRP/panel transmission LG Electronics
11. R1-2003954 Remaining issues on multi-TRP/panel transmission CMCC
12. R1-2003987 Discussion on remaining issues of multi-TRP operation Spreadtrum Communications
13. R1-2004047 Text proposals for enhancements on multi-TRP and panel Transmission OPPO
14. R1-2004229 Remaining issues for Multi-TRP enhancement Apple
15. R1-2004265 Maintenance of Rel-16 Multi-TRP operation Nokia, Nokia Shanghai Bell
16. R1-2004311 Remaining issues on multi-TRP transmission NEC
17. R1-2004395 Remaining issues on multi-TRP/panel transmission NTT DOCOMO, INC
18. R1-2004432 Remaining issues on Multi-TRP/Panel Transmission Ericsson
19. R1-2004463 Multi-TRP Enhancements Qualcomm Incorporated
20. R1-2004592 Clarification on Multi-TRP URLLC Scheme 4 Convida Wireless
21. R1-2004719 FL summary #2 for Multi-TRP/Panel Transmission Moderator(OPPO)