**3GPP TSG RAN WG1 #110 R1-2207702**

**Toulouse, France, August 22nd – 26th, 2022**

**Agenda item:** 8.16.2

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** Summary on UE features for NR coverage enhancement

**Document for:** Discussion and Decision

# **Introduction**

This document summarizes contributions submitted to AI 8.16.2 regarding UE features for NR coverage enhancement and captures company views based on the announcement in the following email thread.

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| --- |
| [110-R17-UE\_features\_1] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc – Hiroki (DOCOMO)* eIIoT & URLLC, RedCap, UE power saving, coverage enhancement, NB-IoT & eMTC, sidelink, MBS, 5G terrestrial broadcast, UL TX switching, SDT
 |

Based on the latest RAN1 UE features list in [1] and contributions in AI 8.16.2, the issues to be discussed are tagged and colour coded with High priority or Low priority based on potential RAN2 spec impact (including description update in TS38.306).

# **Discussion**

## **2.1 30-1 to 30-2: Enhancements for PUSCH Type A repetitions**

In [1], FGs 30-1 to 30-2 are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  30. NR\_cov\_enh | 30-1 | Increased maximum number of PUSCH Type A repetitions | Maximum value of K (the number of repetitions) = 32For DG PUSCH, the number of repetitions is indicated in a TDRA list. A row index of the TDRA list is indicated by a DCI.For Type 1 CG PUSCH, the number of repetitions is indicated by repK-r17For Type 2 CG PUSCH, the number of repetitions is indicated in a TDRA list or by repK-r17. | 5-14, 5-16, or 5-17 | Yes | N/A | UE does not support more than 16 repetitions PUSCH. | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-2 | PUSCH Type A repetitions based on available slots | Transmission occasions for [K] repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots. | One of {5-14, 5-16, 5-17, [11-6, 30-1]} | Yes | N/A | UE does not support dynamic or configured grant PUSCH repetitions counted on the basis of available slots. | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Following views are provided in contributions for the RAN1#110 meeting.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | We summary the prerequisite feature groups for FGs of coverage enhancement as following table.

|  |  |  |
| --- | --- | --- |
| **Index** | **Feature group** | **Prerequisite feature groups** |
| 30-2 | PUSCH Type A repetitions based on available slots | One of {5-14, 5-16, 5-17, ~~[~~11-6, 30-1~~]~~} |

 |
| [3] | ZTE | As agreed for PUSCH repetition type A in maintenance session, counting based on available slot only applies to repetition number K>1. Therefore the components of FG 30-2 can be updated correspondingly.Regarding the prerequisite of FG 30-2, we see no much need to add FG 11-6 and 30-1 considering the fundamental FGs {5-14, 5-16, 5-17} have been included. If a UE needs to support available slot together with dynamic indication or increased maximum number of repetitions, it can always report related FGs together. With above, we have the following proposal. ***Proposal 1: For FG 30-2, adopt the following updates.***

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 30-2 | PUSCH Type A repetitions based on available slots | Transmission occasions for K>1~~[K]~~ repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots. | One of {5-14, 5-16, 5-17~~, [11-6, 30-1]~~} |

 |
| [4] | Intel Corporation | At the RAN1#108-e meeting, it was agreed to merge FGs 30-2 and 30-2a into an FG with per band and merge FGs 30-1 and 30-1a into an FG with per band with K = {20, 24, 28, 32} [3]. In addition, at the RAN1#106b-e meeting, it was agreed that maximum number of repetitions accounted for available slots supported by Rel-17 PUSCH repetition Type A is 32 [4]. In our view, for the UE feature groups for PUSCH repetition type A enhancement, all the K values should be supported for the case with counting based on available slots. Based on the discussions above, Table 1 illustrates suggested update for UE feature group for PUSCH repetition type A enhancement. Table 1. UE feature group for PUSCH repetition type A enhancement

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 30-2 | PUSCH Type A repetitions based on available slots | Transmission occasions for ~~[~~K~~]~~ repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots~~.~~, where K = 2, 3, 4, 7, 8, 12, 16, 20, 24, 28, 32. | One of {5-14, 5-16, 5-17, ~~[~~11-6, 30-1~~]~~} |

**Proposal 1*** For UE feature group of PUSCH repetition type A enhancement,
	+ Consider Table 1 for UE feature group of PUSCH repetition type A enhancement.
 |
| [5] | Xiaomi | The prerequisite FG for FG 30-1 and FG 30-2 were discussed in the last meeting but weren’t reached agreements yet. For FG 30-1, as the following conclusion reached in RAN1#107bis-e meeting, since *pusch-aggregationFactor-r17* is not introduced, it is unreasonable to take FG 5-17 as the prerequisite FG for FG 30-1. Instead, FG 6-11 with number of repetitions configured in the TDRA table should be involved.

|  |
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| **Conclusion:**No consensus to introduce *pusch-AggregationFactor-r17*. |

For FG 30-2, we think it can be implemented in combination with any of the PUSCH repetition type A in R15/16/17(with increased number of repetitions) for a R17 UE, and can be applied for DG and/or CG (both type-1 and type-2). Thus, we propose to take one of FG {5-14, 5-16, 5-17, 11-6, 30-1} as the prerequisite FG for FG 30-2.**Proposal 1: Replace FG 5-17 with FG 6-11 as the prerequisite FG for FG 30-1.** **Proposal 2: The prerequisite FG for FG 30-2 is one of {5-14, 5-16, 5-17, 11-6, 30-1}.** |
| [6] | China Telecom | In our understanding, available slot counting can applies to Rel-15 PUSCH repetition (FG 5-14, 5-16, or 5-17), Rel-16 PUSCH repetition type A (FG 11-6) and Rel-17 enhanced PUSCH repetition type A (FG 30-1). We have the following proposal.**Proposal 1: FGs for PUSCH repetition type A enhancements.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Note | Mandatory/Optional |
|  30. NR\_cov\_enh | 30-1 | Increased maximum number of PUSCH Type A repetitions | Maximum value of K (the number of repetitions) = 32For DG PUSCH, the number of repetitions is indicated in a TDRA list. A row index of the TDRA list is indicated by a DCI.For Type 1 CG PUSCH, the number of repetitions is indicated by repK-r17For Type 2 CG PUSCH, the number of repetitions is indicated in a TDRA list or by repK-r17. | 5-14, 5-16, or 5-17 | UE does not support more than 16 repetitions PUSCH. | Per band |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-2 | PUSCH Type A repetitions based on available slots | Transmission occasions for ~~[~~K~~]~~ repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots. | One of {5-14, 5-16, 5-17, ~~[~~11-6, 30-1~~]~~} | UE does not support dynamic or configured grant PUSCH repetitions counted on the basis of available slots. | Per band |  | Optional with capability signalling |

 |
| [11] | Ericsson | There are two remaining open issues for FG 30-2, which were put in brackets in [1], including the value of K for available slot counting and the prerequisite feature groups.According to the following agreement made in RAN1#108 meeting, K=1 doesn’t apply to Available slot counting for DG-PUSCH or CG-PUSCH repetition Type A. FG 30-2 is only about the available slot counting, so it would be clear without mentioning K in the column of components in UE feature list.

|  |
| --- |
| Agreement* For DG-PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, the legacy counting method applies when K=1, regardless of whether AvailableSlotCounting is enabled or not
	+ Note: The legacy assumption on the K2 offset is applied, i.e., no RAN1 spec impact on the K2 offset is expected.
* For CG-PUSCH repetition Type A,  the legacy counting method applies when K=1, regardless of whether AvailableSlotCounting is enabled or not.
	+ Note: No RAN1 spec impact is expected.
	+ Note: No additional restriction on CG periodicity configurations, compared to Rel-16, is considered for CG-PUSCH with K=1.
* For CG-PUSCH repetition Type A, when AvailableSlotCounting is enabled, and for K>1, a UE assumes that the slot (i.e., the first configured slot in a CG period) determined in 38.321 Section 5.8.2 can be the slot which is not counted in K available slots.
	+ Note: No RAN1 spec impact is expected.
 |

Regarding the prerequisite feature groups, since the feature does not depend on 30-1 or 11-6 but can be combined with 30-1 and 11-6. The FGs {5-14, 5-16, or 5-17} would suffice.For Type A PUSCH repetition, the UE feature discussed so far is summarized and updated in Table 1. Table 1: Capabilities for PUSCH Repetition Type A Enhancement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Comments |
| 30-2 | PUSCH Type A repetitions based on available slots  | Transmission occasions for ~~[K]~~ repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots. | One of {5-14, 5-16, 5-17~~, [11-6, 30-1]~~} |  |

1. UE features for PUSCH Repetition Type A Enhancement are defined according to Table 1.
 |
| [12] | Qualcomm Incorporated | We make the following proposals to revise the UE capabilities for PUSCH Type A repetitions.**Proposal 2:** UE capabilities for enhanced PUSCH Type A repetitions are revised as follows:* The prerequisites for FG 30-2 are one of {5-14. 5-16, 5-17}.
 |
| [14] | NTT DOCOMO, INC. | The relationship between FG 30-1 and 30-2 is the remaining discussion point, and following points are FFS points.1. Number of repetitions (K) for FG 30-2: 8 or 16 or 322. Prerequisite for FG 30-2: including 30-1 or notNumber of repetitions is independent from the FG 30-2, since it depends on whether UE supports repetitions of 16/32 or not, and FG 30-2 is just for available slot counting. Therefore, component of FG 30-2 does not need to include the number of repetition (K). In addition, since both available slot counting and increased number of repetitions can be configured simultaneously, FG 30-1 can be included as one of the prerequisite FGs for FG 30-2. **Proposal 1: Remove number of repetition (K) from component of FG 30-2.****Proposal 2: FG 30-1 can be included in one of the prerequisite FGs for FG 30-2.** |
| [15] | Nokia, Nokia Shanghai Bell | * **30-1:**
	+ Add 11-6 as prerequisite since the increased maximum number of PUSCH repetitions is supported for *numberOfRepetitions*, which was introduced in 11-6, and remove 5-17 as the increased maximum number of PUSCH repetitions is not supported for *pusch-AggregationFactor*.
* **30-2:**
	+ Replace list of pre-requisites with “one of {FG30-1 or 11-6}” as 30-1 already includes one of {5-14, 5-16, 5-17}.
 |

Based on above, following proposal should be discussed at the RAN1#110 meeting.

### **High priority proposal 2-1-1:**

* **Apply either one of following alternatives for the prerequisite feature groups for FG 30-1**
	+ **Alt.1: Keep current prerequisite FGs (5-14, 5-16, or 5-17)**
	+ **Alt.2: Replace FG 5-17 with FG 6-11 [5]**
	+ **Alt.3: Add 11-6 [15]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Since there’s no agreement on supporting *pusch-AggregationFactor,* FG 5-17 should be removed, and 11-6 is needed since increasing number of repetitions is only performed in TDRA tables.Therefore, we do not support any of the 3 FL proposed alternatives, instead, we propose to **replace** **5-17 with 11-6**. |
| ZTE | Ok to replace 5-17 with 11-6. |
| NTT DOCOMO | We support Alt.1 to keep the current prerequisite. “FG 6-11” in Alt.2 seems typo and Alt.2 should be same as Alt.3. |

### **High priority proposal 2-1-2:**

* **Apply either one of following alternatives for the prerequisite feature groups for FG 30-2**
	+ **Alt.1: One of {5-14, 5-16, 5-17, 11-6, 30-1} [2, 4, 5, 6, 14]**
	+ **Alt.2: One of {5-14, 5-16, 5-17} [3, 11, 12]**
	+ **Alt.3: One of {11-6, 30-1} [15]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.2. Increasing number of repetitions and repetition based on available slot are 2 independent features, therefore, 30-1 should be removed in the prerequisite feature list. |
| ZTE | Alt 2.  |
| NTT DOCOMO | We support Alt.1 since any one of FGs for PUSCH repetitions can be the prerequisite FGs for FG 30-2. And the prerequisite feature groups of FG 30-1 is 5-14, 5-16, or 5-17, so that we also fine with Alt.2.  |

### **High priority proposal 2-1-3:**

* **Apply either one of following alternatives for the number of repetitions (K) for transmission occasions for FG 30-2**
	+ **Alt.1: K>1 [3]**
	+ **Alt.2: K = 2, 3, 4, 7, 8, 12, 16, 20, 24, 28, 32 [4]**
	+ **Alt.3: K [6]**
	+ **Alt.4: Remove K [11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt. 4. |
| Samsung | Alt.4 |
| ZTE | Alt.1 or Alt 2 to align with the RAN1 agreements and make it clear.  |
| NTT DOCOMO | We support Alt.4, since FG 30-2 is for available slot counting so that number of repetitions (K) is not necessary. |

**2.2 30-3 to 30-3a: TB processing over multi-slot PUSCH**

In [1], FGs 30-3 to 30-3a are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG and CG in RRC connected mode. | [11-6] | Yes | N/A | UE does not support TB processing over multi-slot PUSCH. | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-3a | Repetition of TB processing over multi-slot PUSCH | Support repetition of TB processing over multi-slot PUSCH in RRC connected mode. | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Following views are provided in contributions for the RAN1#110 meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | ***Proposal 7:*** *In summary, adopt the changes of the table in Appendix.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG and CG in RRC connected mode. | ~~[11-6]~~ | Yes | N/A | UE does not support TB processing over multi-slot PUSCH. | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-3a | Repetition of TB processing over multi-slot PUSCH | Support repetition of TB processing over multi-slot PUSCH in RRC connected mode. | ~~TBD~~30-3 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| [3] | ZTE | The only remaining issue for FGs for TBoMS, i.e., FG 30-3 and FG 30-3a, is about the prerequisites. For FG 30-3, we don’t think a prerequisite is needed since TBoMS is a totally new functionality and have different UE behavior compared to legacy PUSCH repetition type A. For FG 30-3a, we think it only depends on FG 30-3, and it doesn’t unnecessarily require the UE to support legacy PUSCH repetition. As a result, we have the following proposal. ***Proposal 2: For FGs for TBoMS, no prerequisite is needed for FG 30-3 and the prerequisite of FG 30-3a is FG 30-3.***  |
| [4] | Intel Corporation | At the RAN1#108-e meeting, it was agreed that FG 30-3 is not split into 2 separate FGs: 1st one for DG, 2nd one for CG, and Type of FG 30-3 and 30-3a is per band [3]. Note that the number of allocated slots for TBoMS is indicated via a new column added to the TDRA table. Further, only DG-PUSCH and Type-2 CG-PUSCH are supported for TBoMS. Considering that TBoMS is a new feature for coverage enhancement, it may be reasonable not to apply prerequisite for FG30-3. Based on the discussions above, Table 2 illustrates suggested updates for UE feature groups for TBoMS. Table 2. UE feature groups for TBoMS

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG and Type-2 CG in RRC connected mode. | ~~[11-6]~~ |
| 30-3a | Repetition of TB processing over multi-slot PUSCH | Support repetition of TB processing over multi-slot PUSCH in RRC connected mode. | ~~TBD~~ 11-6, 30-3 |

**Proposal 2*** For UE feature groups of TBoMS,
	+ Consider Table 2 for UE feature groups of TBoMS.
 |
| [5] | Xiaomi | **Proposal 3: Don’t support taking FG 11-6 and FG 30-2 as the prerequisite feature groups for FG 30-3.****Proposal 4: Revise “DG and CG” in the components of FG30-3 to “DG and CG type-2”.****Proposal 6: Determine N\*K slots based on available slots is mandatory for repetition of TBoMS in unpaired spectrum or paired spectrum for HD-FDD UEs.** |
| [6] | Chain Telecom | **Proposal 2: FGs for TB processing over multi-slots.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG and CG in RRC connected mode. | ~~[11-6]~~ | UE does not support TB processing over multi-slot PUSCH. | Per band |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-3a | Repetition of TB processing over multi-slot PUSCH | Support repetition of TB processing over multi-slot PUSCH in RRC connected mode. | ~~TBD~~30-3 | UE does not support repetition of TB processing over multi-slot PUSCH. | Per band |  | Optional with capability signalling |

 |
| [11] | Ericsson | Table 2: Capabilities for Transport Block over Multi-slot PUSCH

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Comments |
| 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG ~~and~~ or CG without repetition in RRC connected mode. | ~~[11-6]~~ |  |
| 30-3a | Repetition of TB processing over multi-slot PUSCH | Support Repetition of TB processing over multi-slot PUSCH in RRC connected mode. | ~~TBD~~30-3, 11-6 |  |

1. UE features for transport block over multi-slot PUSCH are defined according to Table 2.
 |
| [12] | Qualcomm Incorporated | **On TBOMS**We make the following proposals to revise the UE capabilities for TBOMS.**Proposal 5:** UE capabilities for TBOMS are revised as follows:* The prerequisites for FG 30-3 are 30-2.
* The prerequisites for FG 30-3a are 30-3.
 |
| [14] | NTT DOCOMO | The prerequisite FGs of FG30-3 and 30-3a have not been decided yet. As the repetition and TBoMS can be viewed as independent features, FG 11-6 does not need to be prerequisite FG for FG30-3 in our view. On the other hand, the repetition of TBoMS can be viewed as enhanced TBoMS. Hence, FG30-3 should be the prerequisite FG for FG 30-3a. **Proposal 3: There is no prerequisite FG for FG 30-3.****Proposal 4: FG 30-3 is the prerequisite FG for FG 30-3a.** |
| [15] | Nokia, Nokia Shanghai Bell | * **30-3:**
	+ No need to have 11-6 as pre-requisite.
 |

**High priority proposal 2-2-1:**

* **Add “UE does not support repetition of TB processing over multi-slot PUSCH” in “Consequence if the feature is not supported by the UE” of FG30-3a [6].**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| Samsung | Fine |
| ZTE | Ok |
| NTT DOCOMO | Support the proposal. |

**High priority proposal 2-2-2:**

* **Apply either one of following alternatives for the prerequisite feature groups for FG 30-3**
	+ **Alt.1: No prerequisite FG [2,3,4,5,6,11,14]**
	+ **Alt.2: FG 30-2 [12]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.2. TBoMS must be based on available slot and its number of slots can only be signaled in TDRA list introduced in Rel-16.  |
| ZTE | Alt. 1. TBoMS is a totally new functionality and have different UE behavior compared to legacy PUSCH repetition type A.  |
| NTT DOCOMO | Support Alt.1. TBoMS can be viewed as an independent feature from PUSCH repetition type A. |

**High priority proposal 2-2-3:**

* **Apply either one of following alternatives for the prerequisite feature groups for FG 30-3a**
	+ **Alt.1: FG 30-3 [2, 3, 12,14]**
	+ **Alt.2: FG 11-6 and FG 30-3 [4, 5, 11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.1. TBoMS repetition should be based on TBoMS. |
| Samsung | Alt.1 |
| ZTE | Alt.1  |
| NTT DOCOMO | Support Alt.1. It is not necessary to consider dynamic indicated PUSCH repetition type A (FG11-6) as the prerequisite of TBoMS repetition. TBoMS (FG 30-3) already covers dynamic slot indication, and TBoMS repetition can be viewed as enhanced TBoMS which is independent of PUSCH repetition type A. |

**High priority proposal 2-2-4:**

* **Update Component description of FG 30-3**
	+ **Option.1:** **Replace “DG and CG” with “DG and Type2 CG” [4, 5]**
	+ **Option.2: Replace “DG and CG” with “DG or CG without repetition” [11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Option 1. The “CG” must be “CG Type 2” for which a TBoMS can be signaled in Rel-16 TDRA list via activation DCI, which should be captured in the description field. |
| NTT DOCOMO | Support Option1. We think it is obvious that FG 30-3 is about only TBoMS not TBoMS repetition even from the current description. |
|  |  |

**2.3 30-4 to 30-4h: DM-RS bundling**

In [1], FGs 30-4 to 30-4h are captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power consisitency and phase continuity to support DM-RS bundling for PUSCH/PUCCH | FFS | Yes | N/A | UE does not support DM-RS bundling for PUSCH/PUCCH | Per band | N/A | N/A | N/A | Candidate values for the maximum duration for FDD are {4, 8, 16, 32}Candidate values for the maximum duration for TDD are {2, 4, 8, 16} | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A | [30-4], [30-1] or [30-2] | Yes | N/A | UE does not Support DM-RS bundling for PUSCH repetition type A | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B | [30-4], [11-5] [30-1] | Yes | N/A | UE does not Support DM-RS bundling for PUSCH repetition type B | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH | [30-4], [30-3] | Yes | N/A | UE does not Support DM-RS bundling for TB processing over multi-slot PUSCH | [Per UE] | FFS | [No] | [N/A] | Note: If a UE reports support of FG 30-3a and 30-4c, the UE supports DMRS bundling for the repetitions of TBoMS | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4 | [30-4], [4-23] | Yes | N/A | UE does not support DMRS bunding for PUCCH repetitions | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4e | Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | [30-4a] or [30-4b] or [30-4c] | Yes | N/A | UE does not support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | [30-4d] | Yes | N/A | UE does not support Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4g | [Restart DM-RS bundling after the events that violate power consistency and phase continuity] | [Support restarting DM-RS bundling after the events that violate power consistency and phase continuity] | [30-4] | Yes | N/A | [UE does not support restarting DM-RS bundling after the events that violate power consistency and phase continuity] | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for [non-back-to-back transmission for consecutive slots] for PUSCH and PUCCH only for [corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d)] | [30-4a, 30-4b, 30-4c, or 30-4d] | Yes | N/A | UE does not Support DM-RS bundling for non-back-to-back transmission | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |

Following views are provided in contributions for the RAN1#110 meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei | **1) Modulation order support** On FG 30-4, RAN4 confirms that the maximum modulation order supported in Rel-17 requirements is QPSK and proposes to add the following note to RAN1 UE feature to ensure clarity of what is supported in Rel-17 specs.***Proposal 1:*** *The following note should be added to FG 30-4:* * *NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders, as defined in TS 38.101-1 & 38.101-2, for the corresponding physical channels.*

**2) CA/DC/SUL support** Configuring UL-CA to a coverage-limited UE is not a practical use case. It is meaningless to support DMRS bundling in UL CA.Please note that such potential break of phase continuity cannot be caused by a Tx switching for PUSCH/PUCCH transmission on the other carrier because the PUSCH/PUCCH operations on NUL and SUL band are within the same serving cell where out-of-order PUSCH/PUCCH scheduling is not allowed since Rel-15, i.e. a PUSCH/PUCCH transmission **with/without** repetition on one carrier cannot be scheduled to be overlapped in time with the other PUSCH/PUCCH **with** repetition on the other carrier within the same serving cell.As a result, the only potential break of phase contiguity could be caused by SRS transmission on the other carrier.***Proposal 2:*** *It is not expected to introduce additional RAN1 specification impact for applying DMRS bundle to DL CA with “additional” UL carrier configured with SRS only, FR1 inter-band UL CA, or SUL,** *DMRS bundling for FR1 inter-band UL CA should not be supported.*
* *DMRS bundling for Rel-15 SUL (without UL Tx switching) has been supported.*
* *If DMRS bundling for DL CA with “additional” UL carrier configured with SRS only or DMRS bundling for UL Tx switching with SUL is supported, within a DMRS bundling duration on one carrier, it is not expected that any SRS transmission occurs on other carriers.*
* *For SUL, the additional restriction that only one band can be configured with DMRS bundling at a time is unnecessary.*

***Proposal 3:*** *The type of the granularities for FG 30-4a/4b/4c/4d/4e/4f/4g/4h are per band.*scenarios mentioned in the reply LS from RAN4 except inter-band UL CA, operations of different bands are independent or concurrency is avoided by scheduling restrictions. Thus, per-band per band combination is not necessary.***Proposal 4:*** *For FG 30-4a/4b/4c/4d/4e/4f/4g/4h,* * *No for the need for FR1/FR2 differentiation and TDD/FDD differentiation.*
* *N/A for the capability interpretation for mixture of FDD/TDD and/or FR1/FR2.*

***Proposal 5:*** *A UE capability should be introduced to indicate whether to support tpc-PUSCH-RNTI and tpc-PUCCH-RNTI when DMRS bundling is enabled as FG 30-4i and 30-4j in Appendix.****Proposal 7:*** *In summary, adopt the changes of the table in Appendix.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power consisitency and phase continuity to support DM-RS bundling for PUSCH/PUCCH | ~~FFS~~ | Yes | N/A | UE does not support DM-RS bundling for PUSCH/PUCCH | Per band | N/A | N/A | N/A | Candidate values for the maximum duration for FDD are {4, 8, 16, 32}Candidate values for the maximum duration for TDD are {2, 4, 8, 16}NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders, as defined in TS 38.101-1 & 38.101-2, for the corresponding physical channels. | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A | ~~[~~30-4~~]~~, ~~[30-1] or [30-2]~~ one of {5-14, 5-16, 5-17, 11-6, 30-1} | Yes | N/A | UE does not Support DM-RS bundling for PUSCH repetition type A | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B | ~~[~~30-4~~]~~, ~~[~~11-5~~]~~ ~~[30-1]~~ | Yes | N/A | UE does not Support DM-RS bundling for PUSCH repetition type B | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH | ~~[~~30-4~~]~~, ~~[~~30-3~~]~~ or 30-3a | Yes | N/A | UE does not Support DM-RS bundling for TB processing over multi-slot PUSCH | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ | Note: If a UE reports support of FG 30-3a and 30-4c, the UE supports DMRS bundling for the repetitions of TBoMS | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4 | ~~[~~30-4~~]~~, ~~[~~4-23~~]~~ or 25-2 | Yes | N/A | UE does not support DMRS bunding for PUCCH repetitions | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4e | Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | ~~[~~30-4a~~]~~ or ~~[~~30-4b~~]~~ or ~~[~~30-4c~~]~~ | Yes | N/A | UE does not support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[~~30-4d~~]~~ | Yes | N/A | UE does not support Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4g | ~~[~~Restart DM-RS bundling after the dynamic events that violate power consistency and phase continuity~~]~~ | ~~[~~Support restarting DM-RS bundling after the dynamic events that violate power consistency and phase continuity~~]~~ | ~~[~~30-4~~]~~ | Yes | N/A | ~~[~~UE does not support restarting DM-RS bundling after the dynamic events that violate power consistency and phase continuity~~]~~ | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for [non-back-to-back transmission for consecutive slots] for PUSCH and PUCCH only for [corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d)] | ~~[~~30-4a, or 30-4b, or 30-4c or 30-4d~~]~~ | Yes | N/A | UE does not Support DM-RS bundling for non-back-to-back transmission | ~~[Per UE]~~Per band | ~~FFS~~No | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4i | tpc-PUSCH-RNTI when DMRS bundling is enabled | Support tpc-PUSCH-RNTI when DMRS bundling for PUSCH is enabled | 30-4, 8-4 | Yes | N/A | UE does not Support tpc-PUSCH-RNTI when DMRS bundling is enabled | Per band | No | No | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4j | tpc-PUCCH-RNTI when DMRS bundling is enabled | Support tpc-PUCCH-RNTI when DMRS bundling for PUCCH is enabled | 30-4, 8-5 | Yes | N/A | UE does not Support tpc-PUCCH-RNTI when DMRS bundling is enabled | Per band | No | No | N/A |  | Optional with capability signalling |

 |
| [3] | ZTE | In RAN1#109-e, companies didn’t reach consensus on the reporting type of FG 30-4x. The main discussion point is, if a UE supports DMRS bunding in Band A and Band B, whether it can be assumed the UE supports DMRS bundling simultaneously in both bands. It also involves the discussion on the support of DMRS bundling for UL CA/SUL. According to RAN4 LS in [3], RAN4 has agreed to define requirements for FR1+FR2 UL CA. In addition, we find no spec impacts to support FR1/FR2 intra/inter-band UL CA as discussed in our contribution [4]. In such case, we feel per band and band combination reporting as discussed in RAN1#109-e is a good compromise. ***Proposal 3: Reporting type of FGs 30-4a/b/c/d/g/h is per band and per BC.******Proposal 4: Reporting type of FGs 30-4e/f is per UE.**** **Prerequisite of FG 30-4**
* ***Proposal 5: For FG 30-4x, the prerequisites are setting as follows, and is reported per UE with no need differentiation for TDD/FDD or FR1/FR2 or mixture of them***
	+ **FG 30-4a**
		- **FG 30-4 and FG 5-14 or 5-16 or 5-17**
	+ **FG 30-4b**
		- **FG 30-4 and FG 11-5**
	+ **FG 30-4c**
		- **FG 30-4 and FG 30-3**
	+ **FG 30-4d**
		- **FG 30-4 and FG 4-23**
	+ **FG 30-4e**
		- **FG 30-4a or 30-4b or 30-4c**
	+ **FG 30-4f**
		- **FG 30-4d**
	+ **FG 30-4g**
		- **FG 30-4**
	+ **FG 30-4h**
		- **FG 30-4a or 30-4b or 30-4c or 30-4d**
 |
| [4] | Intel Corporation | Table 3. UE feature groups for DMRS bundling

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A | ~~[~~30-4~~]~~, ~~[~~30-1~~]~~, ~~or~~ ~~[~~30-2~~],~~ one of {5-14, 5-16, 5-17, 11-6} |
| 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B | ~~[~~30-4~~]~~, ~~[~~11-5~~]~~ ~~[30-1]~~ |
| 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH | ~~[~~30-4~~]~~, ~~[~~30-3~~]~~ |
| 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4 | ~~[~~30-4~~]~~, ~~[~~4-23~~]~~ |
| 30-4e | Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | ~~[~~30-4a~~]~~ or ~~[~~30-4b~~]~~ or ~~[~~30-4c~~]~~ |
| 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[~~30-4d~~]~~ |
| 30-4g | ~~[~~Restart DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity~~]~~ | ~~[~~Support restarting DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity~~]~~Note: Events which are triggered by DCI or MAC CE, but regarded as semi-static events, e.g., frequency hopping, UL beam switching for multi-TRP operation, or other if defined, are excluded. | ~~[30-4]~~30-4a, 30-4b, 30-4c, or 30-4d |
| 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for ~~[~~non-back-to-back transmission for consecutive slots~~]~~ for PUSCH and PUCCH only for ~~[~~corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d)~~],~~ respectively, | ~~[~~30-4a, 30-4b, 30-4c, or 30-4d~~]~~ |

**Proposal 3*** For UE feature groups of DMRS bundling for PUSCH and PUCCH
	+ UE features for DMRS bundling are defined per band.
	+ Consider Table 3 for UE feature groups of DMRS bundling.
 |
| [5] | Xiaomi | Table 1 UE feature list for DM-RS bundling

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eatures** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** |
| **30. NR\_cov\_enh** | **30-4g** | **Restart DM-RS bundling after the dynamic events that violate power consistency and phase continuity** | **Support restarting DM-RS bundling after the dynamic events that violate power consistency and phase continuity** | **[30-4]** | **Yes** |

Besides, from the feasibility of testing and application point of view, it is more reasonable to take all the features with respect to DM-RS bundling as per band.**Proposal 7: Updating the FG30-4g to apply to dynamic event only.****Proposal 8: Reporting type of FGs 30-4a to 30-4h is per band** |
| [6] | China Telecom | **Proposal 3: FGs for DMRS bundling for PUSCH/PUCCH.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power ~~consisitency~~ consistency and phase continuity to support DM-RS bundling for PUSCH/PUCCH. | ~~FFS~~ | UE does not support DM-RS bundling for PUSCH/PUCCH | Per band | Candidate values for the maximum duration for FDD are {4, 8, 16, 32}Candidate values for the maximum duration for TDD are {2, 4, 8, 16}NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders, as defined in TS 38.101-1 & 38.101-2, for the corresponding physical channels. | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A | ~~[~~30-4~~]~~, One of {5-14, 5-16, 5-17, 11-6, ~~[~~30-1~~]~~} ~~or [30-2]~~ | UE does not Support DM-RS bundling for PUSCH repetition type A | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B | ~~[~~30-4~~]~~, ~~[~~11-5~~]~~ ~~[30-1]~~ | UE does not Support DM-RS bundling for PUSCH repetition type B | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
|  30. NR\_cov\_enh | 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH | ~~[~~30-4~~]~~, ~~[~~30-3~~]~~ | UE does not Support DM-RS bundling for TB processing over multi-slot PUSCH | ~~[Per UE]~~Per band per BC or Per band and per BC | Note: If a UE reports support of FG 30-3a and 30-4c, the UE supports DMRS bundling for the repetitions of TBoMS | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4 | ~~[~~30-4~~]~~, ~~[~~4-23~~]~~ | UE does not support DMRS bunding for PUCCH repetitions | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4e | Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | ~~[~~30-4a~~]~~ or ~~[~~30-4b~~]~~ or ~~[~~30-4c~~]~~ | UE does not support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[~~30-4d~~]~~ | UE does not support Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4g | ~~[~~Restart DM-RS bundling after the events that violate power consistency and phase continuity~~]~~ | ~~[~~Support restarting DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity~~]~~Note: Events which are triggered by DCI or MAC CE, but regarded as semi-static events, e.g. frequency hopping, UL beam switching for multi-TRP operation, or other if defined, are excluded. | ~~[~~30-4~~]~~ | ~~[~~UE does not support restarting DM-RS bundling after the events that violate power consistency and phase continuity~~]~~ | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for ~~[~~non-back-to-back transmission for consecutive slots~~]~~ for PUSCH and PUCCH only for ~~[~~corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d)~~]~~ | ~~[~~30-4a, or 30-4b, or 30-4c, or 30-4d~~]~~ | UE does not Support DM-RS bundling for non-back-to-back transmission | ~~[Per UE]~~Per band per BC or Per band and per BC |  | Optional with capability signalling |

 |
| [7] | vivo | As discussed in previous meetings, DMRS bundling should at least be a per band feature. However, for a UE supporting DMRS bunding in each of a set of bands, it may be not able to support DMRS bundling simultaneously in all combinations of bands selected from the set of bands. Furthermore, same or different RF circuits may be used for different combinations of bands in UE implementation, therefore FG 30-4a to FG 30-4h should be per band per BC.**Proposal 1: For DMRS bundling, FG 30-4a to FG 30-4h should be per band per BC.** |
| [8] | Samsung | **Proposal 1: Update 30-4g as following in alignment with the corresponding RRC parameter description.**

|  |  |  |
| --- | --- | --- |
| 30-4g | ~~[~~Restart DM-RS bundling ~~after the events that violate power consistency and phase continuity]~~ | ~~[~~Support restarting DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity~~]~~Note: Events which are triggered by DCI or MAC CE, but regarded as semi-static events, e.g. frequency hopping, UL beam switching for multi-TRP operation, or other if defined, are excluded. |

**Proposal 2: Update the ‘Consequence if the feature is not supported by the UE’ for 30-4g as following.**~~[~~UE does not support restarting DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity~~]~~ |
| [9] | CMCC | FG 30-4 is the basis of DMRS bundling, the prerequisite FG of this feature should be vacant. The prerequisite of FG 30-4a should include at least FG 30-4. And for the part of PUSCH repetition Type A in FG 30-4a, the prerequisite FG could be one of the {5-14,5-16,5-17}. No need to limited the DMRS bundling only work based on the Rel-16 or Rel-17 repetition enhancements. It is similar for FG 30-4b. The prerequisite of DM-RS bundling for PUSCH repetition type B should contain FG 30-4 and FG 11-6. The prerequisite of FG 30-4c the DMRS bundling of TBOMS should contain FG 30-4 for DMRS bundling and FG 30-3 for TBOMS. The prerequisite of FG 30-4d the DMRS bundling for PUCCH repetitions should contain FG 30-4 and FG 4-23 for PUCCH repetitions.FG 30-4e the enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling should work under prerequisite of at least one of DMRS bundling scenarios, such as 30-4a, 30-4b or 30-4c. FG 30-4f is more straightforward with FG 30-4d as prerequisite. **Proposal 1:** **The prerequisite FG of FG 30-4 should be vacant.** **The prerequisite FG of FG 30-4a should be FG 30-4 and one of the {5-14,5-16,5-17}.****The prerequisite FG of FG 30-4b should be FG 30-4 and FG 11-6.****The prerequisite FG of FG 30-4c should be FG 30-4 and FG 30-3.****The prerequisite FG of FG 30-4d should be FG 30-4 and FG 4-23.****The prerequisite FG of FG 30-4e should be one of FG {30-4a, 30-4b or 30-4c}.****The prerequisite FG of FG 30-4f should be FG 30-4d.**In the RAN4 LS R1-2205715(R4-2211225), RAN4 informed that in FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2, DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time. Based on the above information, per band report should be enough, because the UL/CA and DMRS bundling is independent.And it was concluded that the FG 30-4 is per band reported. Then the FGs based on FG 30-4 should be also per band reported, such as FG 30-4a 30-4b. And consequently, for those per band reported FGs, FR1 and FR2 differentiation is needed. **Proposal 2:** **FG 30-4a to 30-4h should be per band reported and differentiated between FR1 and FR2.** Considering the behavior of the DMRS bundling within the nominal and actual TDWs are the same for both TDD and FDD. There is no need to differentiate TDD and FDD for those features.**Proposal 3：** **No need to differentiate TDD and FDD for FG 30-4a to FG 30-4h.**FG 30-4h is the feature for UE support DM-RS bundling for non-back-to-back transmission. For a UE support DM-RS bundling, supporting non-back-to-back transmission is a advanced capability than the back-to-back transmission. If a UE want support any non-back-to back PSUCH repetitions, it should support at least one of 30-4a, 30-4b, 30-4c, or 30-4d for the back to back PUSCH repetitions for the specific feature. so the prerequisite of FG 30-4h should be {30-4a, 30-4b, 30-4c, or 30-4d}. **Proposal 4:** **Remove the bracket for Feature group and Components in FG 30-4h.** |
| [10] | MediaTek Inc. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (Sidelink WI only)”. | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power consistency and phase continuity to support DM-RS bundling for PUSCH/PUCCH | FFS | Yes | N/A | UE does not support DM-RS bundling for PUSCH/PUCCH | Per band | N/A | N/A | N/A | NOTE 1: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders, as defined in TS 38.101-1 & 38.101-2, for the corresponding physical channels.NOTE2: For support of CA/DC cases: * FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time.
* FR1 inter-band DL CA with a “single” uplink band configured, meaning no switching to transmit SRS on another carrier.
 | Optional with capability signalling |

Proposal 1: Adopt the above changes for FG 30-4. |
| [11] | Ericsson | An alternative approach could be based on the definition of powerClass in 38.306, which has both per band and per band combination capabilities. Here we give an example using 30-4, but this could be applied to other DMRS bundling related UE capabilities.Table 3a: Example Per Band + Per Band Capability Definition

| **Definitions for parameters** | **Per** |
| --- | --- |
| ***maxDMRS-BundlingDurationBand-r17***Indicates the maximum number of consecutive slots during which the UE is able to maintain power consistency and phase continuity to support DM-RS bundling for a PUSCH or PUCCH when UE is configured with a single UL serving cell. | Band |
| ***DMRS-BundlingBC-r17***Indicates that the UE supports DM-RS bundling for a PUSCH or PUCCH also when UE is configured with more than one UL serving cell. The capability per band of the band combination is then given by *maxDMRS-BundlingDurationBand-r17*. | BC |

The per band + BC capability seems appropriate for 30-4a,b,c,d and 30-4g,h since these features in our view are ‘DMRS bundling’ features. However, frequency hopping is not affected by CA configurations, and indeed Rel-15 inter-slot hopping for PUSCH (UE feature 5-10) has per UE granularity. Given that 5-10 is per UE, we think that is a reasonable granularity for Rel-17 for UE features 30-4e and 30-4f. Per-band capability can also be considered if sufficiently motivated, e.g. to address IoDT test issues.Table 3b: Capabilities for PUSCH and PUCCH Joint Channel Estimation

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Note |
| 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power ~~consisitency~~ consistency and phase continuity to support DM-RS bundling for PUSCH/PUCCH | FFS | Per Band | Candidate values for the maximum duration for FDD are {4, 8, 16, 32}Candidate values for the maximum duration for TDD are {2, 4, 8, 16}UE capability for DM-RS bundling is only ~~applicable~~ defined for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders~~, as defined in TS 38.101-1 & 38.101-2~~, for the corresponding physical channels. |
| 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A over consecutive symbols | ~~[~~30-4~~]~~, and ~~[30-1] or [30-2]~~~~[~~{5-14, 5-16, or 5-17}~~]~~ | ~~[Per UE]~~Per Band and Per BC, according to the approach above. |  |
| 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B over consecutive symbols | ~~[~~30-4~~]~~, ~~[~~11-5~~]~~ ~~[30-1]~~ | ~~[Per UE]~~Per Band and Per BC, according to the approach above. |  |
| 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH over consecutive symbols | ~~[~~30-4~~]~~, [30-3~~]~~ | ~~[Per UE]~~Per Band and Per BC, according to the approach above. | Note: If a UE reports support of FG 30-3a and 30-4c, the UE supports DMRS bundling for the repetitions of TBoMS |
| 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions over consecutive symbols for PUCCH formats 1/3/4 | ~~[~~30-4~~]~~, ~~[~~4-23~~]~~ | ~~[Per UE]~~Per Band and Per BC, according to the approach above. |  |
| 30-4e | Enhanced Inter-slot frequency hopping with inter-slot bundling for PUSCH  | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH  | ~~[~~30-4a~~]~~ or ~~[~~30-4b~~]~~ or ~~[~~30-4c~~]~~ | ~~[~~Per UE~~]~~ |  |
| 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | ~~[~~30-4d~~]~~ | ~~[~~Per UE~~]~~ |  |
| 30-4g | [Restart DM-RS bundling after the events that violate power consistency and phase continuity] | ~~[Support restarting DM-RS bundling after the events that violate power consistency and phase continuity]~~ Support power consistency and phase continuity over an actual TDW created in response to events identified in 38.214 subclause 6.1.7, where such support of consistency/continuity for the event requires UE capability. | ~~[~~30-4~~]~~, and {30-4a, 30-4b, or 30-4c} | ~~[Per UE]~~Per Band and Per BC, according to the approach above. |  |
| 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for ~~[~~non-back-to-back transmission for consecutive slots~~]~~ for PUSCH and PUCCH only for ~~[~~corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d) ~~]~~ | [30-4a, 30-4b, 30-4c, or 30-4d] | ~~[Per UE]~~Per Band and Per BC, according to the approach above. |  |

UE features for PUSCH and PUCCH joint channel estimation are defined according to Tables 3a and 3b |
| [12] | Qualcomm Incorporated | **On DMRS bundling for PUSCH/PUCCH repetitions**We have the following proposals on UE capability reporting for PUSCH/PUCCH DMRS bundling.**Proposal 3:** On UE features 30-4 to 30-4g: all features on DMRS Bundling (PUSCH and PUCCH) to be indicated at the per FS granularity.  |
| [13] | Apple | **Proposal 1: The report type of FGs 30-4a/b/c/d/e/f/g/h is per band.**Regarding DMRS bundling feature differentiation, there is no clear difference between FR1 and FR2, TDD and FDD from implementation perspective. Thus, no differentiation is needed.**Proposal2: No need to differentiate FDD/TDD and FR1/FR2 for FGs30-4a/b/c/d/e/f/g/h.** |
| [14] | NTT DOCOMO | **Proposal 5: Note in FG 30-4 should be added as RAN4 suggested.****Proposal 6: FGs 30-4a to 30-4h can be supported as per band with adding a note “a single uplink carrier at a time is expected”.****Proposal 7:** * **There is no prerequisite FG for FG 30-4.**
* **FG 30-4 and FGs 5-14 or 5-16 or 5-17 are the prerequisite FGs for 30-4a.**
* **FGs 30-4 and 11-5 are the prerequisite FGs for 30-4b.**
* **FGs 30-4 and 30-3 are the prerequisite FGs for 30-4c.**
* **FGs 30-4 and 4-23 are the prerequisite FGs for 30-4d.**
* **FGs 30-4a or 30-4b or 30-4c are the prerequisite FGs for 30-4e.**
* **FG 30-4d is the prerequisite FG for 30-4f.**
* **FG 30-4 is the prerequisite FG for 30-4g.**
* **FGs 30-4a or 30-4b or 30-4c or 30-4d are the prerequisite FGs for 30-4h.**

**Proposal 8: Discuss potential capability for restarting DMRS bundling in either AI 8.8 or AI 8.16.2.****Proposal 9: Support either Alt1 or Alt2.*** **Alt1: Update components of FG30-4g as follows.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-4g | [Restart DM-RS bundling after the events that violate power consistency and phase continuity] | 1. Support of restarting DMRS bundling subject to semi-static events, even when a dynamic event is precedent or overlapping with the corresponding semi-static event.
2. Support of restarting DMRS bundling subject to dynamic events.
 | [30-4] | Yes | N/A | UE has the ability to restart DMRS bundling subject to semi-static events, unless any dynamic event is overlap-ping or triggered before the corresponding semi-static event within the nominal TDW. | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |

* **Alt2: Update FG30-4g and introduce another FG related restarting DMRS bundling as follows.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-4g | Restart DM-RS bundling after the dynamic events that violate power consistency and phase continuity | Support of restarting DMRS bundling subject to dynamic events. | 30-4i | Yes | N/A | UE cannot restart DMRS bundling subject to dynamic events  | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4i | Restart DM-RS bundling after the semi-static events after dynamic events. that violate power consistency and phase continuity | Support of restarting DMRS bundling subject to semi-static events, even when a dynamic event is precedent or overlapping with the corresponding semi-static event. | 30-4 | Yes | N/A | UE has the ability to restart DMRS bundling subject to semi-static events, unless any dynamic event is overlap-ping or triggered before the corresponding semi-static event within the nominal TDW. | [Per UE] | FFS | [No] | [N/A] |  | Optional with capability signalling |

**Proposal 10: Remove the brackets in Components of FG 30-4h.** |
| [15] | Nokia, Nokia Shanghai Bell | * **30-4a/b/c/d:**
	+ Per band seems appropriate, considering the UE needs to maintaing consistency among DM-RS transmissions, and that might be band-dependent.
* **30-4e:**
	+ Confirm prerequisites one of {30-4a, 30-4b, 30-4c}.
	+ Per UE is sufficient if prerequisites are agreed per band. No differentiation needed.
* **30-4g:**
	+ Description of "Feature group" should be (changes are highlighted in red):
		- "Restart DM-RS bundling after the dynamic events that violate power consistency and phase continuity"
	+ Description of "Components" should be (changes are highlighted in red):
		- "Support restarting DM-RS bundling after the events triggered by DCI or MAC-CE that violate power consistency and phase continuity, except events which are triggered by DCI or MAC CE but regarded as semi-static events"
	+ Description of "Consequence if the feature is not supported by the UE" should be (changes are highlighted in red):
		- "UE does not support restarting DM-RS bundling after the dynamic events that violate power consistency and phase continuity"
	+ Per UE is sufficient if prerequisites are agreed per band. No differentiation needed.
* **30-4h:**
	+ It is not consistent if 30-4h is the only place where it is indicated that 30-4a/b/c/d are limited to back-to-back cases. The simpler solution seems to be to update the description of 30-4/a/b/c/d to indicate this restriction explicitly, in which case the yellow highlighted text in 30-4h can be confirmed as is.
	+ Confirm the prerequisites
 |

**High priority proposal 2-3-1:**

* **Add one of the following notes to FG 30-4**
	+ **Alt.1: “NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders, as defined in TS 38.101-1 & 38.101-2, for the corresponding physical channels.” [2, 6, 10, 14]**
	+ **Alt.2: “UE capability for DM-RS bundling is only defined for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders for the corresponding physical channels"[11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.1. |
| Samsung | Alt.1 |
| ZTE | Alt.2 is preferred.  |
| NTT DOCOMO | We are fine with either one.  |

**High priority proposal 2-3-2:**

* **Apply either one of following alternatives for the type of FGs 30-4a/b/c/d/h**
	+ **Alt.1: Per band [2, 5, 9, 13, 14, 15]**
		- **Alt1-1: No differentiation for TDD/FDD and FR1/FR2 [2, 13]**
		- **Alt1-2: Differentiation for FR1/FR2 and no differentiation for TDD/FDD**
	+ **Alt.2: Per band and per BC [3, 6, 11]**
	+ **Alt.3: Per FS [6, 7, 12]**

|  |  |
| --- | --- |
| Company | Comment |
| Vivo | Alt. 2. or Alt.3. |
| Samsung | The discussion is related with the outcome of response on RAN4 LS in R1-2205715 (point 2 - CA/DC/SUL support). |
| ZTE | Alt 2 is a good middle ground.  |
| NTT DOCOMO | We can discuss this issue after determining whether to support inter-band UL CA in AI 8.8. |

**High priority proposal 2-3-3:**

* **Apply either one of following alternatives for the type of FGs 30-4e**
	+ **Alt.1: Per UE [3, 11, 15]**
		- **Alt1-1: No differentiation for TDD/FDD and FR1/FR2 [15]**
	+ **Alt.2: Per band [2, 5, 9, 13, 14]**
		- **Alt2-1: No differentiation for TDD/FDD and FR1/FR2 [2, 13]**
		- **Alt2-2: Differentiation for FR1/FR2 and no differentiation for TDD/FDD [9]**
	+ **Alt.3: Per band and per BC [6]**
	+ **Alt.4: Per FS [6, 7, 12]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt 3 or alt 4. Should be same as its prerequisite features. |
| ZTE | Alt 1. Per UE reporting is sufficient similar as Rel-15 FG 5-10 for inter-slot hopping for PUSCH.  |
| NTT DOCOMO | Per band is sufficient, unless any clear issue is mentioned. |

**High priority proposal 2-3-4:**

* **Apply either one of following alternatives for the type of FGs 30-4f**
	+ **Alt.1: Per UE [3, 11]**
	+ **Alt.2: Per band [2, 5, 9, 13, 14]**
		- **Alt2-1: No differentiation for TDD/FDD and FR1/FR2 [2, 13]**
		- **Alt2-2: Differentiation for FR1/FR2 and no differentiation for TDD/FDD [9]**
	+ **Alt.3: Per band and per BC [6]**
	+ **Alt.4: Per FS [6, 7, 12]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt 3 or alt 4. Should be same as its prerequisite features. |
| ZTE | Alt 1. Similar comment as for 30-4e.  |
| NTT DOCOMO | Per band is sufficient, unless any clear issue is mentioned. |

**High priority proposal 2-3-5:**

* **Apply either one of following alternatives for the type of FGs 30-4g**
	+ **Alt.1: Per UE [15]**
		- **Alt1-1: No differentiation for TDD/FDD and FR1/FR2 [15]**
	+ **Alt.2: Per band [2, 5, 9, 13, 14]**
		- **Alt2-1: No differentiation for TDD/FDD and FR1/FR2 [2, 13]**
		- **Alt2-2: Differentiation for FR1/FR2 and no differentiation for TDD/FDD [9]**
	+ **Alt.3: Per band and per BC [3, 6, 11]**
	+ **Alt.4: Per FS [6, 7, 12]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt 3 or alt 4. Should be same as its prerequisite features. |
| ZTE | Ok with Alt 3.  |
| NTT DOCOMO | Per band is sufficient, unless any clear issue is mentioned. |

**High priority proposal 2-3-6:**

* **Support the additional FGs of DCI format 2\_2 with DMRS bundling for PUSCH and PUCCH [2]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Not necessary, as RAN1 only concluded to have no consensus on confirming on the WA to handle group common TPC commands during the configured TDW.**Conclusion*** No consensus on confirming the following working assumption in R17.

**Working Assumption (**Made in RAN1 #107-e**)*** The action of group common TPC commands with format 2\_2 does not constitute an event that violates power consistency and phase continuity.
	+ If UE is configured to accumulate TPC commands,
		- If UE receives TPC commands that would take into effect during a configured TDW, UE accumulates TPC commands without taking effect during the current configured TDW. TPC commands take effect after the current configured TDW.
	+ If UE is not configured to accumulate TPC commands
		- the last TPC command that would take effect within a configured TDW supersedes all previous TPC commands that take effect within that configured TDW and only the last TPC command is applied by the UE after the current configured TDW.
			* FFS: no more than 1 TPC command is expected to take effect during a configured TDW.
 |
| ZTE | No need as commented by vivo.  |
| NTT DOCOMO | We should discuss how UE behaves to DCI format 2\_2 with DMRS bundling in AI 8.8 first. |

**High priority proposal 2-3-7:**

* **Apply either one of following alternatives for restarting DMRS bundling**
	+ **Alt.1: Keep only one related to restarting DMRS bundling (FG 30-4g)**
		- **Alt.1-1: Keep one component**
		- **Alt.1-2: Have two components for i) capability for restarting DMRS bundling subject to semi-static events after dynamic events within a nominal TDW and ii) capability for restarting DMRS bundling subject to dynamic events [14]**
	+ **Alt.2: Introduce two FGs for i) capability for restarting DMRS bundling subject to semi-static events after dynamic events within a nominal TDW and ii) capability for restarting DMRS bundling subject to dynamic events [14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | This depends on the discussions in agenda 8.8. Alt.1-1 is preferred by us. No RAN1 specification change is needed with this alternative adopted, i.e. as long as semi-static event happens, TDW should be restarted according to current specification. |
| Samsung | Alt.1 |
| ZTE | Better to wait for the progress in maintenance session. |
| NTT DOCOMO | We should discuss the restating DMRS bundling capability in AI 8.8 first. |

**High priority proposal 2-3-8:**

* **Update no prerequisite feature group for FGs 30-4 [2, 6, 9, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Seems fine. |
| Samsung | OK |
| ZTE | Fine |
| NTT DOCOMO | Support the proposal.  |

**High priority proposal 2-3-9:**

* **Apply either one of following alternatives for the prerequisite feature groups of FGs 30-4a**
	+ **Alt.1: FG 30-4 and FG 5-14 or 5-16 or 5-17 or 11-6 or 30-1 [2, 6]**
	+ **Alt.2: FG 30-4 and FG 5-14 or 5-16 or 5-17 [3, 9, 11, 14]**
	+ **Alt.3: FG 30-4 and FG 30-1 and FG 30-2 and FG 5-14 or 5-16 or 5-17 or 11-6 [4]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.2. |
| ZTE | Alt.2. No need to add FG 11-6 and 30-1 considering their prerequisite FGs {5-14, 5-16, 5-17} have already been included.  |
| NTT DOCOMO | Support Alt.2. We think FG 30-4a does not need to require enhanced features of PUSCH repetition type A in Rel-16 and Rel-17. |

**High priority proposal 2-3-10:**

* **Update FG 30-4 and FG 11-5 as the prerequisite feature groups of FGs 30-4b [2, 3, 4, 6, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| ZTE | Support |
| NTT DOCOMO | Support the proposal. Enhanced feature of PUSCH repetition type A (FG 30-1) is irrelevant to DMRS bundling with PUSCH repetition type B. |

**High priority proposal 2-3-11:**

* **Apply either one of following alternatives for the prerequisite feature groups of FGs 30-4c**
	+ **Alt.1: FG 30-4 and FG 30-3 or 30-3a [2]**
	+ **Alt.2: FG 30-4 and FG 30-3 [3, 4, 9, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.2. |
| ZTE | Alt.2. |
| NTT DOCOMO | Support the Alt.2. Since the prerequisite FGs of FG 30-3a should include FG30-3, all UE supporting FG 30-3a should support FG 30-3.  |

**High priority proposal 2-3-12:**

* **Apply either one of following alternatives for the prerequisite feature groups of FGs 30-4d**
	+ **Alt.1: FG 30-4 and FG 4-23 [3, 4, 6, 9, 11, 14]**
	+ **Alt.2: FG 30-4 and FG 4-23 or FG 25-2 [2]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.1. |
| ZTE | Alt.1. |
| NTT DOCOMO | Support the Alt.1. Since the prerequisite FGs of FG 25-2 should include FG 4-23, all UE supporting FG 25-2 should support FG 4-23.  |

**High priority proposal 2-3-13:**

* **Confirm FG 30-4a or 30-4b or 30-4c as the prerequisite feature groups of FGs 30-4e [2, 3, 4, 6, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| ZTE | Support |
| NTT DOCOMO | Support the proposal. |

**High priority proposal 2-3-14:**

* **Confirm FG 30-4d as the prerequisite feature group of FGs 30-4f [2, 3, 4, 6, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| ZTE | Support |
| NTT DOCOMO | Support the proposal. |

**High priority proposal 2-3-15:**

* **Apply either one of following alternatives for the prerequisite feature groups of FGs 30-4g**
	+ **Alt.1: FG 30-4 [2, 3, 6, 14]**
	+ **Alt.2: FG 30-4a or 30-4b or 30-4c or 30-4d [4]**
	+ **Alt.3: FG 30-4 and FG 30-4a or 30-4b or 30-4c or 30-4d [11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.1. |
| ZTE | Alt.1. |
| NTT DOCOMO | We are fine with any alternatives listed in the proposal. Slightly prefer Alt.1 though. |

**High priority proposal 2-3-16:**

* **Confirm FG 30-4a or 30-4b or 30-4c or 30-4d as the prerequisite feature group of FGs 30-4h [2, 3, 4, 6, 14, 15]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| ZTE | Support |
| NTT DOCOMO | Support the proposal. |

**High priority proposal 2-3-17:**

* **Update the Component description of FG 30-4a to 30-4d**
	+ **Option.1: Add “over consecutive symbols” [11]**
	+ **Option.2: Confine the description to back-to-back cases [15]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Option 2. |
| ZTE | Don’t see much need to update.  |
| NTT DOCOMO | Fine with either option. |

**High priority proposal 2-3-18:**

* **Apply either one of following alternatives for the description of “Feature group” in FG 30-4g**
	+ **Alt.1: Add “dynamic” before “event(s)” [2, 5, 15]**
	+ **Alt.2: Add “triggered by DCI or MAC CE” after “event(s)” [4, 6]**
	+ **Alt.3: Remove “after the events that violate power consistency and phase continuity” [8]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Considering some dynamic events, like the frequency hopping events is not related to this capability, we propose to update the text as “after the events triggered by DCI other than frequency hopping or by MAC-CE and that violate power consistency and phase continuity” similar to the wording used in section 6.1.7 of 38.214. |
| Samsung | Alt.3 |
| ZTE | No change or update as suggested by vivo.  |
| NTT DOCOMO | We can discuss after the discussion in high priority proposal 2-3-7. |

**High priority proposal 2-3-19:**

* **Apply either one of following alternatives for the description of “Components” in FG 30-4g**
	+ **Alt.1: Make it aligned with RRC parameter description [4, 6, 8, 15]**
	+ **Alt.2: Add “dynamic” before “events” in the description [2, 5]**
	+ **Alt.3: Modify it into “Support power consistency and phase continuity over an actual TDW created in response to events identified in 38.214 subclause 6.1.7, where such support of consistency/continuity for the event requires UE capability” [11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Considering some dynamic event, like the frequency hopping event is not related to this capability, it might be good to update the text as “after the events triggered by DCI other than frequency hopping or by MAC-CE and that violate power consistency and phase continuity” similar to the wording used in section 6.1.7 of 38.214. |
| Samsung | Alt.1 |
| ZTE | Ok with the suggestion from vivo.  |
| NTT DOCOMO | We can discuss after the discussion in high priority proposal 2-3-7. |

**High priority proposal 2-3-20:**

* **Apply either one of following alternatives for the description of “Consequence if the feature is not supported by the UE” in FG 30-4g**
	+ **Alt.1: Add “dynamic” before “events”: [2, 15]**
	+ **Alt.2: Add “triggered by DCI or MAC CE” after “event(s)” in the description [8]**
	+ **Alt.3: Modify it into “Support power consistency and phase continuity over an actual TDW created in response to events identified in 38.214 subclause 6.1.7, where such support of consistency/continuity for the event requires UE capability” [11]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Considering some dynamic event, like the frequency hopping event is not related to this capability, it might be good to update the text as “after the events triggered by DCI other than frequency hopping or by MAC-CE and that violate power consistency and phase continuity” similar to the wording used in section 6.1.7 of 38.214. |
| Samsung | Alt.2 |
| ZTE | No change or update as suggested by vivo.  |
| NTT DOCOMO | We can discuss after the discussion in high priority proposal 2-3-7. |

**High priority proposal 2-3-21:**

* **Remove the bracket in the description of “Components” of FG 30-4h [4, 6, 9, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| Samsung | OK |
| ZTE | OK |
| NTT DOCOMO | Support the proposal. |

**Low priority proposal 2-3-22:**

* **Fix the typo “consis~~i~~tency” in the description of “Components” of FG 30-4 [6, 11]**

|  |  |
| --- | --- |
| Company | Comment |
| Moderator (NTT DOCOMO, INC.) | The typo will be anyway fixed in next update and no need discussion. |

**Low priority proposal 2-3-23:**

* **Add “, respectively” at the end of the description of “Components” of FG 30-4h [4]**

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

**High priority proposal 2-3-24:**

* **Discuss following restrictions either in AI 8.8 or AI 8.16.2**
	+ **Not support DMRS bundling for FR1 inter-band UL CA [2]**
	+ **Not support the additional restriction that only one band can be configured with DMRS bundling at a time [2]**
	+ **UE does not expect SRS transmission on one carrier within a DMRS bundling on the other carrier, if DMRS bundling for DL CA with “additional” UL carrier configured with SRS only or DMRS bundling for UL Tx switching with SUL is supported [2]**

|  |  |
| --- | --- |
| Company | Comment |
| Moderator (NTT DOCOMO) | The moderator thinks this proposal should be discussed in AI 8.8 first. |
| vivo | Agree that this should be discussed in agenda 8.8 in RAN1 and related agendas in RAN4 first. |
| Samsung | Agree. Relevant RAN4 LS (R1-2205715) discussion is expected.  |
| ZTE | Agree with moderator.  |
| NTT DOCOMO | Agree with the moderator. |

## **2.4 30-5: Slot based dynamic PUCCH repetition indication**

In [1], FG 30-5 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-5 | Slot based dynamic PUCCH repetition indication | Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4 | [4-23 and/or 25-2] | Yes | N/A | UE does not support Dynamic PUCCH repetition indication | Per UE | No | No | N/A |  | Optional with capability signalling |

Following views are provided in contributions for the RAN1#110 meeting.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | We summary the prerequisite feature groups for FGs of coverage enhancement as following table.

|  |  |  |
| --- | --- | --- |
| **Index** | **Feature group** | **Prerequisite feature groups** |
| 30-5 | Slot based dynamic PUCCH repetition indication | ~~[~~4-23 ~~and/~~or 25-2~~]~~ |

 |
| [3] | ZTE | The only remaining issue for FG 30-5 is the prerequisite FG. In our view, both legacy FG 4-23 for PUCCH repetition for PUCCH format 1/3/4 or new Rel-17 FG 25-2 for PUCCH repetition for PUCCH format 0/2 are the prerequisite FG for FG 30-5. ***Proposal 6: For FG 30-5, the prerequisite FG is 4-23 or 25-2.***  |
| [4] | Intel Corporation | At the RAN1#106b-e meeting, the following agreement was made for dynamic PUCCH repetition indication [4].

|  |
| --- |
| **Agreement** Support dynamic PUCCH repetition factor indication for all PUCCH formats including format 0, 1, 2, 3, 4 with a unified mechanism as agreed in RAN1#106e under agenda 8.8.2. Note: it does not impact the discussion of slot level or sub-slot level repetition |

Based on this and considering that slot based PUCCH repetition is mainly targeted for coverage enhancement, Table 4 illustrates suggested updates for UE feature groups for dynamic PUCCH repetition factor indication. Table 4. UE feature groups for dynamic PUCCH repetition factor indication

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 30-5 | Slot based dynamic PUCCH repetition indication | Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4 | ~~[~~4-23 ~~and/~~or 25-2~~]~~ |

**Proposal 4*** For UE feature group of dynamic PUCCH repetition factor indication
	+ Consider Table 4 for UE feature group of dynamic PUCCH repetition factor indication.
 |
| [6] | China Telecom | **Proposal 4: FGs for dynamic PUCCH repetition indication.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-5 | Slot based dynamic PUCCH repetition indication | Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4 | ~~[~~4-23 and/or 25-2~~]~~ | UE does not support Dynamic PUCCH repetition indication | Per UE |  | Optional with capability signalling |

 |
| [11] | Ericsson | The following has been agreed:**Agreement (from RAN1#107)*** **Revised the component in FG 30-5 as “Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4”**
* **Add a component in FG 30-5 for support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4**
* **FG 4-23 and/or FG 25-2 are the prerequisite feature groups for FG 30-5**
* **Add FFS whether to split FG 30-5 into 2 FGs; one for PUCCH formats 0/2 and the other for PUCCH formats 1/3/4**

**Agreement (from RAN1#108)*** FG 30-5 is not split to one for PUCCH formats 1/3/4 and the other for PUCCH formats 0/2

Since both format 1/3/4 and 0/2 are agreed, the prerequisite feature groups of FG 30-5 should be 4-23 and/or 25-2. Therefore, we suggest to drop the brackets.Table 4: Capabilities for PUCCH Repetition Enhancement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Comments |
| 30-5 | Slot based dynamic PUCCH repetition indication | Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4 | ~~[~~4-23 and/or 25-2~~]~~ |  |

1. UE features for PUCCH repetition enhancement are defined according to Table 4
 |
| [14] | NTT DOCOMO, INC. | Since FG 30-5 is for both PUCCH formats 1/3/4 and 0/2, therefore the prerequisite feature groups of FG 30-5 is 4-23 and/or 25-2.**Proposal 11: FGs 4-23 and/or 25-2 are the prerequisite FGs for 30-5.** |

Based on above, following proposal should be discussed at the RAN1#110 meeting.

### **High priority proposal 2-4-1:**

* **Apply either one of following alternatives for the prerequisite feature groups for FG 30-5**
	+ **Alt.1: 4-23 or 25-2 [2, 3, 4]**
	+ **Alt.2: 4-23 and/or 25-2 [6, 11, 14]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Alt.2. according to the agreement mentioned by Ericsson. |
| ZTE | Alt.1. We are not sure what does ‘and/or’ mean. Using ‘or’ seems sufficient.  |
| NTT DOCOMO | We can live with both alternatives. |

**2.5 30-6: Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI**

In [1], FG 30-6 is captured as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | [Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI]  |  | Yes | N/A | UE does not support repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Following views are provided in contributions for the RAN1#110 meeting.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [2] | Huawei, HiSilicon | ***Proposal 7:*** *In summary, adopt the changes of the table in Appendix.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 30. NR\_cov\_enh | 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | [Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI]  |  | Yes | N/A | UE does not support repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. | Per band | ~~[~~No~~]~~ | ~~[~~No~~]~~ | ~~[~~N/A~~]~~ |  | Optional with capability signalling |

 |
| [3] | ZTE | For FG 30-6, the only remaining issue is the descriptions in the ‘Components’ column is left in square brackets, for which we see no need to update the contents.***Proposal 7: For FG 30-6, remove the square brackets in the ‘Components’ column.***  |
| [4] | Intel corporation | At the RAN1#109e meeting, it was agreed that FG 30-6 for Msg3 PUSCH repetition is defined per band [1]. Note that for Msg3 with repetition, it is supported for both PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. Based on the discussions above, Table 5 illustrates suggested update for UE feature group for Msg3 PUSCH repetition. Table 5. UE feature group for Msg3 PUSCH repetition

|  |  |  |  |
| --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | ~~[~~Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI~~]~~  |  |

**Proposal 5*** For UE feature group of Msg3 PUSCH repetition
	+ Consider Table 5 for UE feature group of Msg3 PUSCH repetition.
 |
| [6] | China Telecom | **Proposal 5: FGs Msg.3 repetition.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | ~~[~~Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI~~]~~  |  | UE does not support repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. | Per band |  | Optional with capability signalling |

 |
| [11] | Ericsson | Table 5: Capabilities for Type A PUSCH repetition for Msg3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) |
| 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | ~~[~~Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI~~]~~ |  | Per band |

1. UE features for Type A PUSCH repetition for Msg3 are defined according to Table 5
 |
| [14] | NTT DOCOMO | **Proposal 12: Remove the bracket in Components of FG 30-6.** |
| [15] | Nokia, Nokia Shanghai Bell | * **30-6:**

Confirm FG description |

Based on above, following proposal should be discussed at the RAN1#110 meeting.

**High priority proposal 2-5-1:**

* + **Remove the bracket in Components of FG 30-6 [2, 3, 4, 6, 11, 14, 15]**

|  |  |
| --- | --- |
| Company | Comment |
| vivo | Fine. |
| Samsung | OK |
| ZTE | Support |
| NTT DOCOMO | Support the proposal. |

# **Conclusions**

TBD

# **References**

[1] R1-2205608 Updated RAN1 UE features list for Rel-17 NR after RAN1 #109-e including remaining RAN1 issues Moderators (AT&T, NTT DOCOMO, INC.)

[2] R1-2205778 Rel-17 UE features for NR coverage enhancement Huawei, HiSilicon

[3] R1-2205957 Discussion on UE features for NR coverage enhancement ZTE

[4] R1-2206566 Discussion on UE features for NR coverage enhancement Intel Corporation

[5] R1-2206612 Discussion on UE features for NR coverage enhancement Xiaomi

[6] R1-2206685 Remaining issues on UE features for Rel-17 NR coverage enhancements China Telecom

[7] R1-2206767 Remaining issues on UE features for NR coverage enhancement vivo

[8] R1-2206808 UE features for NR coverage enhancement Samsung

[9] R1-2206892 Maintenance on Rel.17 UE features for NR coverage enhancement CMCC

[10] R1-2207017 Discussion on UE features for NR Coverage Enhancement MediaTek Inc.

[11] R1-2207162 UE Features for NR Coverage Enhancement Ericsson

[12] R1-2207211 UE features for NR coverage enhancement Qualcomm Incorporated

[13] R1-2207316 On Rel-17 NR coverage enhancement UE Features Apple

[14] R1-2207389 Discussion on remaining issues in RAN1 UE features for NR coverage enhancement NTT DOCOMO, INC.

[15] R1-2207582 On UE features for NR coverage enhancement Nokia, Nokia Shanghai Bell