**3GPP TSG RAN WG1 #107b-e R1-22xxxxx**

**e-Meeting, January 17th – 25th, 2022**

**Agenda Item: 8.8.1.3**

**Source: Moderator (China Telecom)**

**Title: [107bis-e-R17-CovEnh-03] Email discussion regarding joint channel estimation for PUSCH**

**Document for: Discussion**

1. Introduction

In RAN #90 e-meeting, a new Rel-17 work item on NR coverage enhancements was approved [1] and was revised in [2]. The objective of this work item is to specify enhancements for PUSCH, PUCCH and Msg3 PUSCH for both FR1 and FR2 as well as TDD and FDD.

The detailed objectives are as follows.

* *Specification of PUSCH enhancements [RAN1, RAN4]*
	+ *Specify the following mechanisms for enhancements on PUSCH repetition type A [RAN1]*
		- *Increasing the maximum number of repetitions up to a number to be determined during the course of the work.*
		- *The number of repetitions counted on the basis of available UL slots.*
	+ *Specify mechanism(s) to support TB processing over multi-slot PUSCH [RAN1]*
		- *TBS determined based on multiple slots and transmitted over multiple slots.*
	+ *Specify mechanism(s) to enable joint channel estimation [RAN1, RAN4]*
		- *Mechanism(s) to enable joint channel estimation over multiple PUSCH transmissions, based on the conditions to keep power consistency and phase continuity to be investigated and specified if necessary by RAN4 [RAN1, RAN4]*
			* *Potential optimization of DMRS location/granularity in time domain is not precluded*
		- *Inter-slot frequency hopping with inter-slot bundling to enable joint channel estimation [RAN1]*
* *Specification of PUCCH enhancements [RAN1, RAN4]*
	+ *Specify signaling mechanism to support dynamic PUCCH repetition factor indication [RAN1]*
	+ *Specify mechanism to support DMRS bundling across PUCCH repetitions [RAN1, RAN4]*
		- *When applicable, based on similar mechanism(s) for enabling joint channel estimation for PUSCH*
* *Specify mechanism(s) to support Type A PUSCH repetitions for Msg3 [RAN1, RAN2]*

Editors’ CRs on introduction of coverage enhancements in NR have been approved in RAN#94e [3]. This contribution is a summary of the following email discussion.

[107bis-e-R17-CovEnh-03] Email discussion regarding joint channel estimation for PUSCH – Jianchi (China Telecom)

* 1st check point: January 20
* Final check point: January 25
1. Background

## 2.1 Use cases for joint channel estimation

RAN1 has identified the potential use cases for joint channel estimation for PUSCH.

* Use case 1: back-to-back PUSCH transmissions within one slot.
* Use case 2: non-back-to-back PUSCH transmissions within one slot.
	+ Use case 2a: no uplink transmission in the middle of two PUSCH transmissions
	+ Use case 2b: other uplink transmissions in the middle of two PUSCH transmissions
* Use case 3: back-to-back PUSCH transmissions across consecutive slots.
* Use case 4: non-back-to-back PUSCH transmissions across consecutive slots.
	+ Use case 4a: no uplink transmission in the middle of two PUSCH transmissions
	+ Use case 4b: other uplink transmissions in the middle of two PUSCH transmissions
* Use case 5: PUSCH transmissions across non-consecutive slots.
	+ Use case 5a: no uplink transmission in the middle of two PUSCH transmissions
	+ Use case 5b: other uplink transmissions in the middle of two PUSCH transmissions

Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions.

Note: intervening “other uplink transmissions” can be either on the same component carrier or a different component carrier.

In the past RAN1 meetings, it was discussed whether joint channel estimation can be applied to the above uses cases. In addition, during online discussion of RAN1 #106-e meeting, according to the guidance from Chair there would be no further discussion for transmissions with different TBs. Based on the discussion and agreements, the situation is summarized in the following table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Use cases | Repetition type A for the same TB | Repetition type B for the same TB | Transmissions with different TBs | TBoMS |
| 1: B2B PUSCH transmission within one slot | / | Support | Not support | / |
| 2: Non-B2B PUSCH transmission within one slot | / | Not support | Not support | / |
| 3: B2B PUSCH transmissions across consecutive slots | Support | Support | **No further discussion** | Support |
| 4: Non-B2B PUSCH transmissions across consecutive slots | Support(4a) | Support(4a) | **No further discussion** | Support(4a) |
| Not support (4b) | Not support (4b) | Not support (4b) |
| 5: PUSCH transmissions across non-consecutive slots | Not support | Not support | Not support | Not support |

## 2.2 The maximum duration

In the LS [4] and agreed way forward [6] in RAN4, RAN4 provided answers to the related questions about the maximum duration.

|  |  |
| --- | --- |
| **RAN1’s questions** | **RAN4’s answers** |
| For joint channel estimation, is there a maximum duration during which UE is able to maintain power consistency and phase continuity under certain tolerance level? If any, how long is it? | Yes, there is a maximum duration but RAN4 has not agreed how many slots it is [4].Depend on the outcome of “What factors determine the maximum duration”. Note: The number of slots for maximum duration means the consecutive slots. In case of non-scheduled gap and/or other channel transmission, the duration of the non-scheduled gap and/or other channel should be counted [6]. |
| What factors determine the maximum duration? | RAN4 has agreed that TA adjustment should be avoided across the PUSCH/PUCCH transmissions (i.e., from start of first transmission until the end of last transmission) for joint channel estimation. RAN4 is still investigating other factors impact in more detail [4].Phase and power tolerance within the duration [6]. |
| Whether the maximum duration should be the same for different cases for both PUSCH and PUCCH? | Yes [4]. |
| Whether the maximum duration is dependent on the modulation order of transmission, e.g., QPSK, 16QAM, 64QAM? | Considering the scenario of coverage extension, RAN4 recommends to only focus on modulation orders not higher than QPSK, i.e., focus on QPSK (PUCCH and PUSCH), Pi/2 BPSK (PUCCH and PUSCH), BPSK (PUCCH). RAN4 is still discussing whether maximum duration depends on modulation order for the above modulation schemes [4].No. Note: It has been agreed to only focus on the modulation orders not higher than QPSK [6]. |
| Whether the maximum duration is dependent on UL waveform (DFT-s-OFDM vs. OFDM)? | No [4]. |
| Whether the maximum duration is band specific? | The length of maximum duration is [6]:* Option 1: Band specific
* Option 2: FR specific
 |
| Besides the factors listed above, whether or not the maximum duration is further dependent on UE capabilities (e.g., multiple possible values for a given set of factor(s)), and if so, whether the UE should report such a duration. | Still under discussion in RAN4 [4].Down select among the following options once we have the results of the simulations [6]:* Option 1: Subject to a single maximum duration value.
	+ The value is defined for a given set of factors which are depends on the conclusion for the other issues under discussion.
* Option 2: Subject to multiple maximum duration value and UE could report the supported value(s).
 |

Based on LS [5], the length(s) of maximum duration is still being analyzed in RAN4. RAN4 is studying the impact of enabling up to 32 slots. Other numbers beyond 32 slots are not analyzed in RAN4. RAN4 is still discussing whether the max duration would be best defined per-FR or per-band.

1. Summary of contributions in RAN1#107bis-e

## 3.1 Time domain window

#### Issue #1: The start of configured TDW for CG PUSCH

For CG PUSCH, companies (**Huawei, HiSilicon, NTT DOCOMO, Spreadtrum**) observe that since the initial transmission for CG-PUSCH could be any transmission occasions associated with RV=0 if startingFromRV0 is set to ‘on’ and RV sequence is {0,0,0,0} or {0,3,0,3}, the start of the first configured TDW also could be any transmission occasions associated with RV=0. gNB might end up with false alarm or miss detection of the actual initial transmission. A misalignment issue of configured TDWs between gNB and UE may be occurred if the scheme of TDW determination for dynamic grant is reused.



The following solution is proposed to solve the above problem by companies:

* For CG PUSCH, to avoid any misalignment of configured TDW between a gNB and UEs, the first configured TDWs should always start from the first physical slot of a CG period.



Companies’ TPs are summarized as follows:

**NTT DOCOMO** proposes to adopt the following TP:

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| **-------------------------- Start of Text Proposal for TS 38.214---------------------------****<Unchanged parts omitted>****6.1.7 UE procedure for determining time domain windows for bundling DM-RS**For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:- For PUSCH transmissions of repetition Type A, PUSCH repetition Type B and TB processing over multiple slots, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:- Given by *PUSCH-TimeDomainWindowLength*, if configured.- Computed as min ([maxDMRS-BundlingDuration], *M*), if *PUSCH-TimeDomainWindowLength* is not configured, where *M* is the time duration in consecutive slots of $N∙K$ PUSCH transmissions, and where:- For PUSCH transmissions of PUSCH repetition Type A, *N*=1 and *K* is the number of repetitions, as defined in Clause 6.1.2.1.- For PUSCH transmissions of PUSCH repetition Type B, *N*=1 and *K* is the number of nominal repetitions, as defined in Clause 6.1.2.1.- For PUSCH transmissions of TB processing over multiple slots, *N* isthe number of slots used for TBS determination and *K* is the number of repetitions of the number of slots *N* used for TBS determination, as defined in Clause 6.1.2.1.- For PUCCH transmissions of PUCCH repetition, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:- Given by *PUCCH-TimeDomainWindowLength*, if configured.- Computed as min ([maxDMRS-BundlingDuration], *M*), if *PUCCH-TimeDomainWindowLength* is not configured, where *M* is the time duration in consecutive slots from the first slot determined for PUCCH transmissions of PUCCH repetition to the last slot determined for PUCCH transmissions of PUCCH repetition according to clause 9.2.6 of [6, TS 38.213].- For PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 ~~and PUSCH repetition Type A with a configured grant~~, when *AvailableSlotCounting* is enabled, and for TB processing over multiple slots:- The start of the first nominal TDW is the first slot determined for the first PUSCH transmission.- The end of the last nominal TDW is the last slot determined for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot determined for PUSCH transmission after the last slot determined for PUSCH transmission of a previous nominal TDW.- For PUSCH transmissions of a PUSCH repetition Type A with a configured grant, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B:- The start of the first nominal TDW is the first slot for the first PUSCH transmission occasion.- The end of the last nominal TDW is the last slot for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.- For PUSCH transmissions of ~~a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2 and~~ PUSCH repetition Type A with a configured grant, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B:- The start of the first nominal TDW is the first slot for the first PUSCH transmission.- The end of the last nominal TDW is the last slot for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.- For PUSCH transmissions of a PUSCH repetition Type A with a configured grant, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B:- The start of the first nominal TDW is the first slot for the first PUSCH transmission occasion.- The end of the last nominal TDW is the last slot for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.- For PUCCH transmissions of a PUCCH repetition:- The start of the first nominal TDW is the first slot determined for the first PUCCH transmission.- The end of the last nominal TDW is the last slot determined for the last PUCCH transmission.- The start of any other nominal TDWs is the first slot determined for PUCCH transmission after the last slot determined for PUCCH transmission of a previous nominal TDW.**<Unchanged parts omitted>****-------------------------- End of Text Proposal for TS 38.214 --------------------------** |

**Spreadtrum** proposes to adopt the following TP (TS 38.214):

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| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**< Unchanged part is omitted >- For PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, when *AvailableSlotCounting* is enabled, and for TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2:- The start of the first nominal TDW is the first slot determined for the first PUSCH transmission.- The end of the last nominal TDW is the last slot determined for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot determined for PUSCH transmission after the last slot determined for PUSCH transmission of a previous nominal TDW.- For PUSCH transmissions of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B scheduled by DCI format 0\_1 or 0\_2:- The start of the first nominal TDW is the first slot for the first PUSCH transmission.- The end of the last nominal TDW is the last slot for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.- For PUSCH transmission of a PUSCH repetition Type A with a configured grant, PUSCH transmission of a PUSCH repetition Type B with a configured grant and for TB processing over multiple slots with a configured grant:- The start of the first nominal TDW is the first transmission occasion in Clause 6.1.2.3.1, Clause 6.1.2.3.2 and Clause 6.1.2.3.3.- The end of the last nominal TDW is the last slot determined for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot determined for PUSCH transmission after the last slot determined for PUSCH transmission of a previous nominal TDW.< Unchanged part is omitted > |

#### Issue #2: Candidate values of the window length *L* of the configured TDW

In RAN1 #107e, the following agreement was achieved for the candidate values of the window length *L* of the configured TDW.

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| **Agreement:*** The candidate values of the window length *L* of the configured TDW can be any integer value that is larger than 1 and no larger than the maximum duration.
 |

**vivo** proposes the time domain window length configured by *PUSCH-TimeDomainWindowLength* should support 1 slot and not exceed 32 slots.

**Nokia** proposes to introduce only two candidate values for *L*, one candidate value is equal to the maximum duration and the other candidate value is FFS.

#### Issue #3: Events that violate power consistency and phase continuity

##### Issue #3-1: Events for multi-TRP operations

In RAN1 #107e, the following agreement was achieved that UL beam switching for multi-TRP operation constitutes an event if DMRS bundling and UL beam switching for multi-TRP operation are configured simultaneously.

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| **Agreement:*** If DMRS bundling and UL beam switching for multi-TRP operation are configured simultaneously, UL beam switching for multi-TRP operation constitutes an event that violates power consistency and phase continuity.
	+ FFS: UL beam switching for multi-TRP operation is regarded as a semi-static event.
 |

Companies (**Samsung, xiaomi, CMCC, Intel**) think UL beam switching is as a semi-static event, the main reason is that it can be known prior to the first PUSCH transmission, similar to frequency hopping. While companies (**ZTE, Panasonic**) think since we have agreed that an event is regarded as a dynamic event if it is triggered by a DCI or MAC CE, UL beam switching in multi-TRP operation should be regarded as a dynamic event. **Interdigital** thinks the event type for UL beam switching depends on whether it is configured by RRC or indicated by DCI, if it is configured by RRC then it is regarded as a semi-static event; else if it is indicated by DCI, then it is regarded as a dynamic event.

**vivo** proposes that PUCCH repetitions with different sets of power control parameters in multi-TRP operation should be regarded as an event and adopt the following TP.

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| ----------------------------------Start of TP#1 for section 9.2.6 of 38.214 V17.0.0----------------------------------**6.1.7 UE procedure for determining time domain windows for bundling DM-RS**For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:<<unchanged text omitted>>Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:- A downlink slot or downlink reception or downlink monitoring based on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* for unpaired spectrum.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, does not exceed 13 symbols but other uplink transmissions are scheduled between the two consecutive PUSCH transmissions or the two consecutive PUCCH transmissions.- For PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B or TB processing over multiple slots, a dropping or cancellation of a PUSCH transmission according to clause 9, clause 11.1 and clause 11.2A of [6, TS 38.213].- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9.2.6 and clause 11.1 of [6, TS 38.213].- For any two consecutive PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, and when two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' or 'noncodebook', a different SRS resource set association is used for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, according to Clause 6.1.2.1.- For any two consecutive PUCCH transmissions of PUCCH repetition, and when a PUCCH resource used for repetitions of a PUCCH transmission by a UE includes first and second spatial relations, or first and second sets of power control parameters, as described in [TS 38.321] and in clause 7.2.1 of [TS 38.213], different spatial relations or different power control parameters, are used for the two PUCCH transmissions of PUCCH repetition, according to Clause 9.2.6 of [6, TS 38.213]. - Uplink timing adjustment in response to a timing advance command according to clause 4.2 of [6, TS 38.213].- Frequency hopping.<<unchanged text omitted>>----------------------------------End of TP#1 for section 7.1.1 of 38.213 V17.0.0---------------------------------- |

##### Issue #3-2: Dynamic & semi-static events

**China Telecom** observes that according to the current specification, when *PUSCH-Window-Restart* or *PUCCH-Window-Restart* is enabled, a new actual TDW is created within the nominal TDW, it seems “UE is mandatory to support restarting DM-RS bundling due to semi-static events” has not been captured into the specification. Moreover, for UE not capable of restarting DM-RS bundling, when *PUSCH-Window-Restart* or *PUCCH-Window-Restart* is enabled, it is not clear whether a new actual TDW is created for the following two cases:

* Case 1: A semi-static event is triggered after one or multiple dynamic events. Whether a new actual TDW is created after the semi-static event?
* Case 2: A semi-static event overlaps with a dynamic event. Whether a new actual TDW is created after the semi-static event?

 

Fig. Illustration of case 1 Fig. Illustration of case 2

To solve the above problem, **China Telecom** has the following proposals:

* A new actual TDW is created after a semi-static event no matter whether there are dynamic events before the semi-static event.
* A new actual TDW is created after a semi-static event in case the semi-static event overlaps with a dynamic event.

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Fig. Illustration of Solution 1 Fig. Illustration of Solution 2

**China Telecom** proposes to adopt the following TP to capture the agreement ‘UE is mandatory to support restarting DM-RS bundling due to semi-static events’ into the specification (TS 38.214):

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| - A new actual TDW is created when *PUSCH-Window-Restart* is enabled or in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The start of a new actual TDW is the first symbol of the PUSCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, and the PUSCH transmission is in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots.- A new actual TDW is created when *PUCCH-Window-Restart* is enabled or in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The start of a new actual TDW is the first symbol of the PUCCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUCCH transmissions of PUCCH repetition within the nominal TDW, and the PUCCH transmission is in a slot determined for transmission of the PUCCH. |

**vivo** proposes that for PUSCH repetition type B, gap with more than 13 OFDM symbols created by invalid symbol pattern is considered as a semi-static event.

##### Issue #3-3: Dropping/Collision rules

**LG** proposes to treat dropping/cancellation based on Rel-17 collision rules as an event.

**Intel** proposes to adopt the following TP to add the case when PUCCH repetition with low priority is dropped when overlapping with PUSCH transmission with high priority, which is defined in Clause 9 in TS38.213, as an event:

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| === Start of text proposal for 38.214 Subclause **6.1.7** ===Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:- A downlink slot or downlink reception or downlink monitoring based on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* for unpaired spectrum.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, does not exceed 13 symbols but other uplink transmissions are scheduled between the two consecutive PUSCH transmissions or the two consecutive PUCCH transmissions.- For PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B or TB processing over multiple slots, a dropping or cancellation of a PUSCH transmission according to clause 9, clause 11.1 and clause 11.2A of [6, TS 38.213].- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9, clause 9.2.6 and clause 11.1 of [6, TS 38.213].- For any two consecutive PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, and when two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook’ or ‘noncodebook’, a different SRS resource set association is used for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, according to Clause 6.1.2.1.- For any two consecutive PUCCH transmissions of PUCCH repetition, and when a PUCCH resource used for repetitions of a PUCCH transmission by a UE includes first and second spatial relations, different spatial relations are used for the two PUCCH transmissions of PUCCH repetition, according to Clause 9.2.6 of [6, TS 38.213]. - Uplink timing adjustment in response to a timing advance command according to clause 4.2 of [6, TS 38.213].- Frequency hopping.=== end of text proposal for 38.214 Subclause **6.1.7** === |

##### Issue #3-4: HD-FDD RedCap UE related issues

**Huawei** proposes that for HD-FDD RedCap UEs, an event is constituted if the scheduled UL symbols overlap with any symbol of an SS/PBCH block provided by *ssb-PositionInBurst*.

**Spreadtrum** proposes that a downlink reception or downlink monitoring based on higher layer singling or DCI format is regarded as an event and adopt the following TP (TS 38.214):

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| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**< Unchanged part is omitted >Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:< Unchanged part is omitted >- For PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B or TB processing over multiple slots, a dropping or cancellation of a PUSCH transmission according to clause 9, clause 11.1, clause 11.2A and clause 17.2 of [6, TS 38.213].- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9.2.6, clause 11.1 and clause 17.2 of [6, TS 38.213].< Unchanged part is omitted > |

##### Issue #3-5: Clarifications on the events

**vivo**: For extended CP case, support to define 11 symbols as the maximum gap length to maintain the power consistency and phase continuity.

**Ericsson**: Revise ‘Frequency hopping’ in the list of events in 38.214 to ‘Change in starting RB for inter-slot frequency hopping’.

**LG**: Other UL transmission in between PUSCH/PUCCH transmission is an event only on the same carrier.

## 3.2 TPC command

#### Issue #4: TPC command

In RAN1 #107e, the following working assumption was achieved for TPC commands.

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| **Working assumption:*** 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.
 |

The majority companies (**NTT DOCOMO, Samsung, Huawei, HiSilicon, vivo, ZTE, Apple, CMCC, Nokia, NSB, LG, xiaomi, InterDigital**) support to confirm the WA. While **Intel** proposes to drop the whole WA and proposes the action of group common TPC commands to be considered as an event for DMRS bundling. **Ericsson** mentioned that absolute TPC is not supported for DCI format 2\_2 and proposes to remove the the second bullet.

Companies’ further views on the above WA are summarized as follows:

* Remove the FFS bullet.
	+ **Support**: NTT DOCOMO, Huawei, HiSilicon, vivo, CMCC, xiaomi, InterDigital
	+ **Not Support**: LG
* No redefinition of transmission occasion for PUSCH/PUCCH in Rel-17.
	+ **Support**: Nokia, NSB, Apple, LG, Huawei, HiSilicon, Qualcomm, Ericsson
* Replace all the “configured TDW” to “actual TDW”.
	+ **Support**: Huawei, HiSilicon
* Replace the FFS bullet with “No TPC command is expected to take effect during a configured TDW.”
	+ **Support**: ZTE

**Sharp** has the following proposal:

Proposal: One of the following two alternatives should be specified for accumulation of TPC commands for DCI format 2\_2:

* Alt 1: The transmission occasion for TPC command includes repetitions over the configured TDW.
* Alt 2: Reuse the legacy transmission occasion (e.g., the new variable value for accumulation of TPC commands is introduced).

**CMCC** proposes the following modification:

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| **Working assumption:*** 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
		- T~~t~~he 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.~~
 |

**Qualcomm** proposes to capture the agreement on deferring TPC updates to the end of nominal TDWs using the following TP in 38.213, Section 7.1.1:

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| If the UE is provided *PUSCH-DMRS-Bundling* = ‘enabled’, and transmission occasion $i$ is not the last transmission occasion within a nominal time domain window, then any TPC command values received via DCI format 2\_2 contained in the set $D\_{i}$ are deleted and added to the set $D\_{j}$ where $j$ is a transmission occasion occurring after the end of the nominal time domain window. |

**Ericsson** proposes to adopt the following TP in 38.213 for accumulated TPC operation:

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| If the UE is provided *PUSCH-DMRS-Bundling* = ‘enabled’, and for processing TPC command values provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI, if a transmission occasion $i$ occurs within a nominal time domain window determined as described in [6, TS 38.214], then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}(i\_{1},l)$, where transmission occasion $i\_{1}$ is a first transmission occasion within the nominal time domain window. For a first transmission occasion $i\_{2}$ after the transmission nominal time domain window,$f\_{b,f,c}\left(i\_{2},l\right)=f\_{b,f,c}\left(i\_{1},l\right)+\sum\_{i=i\_{1}+1}^{i\_{2}}\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$, with $C\left(D\_{i}\right)$ as defined above. |

**Intel** proposes to adopt the following TP:

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| === Start of text proposal for 38.214 Subclause 6.1.7 ===Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:- A downlink slot or downlink reception or downlink monitoring based on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* for unpaired spectrum.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols.- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, does not exceed 13 symbols but other uplink transmissions are scheduled between the two consecutive PUSCH transmissions or the two consecutive PUCCH transmissions.- For PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B or TB processing over multiple slots, a dropping or cancellation of a PUSCH transmission according to clause 9, clause 11.1 and clause 11.2A of [6, TS 38.213].- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9.2.6 and clause 11.1 of [6, TS 38.213].- For any two consecutive PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, and when two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook’ or ‘noncodebook’, a different SRS resource set association is used for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, according to Clause 6.1.2.1.- For any two consecutive PUCCH transmissions of PUCCH repetition, and when a PUCCH resource used for repetitions of a PUCCH transmission by a UE includes first and second spatial relations, different spatial relations are used for the two PUCCH transmissions of PUCCH repetition, according to Clause 9.2.6 of [6, TS 38.213]. - Uplink timing adjustment in response to a timing advance command according to clause 4.2 of [6, TS 38.213].- Transmit power adjustment in response to a TPC command in DCI format 2\_2 according to Clause 7.1 and 7.2 of [6, TS 38.213].- Frequency hopping.=== end of text proposal for 38.214 Subclause 6.1.7 === |

**Samsung** proposes to adopt the following TP:

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| [7.1.1, TS 38.213]-  is the PUSCH power control adjustment state  for active UL BWP  of carrier  of serving cell  and PUSCH transmission occasion  if the UE is not provided *tpc-Accumulation*, where - The  values are given in Table 7.1.1-1-  is a sum of TPC command values in a set  of TPC command values with cardinality  that the UE receives between  symbols before PUSCH transmission occasion  and  symbols before PUSCH transmission occasion  on active UL BWP  of carrier  of serving cell  for PUSCH power control adjustment state , where  is the smallest integer for which  symbols before PUSCH transmission occasion  is earlier than  symbols before PUSCH transmission occasion - If the UE is provided PUSCH-DMRS-bundling = ‘enable’, and for processing TPC command values provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI, transmission occasion i is a first transmission occasion in a nominal time window [6, TS 38.214], transmission occasion i-i0 is a first transmission occasion in the preceding nominal time domain window, if any, and fb, f, c (i, l ) is same for all transmission occasions in the nominal time domain window.…-  is the PUSCH power control adjustment state for active UL BWP  of carrier  of serving cell  and PUSCH transmission occasion  if the UE is provided tpc-Accumulation, where -  absolute values are given in Table 7.1.1-1. If the UE is provided PUSCH-DMRS-bundling = ‘enable’, and for processing TPC command values provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI, transmission occasion i is a first transmission occasion in a nominal time window [6, TS 38.214], transmission occasion i-i0 is a first transmission occasion in the preceding nominal time domain window, if any, and fb, f, c (i, l ) is same for all transmission occasions in the nominal time domain window. |

**Huawei** proposes to adopt the following TP1 (TS 38.213)**:**

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| **7.1.1 UE behaviour**< Unchanged parts are omitted >-  is the PUSCH power control adjustment state  for active UL BWP  of carrier  of serving cell  and PUSCH transmission occasion  if the UE is not provided *tpc-Accumulation*, where - The  values are given in Table 7.1.1-1-  is a sum of TPC command values in a set  of TPC command values with cardinality  that the UE receives between  symbols before PUSCH transmission occasion  and  symbols before PUSCH transmission occasion  on active UL BWP  of carrier  of serving cell  for PUSCH power control adjustment state , where  is the smallest integer for which  symbols before PUSCH transmission occasion  is earlier than  symbols before PUSCH transmission occasion * If the UE is provided *PUSCH-DMRS-Bundling* =‘enabled’, and for processing TPC command values provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI,
* $f\_{b,f,c}^{'}\left(i,l\right)=f\_{b,f,c}^{'}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}\left(m,l\right)$, where $f\_{b,f,c}^{'}\left(0,l\right)$=$f\_{b,f,c}\left(0,l\right)$
* If the transmission occasion $i$ is the first transmission occasion within an actual time domain window determined as described in[6, TS 38.214], or if the transmission occasion $i$ is a transmission occasion that is not within an actual time domain window, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}^{'}\left(i,l\right)$, otherwise $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}^{'}\left(i\_{1},l\right)$ where the transmission occasion $i\_{1}$ is the first transmission occasion within the same actual time domain window as the transmission occasion $i$.

< Unchanged parts are omitted > |

**Huawei** proposes to adopt the following TP2 (TS 38.213)**:**

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| **7.1.1 UE behaviour**< Unchanged parts are omitted >-  is the PUSCH power control adjustment state for active UL BWP  of carrier  of serving cell  and PUSCH transmission occasion  if the UE is provided *tpc-Accumulation*, where-  absolute values are given in Table 7.1.1-1* If the UE is provided *PUSCH-DMRS-Bundling* =‘enabled’, and for processing TPC command values provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI,
* $f\_{b,f,c}^{'}\left(i,l\right)=δ\_{PUSCH,b,f,c}\left(i,l\right)$, where $f\_{b,f,c}^{'}\left(0,l\right) $=$ f\_{b,f,c}\left(0,l\right)$
* If the transmission occasion $i$ is the first transmission occasion within an actual time domain window determined as described in[6, TS 38.214], or if the transmission occasion $i$ is a transmission occasion that is not within an actual time domain window, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}^{'}\left(i,l\right)$, otherwise $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}^{'}\left(i\_{1},l\right)$ where the transmission occasion $i\_{1}$ is the first transmission occasion within the same actual time domain window as the transmission occasion $i$.

< Unchanged parts are omitted > |

**vivo** proposes to adopt the following TP1**:**

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| ----------------------------------Start of TP#1 for section 7.1.1 of 38.213 V17.0.0----------------------------------**7.1.1 UE behaviour**If a UE transmits a PUSCH on active UL BWP $b$ of carrier $f$ of serving cell $c$ using parameter set configuration with index $j$ and PUSCH power control adjustment state with index $l$, the UE determines the PUSCH transmission power $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ in PUSCH transmission occasion $i$ as [dBm]where,- $P\_{CMAX,f,c}(i)$is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS38.101-3] for carrier $f$ of serving cell $c$ in PUSCH transmission occasion $i$.<<unchanged text omitted>>- $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is the PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion $i$ if the UE is not provided *tpc-Accumulation*, where - The $δ\_{PUSCH,b,f,c}$ values are given in Table 7.1.1-1- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{0}$ and $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{0}>0$ is the smallest integer for which $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$- If the UE is provided PUSCH-DMRS-Bundling = ‘enabled’, - for a transmission occasion $i$ occurs within a nominal time domain window determined as described in [6, TS 38.214], $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}(i\_{1},l)$, where transmission occasion $i\_{1}$ is a first transmission occasion within the nominal time domain window; - for the first transmission occasion $i$ occurs after the nominal time domain window, $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i\_{1},l\right)+δ\_{accuTDW}$, where $δ\_{accuTDW}$ is the accumulation of the TPC command values that would take effect in the nominal time domain window.- If a PUSCH transmission is scheduled by a DCI format, $K\_{PUSCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUSCH transmission - If a PUSCH transmission is configured by *ConfiguredGrantConfig*, $K\_{PUSCH}(i)$ is a number of $K\_{PUSCH,min}$ symbols equal to the product of a number of symbols per slot, $N\_{symb}^{slot}$, and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP $b$ of carrier $f$ of serving cell $c$- If the UE has reached maximum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\geq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- If UE has reached minimum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\leq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- A UE resets accumulation of a PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ to $f\_{b,f,c}\left(k,l\right)=0, k=0,1,…,i$- If a configuration for a corresponding $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value is provided by higher layers- If a configuration for a corresponding $α\_{b,f,c}\left(j\right)$ value is provided by higher layerswhere $l$ is determined from the value of $j$ as - If $j>1$ and the UE is provided higher *SRI-PUSCH-PowerControl*, $l$ is the *sri-PUSCH-ClosedLoopIndex* value(s) configured in any *SRI-PUSCH-PowerControl* with the *sri-P0-PUSCH-AlphaSetId* value corresponding to $j$ - If $j>1$ and the UE is not provided *SRI-PUSCH-PowerControl* or $j=0$, $l=0$- If $j=1$, $l$ is provided by the value of *powerControlLoopToUse*- $f\_{b,f,c}\left(i,l\right)=δ\_{PUSCH,b,f,c}\left(i,l\right)$ is the PUSCH power control adjustment state for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion  if the UE is provided *tpc-Accumulation*, where- $δ\_{PUSCH,b,f,c}$ absolute values are given in Table 7.1.1-1- If the UE is provided PUSCH-DMRS-Bundling = ‘enabled’, - for a transmission occasion $i$ occurs within a nominal time domain window determined as described in [6, TS 38.214], then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}(i\_{1},l)$, where transmission occasion $i\_{1}$ is a first transmission occasion within the nominal time domain window, - for the first transmission occasion $i$ occurs after the nominal time domain window, $f\_{b,f,c}\left(i,l\right)=δ\_{PUSCH,b,f,c}(i\_{2},l)$, where $δ\_{PUSCH,b,f,c}\left(i\_{2},l\right)$ is the last TPC command value that would take effect in the nominal time domain window.If the UE transmits a PUSCH associated with the first RS resource index $q\_{d}$, the UE applies the first $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value, the first $α\_{b,f,c}\left(j\right)$ value, and $f\_{b,f,c}\left(i,l\right)$ for determining $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$. If the UE transmits a PUSCH associated with the second RS resource index $q\_{d}$, the UE applies the second $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value, the second $α\_{b,f,c}\left(j\right)$ value, and $f\_{b,f,c}\left(i,l\right)$ or $f\_{b,f,c}\left(i,0\right)$ if *twoPUSCH-PC-AdjustmentStates* is provided or not provided, respectively, for determining $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$.<<unchanged text omitted>>----------------------------------End of TP#1 for section 7.1.1 of 38.213 V17.0.0---------------------------------- |

**vivo** proposes to adopt the following TP2**:**

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| ------------------------------------------------Start of TP#2 for section 7.2.1 of 38.213 V17.0.0----------------------------------**7.2.1 UE behaviour**If a UE transmits a PUCCH on active UL BWP $b$ of carrier $f$ in the primary cell $c$ using PUCCH power control adjustment state with index $l$, the UE determines the PUCCH transmission power $P\_{PUCCH,b,f,c}(i,q\_{u},q\_{d},l)$ in PUCCH transmission occasion $i$ as [dBm]where - $P\_{CMAX,f,c}(i)$ is the UE configured maximum output power defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS38.101-3] for carrier $f$ of primary cell $c$ in PUCCH transmission occasion $i$<<unchanged text omitted>>- $g\_{b,f,c}\left(i,l\right)=g\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is the current PUCCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of primary cell $c$ and PUCCH transmission occasion $i$, where - The $δ\_{PUCCH,b,f,c}$ values are given in Table 7.1.2-1- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $C\_{i}$ of TPC command values with cardinality $C\left(C\_{i}\right)$ that the UE receives between $K\_{PUCCH}\left(i-i\_{0}\right)-1$ symbols before PUCCH transmission occasion $i-i\_{0}$ and  symbols before PUCCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of primary cell $c$ for PUCCH power control adjustment state, where $i\_{0}>0$ is the smallest integer for which $K\_{PUCCH}\left(i-i\_{0}\right)$ symbols before PUCCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$- If the UE is provided PUCCH-DMRS-Bundling = ‘enabled’, - for a transmission occasion $i$ occurs within a nominal time domain window determined as described in [6, TS 38.214], $g\_{b,f,c}\left(i,l\right)=g\_{b,f,c}(i\_{1},l)$, where transmission occasion $i\_{1}$ is a first transmission occasion within the nominal time domain window; - for the first transmission occasion $i$ occurs after the nominal time domain window, $g\_{b,f,c}\left(i,l\right)=g\_{b,f,c}\left(i\_{1},l\right)+δ\_{accuTDW}$, where $δ\_{accuTDW}$ is the accumulation of the TPC command values that would take effect in the nominal time domain window.- If the PUCCH transmission is in response to a detection by the UE of a DCI format, $K\_{PUCCH}\left(i\right)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of primary cell $c$ after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUCCH transmission<<unchanged text omitted>>------------------------------------------------End of TP#2 for section 7.2.1 of 38.213 V17.0.0---------------------------------- |

**OPPO** proposes to adopt the following TP (TS 38.213)**:**

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| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Start of the TP\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***7.1 Physical uplink shared channel**<text omitted>$f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is the PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion $i$ if the UE is not provided *tpc-Accumulation*, where - The $δ\_{PUSCH,b,f,c}$ values are given in Table 7.1.1-1- For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, when PUSCH-DMRS-Bundling is enabled, if TPC command is received in DCI format 2\_2 and the TPC command would take into effect during a nominal TDW, as defined in clause 6.1.7 of [6, TS 38.214], the TPC commands is not applied during the nominal TDW and would be applied after the nominal TDW.- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{0}$ and $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{0}>0$ is the smallest integer for which $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$- If a PUSCH transmission is scheduled by a DCI format, $K\_{PUSCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUSCH transmission - If a PUSCH transmission is configured by *ConfiguredGrantConfig*, $K\_{PUSCH}(i)$ is a number of $K\_{PUSCH,min}$ symbols equal to the product of a number of symbols per slot, $N\_{symb}^{slot}$, and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP $b$ of carrier $f$ of serving cell $c$- If the UE has reached maximum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\geq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- If UE has reached minimum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\leq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- A UE resets accumulation of a PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ to $f\_{b,f,c}\left(k,l\right)=0, k=0,1,…,i$- If a configuration for a corresponding $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value is provided by higher layers- If a configuration for a corresponding $α\_{b,f,c}\left(j\right)$ value is provided by higher layerswhere $l$ is determined from the value of $j$ as - If $j>1$ and the UE is provided higher *SRI-PUSCH-PowerControl*, $l$ is the *sri-PUSCH-ClosedLoopIndex* value(s) configured in any *SRI-PUSCH-PowerControl* with the *sri-P0-PUSCH-AlphaSetId* value corresponding to $j$ - If $j>1$ and the UE is not provided *SRI-PUSCH-PowerControl* or $j=0$, $l=0$- If $j=1$, $l$ is provided by the value of *powerControlLoopToUse*- $f\_{b,f,c}\left(i,l\right)=δ\_{PUSCH,b,f,c}\left(i,l\right)$ is the PUSCH power control adjustment state for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion  if the UE is provided *tpc-Accumulation*, where- $δ\_{PUSCH,b,f,c}$ absolute values are given in Table 7.1.1-1- For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, when PUSCH-DMRS-Bundling is enabled, if TPC command(s) is received in DCI format 2\_2 , and if one or more TPC command(s) that would take effect in a nominal TDW, as defined in clause 6.1.7 of [6, TS 38.214], are received, only the last TPC command is applied after the nominal TDW while the others are omitted. <text omitted>\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*End of the TP\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

**LG** proposes to adopt the following TP**:**

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| ================== Start of Text Proposal for TS38.213 ==================**7.1.1 UE behaviour**<Other parts are omitted>- $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is the PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion $i$ if the UE is not provided *tpc-Accumulation*, where - The $δ\_{PUSCH,b,f,c}$ values are given in Table 7.1.1-1- When *PUSCH-DMRS-Bundling* is enabled and if transmission occasion $i$ is within the first nominal TDW, $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{1}-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{1}-i\_{0}$ and $K\_{PUSCH}(i-i\_{1})$ symbols before PUSCH transmission occasion $i-i\_{1}$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{1}\geq 0$ is the largest integer that transmission occasion $i\_{1}$ and transmission occasion $i$ are within same nominal TDW and $i\_{0}>0$ is the smallest integer for which $K\_{PUSCH}(i-i\_{1}-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{1}-i\_{0}$ is earlier than $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$- When *PUSCH-DMRS-Bundling* is enabled and if transmission occasion $i$ is not within the first nominal TDW, $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{1}-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{1}-i\_{0}$ and $K\_{PUSCH}(i-i\_{1})$ symbols before PUSCH transmission occasion $i-i\_{1}$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{1}\geq 0$ is the largest integer that transmission occasion $i\_{1}$ and transmission occasion $i$ are within same nominal TDW and $i\_{0}>0$ is the largest integer that transmission occasion $i-i\_{1}-i\_{0}$ is within the previous nominal TDW, for which $K\_{PUSCH}(i-i\_{1}-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{1}-i\_{0}$ is earlier than $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$- When *PUSCH-DMRS-Bundling* is not enabled, $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{0}$ and $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{0}>0$ is the smallest integer for which $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$- If a PUSCH transmission is scheduled by a DCI format, $K\_{PUSCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUSCH transmission <Other parts are omitted>- $g\_{b,f,c}\left(i,l\right)=g\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is the current PUCCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of primary cell $c$ and PUCCH transmission occasion $i$, where - The $δ\_{PUCCH,b,f,c}$ values are given in Table 7.1.2-1- When *PUCCH-DMRS-Bundling* is enabled, $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $C\_{i}$ of TPC command values with cardinality $C\left(C\_{i}\right)$ that the UE receives between $K\_{PUCCH}\left(i-i\_{0}\right)-1$ symbols before PUCCH transmission occasion $i-i\_{0}$ and $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of primary cell $c$ for PUCCH power control adjustment state, where $i\_{0}>0$ is the smallest integer for which $K\_{PUCCH}\left(i-i\_{0}\right)$ symbols before PUCCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $C\_{i}$ of TPC command values with cardinality $C\left(C\_{i}\right)$ that the UE receives between $K\_{PUCCH}\left(i-i\_{0}\right)-1$ symbols before PUCCH transmission occasion $i-i\_{0}$ and $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of primary cell $c$ for PUCCH power control adjustment state, where $i\_{0}>0$ is the smallest integer for which $K\_{PUCCH}\left(i-i\_{0}\right)$ symbols before PUCCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUCCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $C\_{i}$ of TPC command values with cardinality $C\left(C\_{i}\right)$ that the UE receives between $K\_{PUCCH}\left(i-i\_{0}\right)-1$ symbols before PUCCH transmission occasion $i-i\_{0}$ and  symbols before PUCCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of primary cell $c$ for PUCCH power control adjustment state, where $i\_{0}>0$ is the smallest integer for which $K\_{PUCCH}\left(i-i\_{0}\right)$ symbols before PUCCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUCCH}\left(i\right)$ symbols before PUCCH transmission occasion $i$<Other parts are omitted>================== End of Text Proposal for TS38.213 ================== |

**Nokia** proposes to adopt the following TP (TS 38.213)**:**

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| --- |
| **\*\*\*Unchanged text is omitted \*\*\*****7.1.1 UE behaviour****\*\*\*Unchanged text is omitted \*\*\***- $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)+\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is the PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion $i$ if the UE is not provided *tpc-Accumulation*, where - The $δ\_{PUSCH,b,f,c}$ values are given in Table 7.1.1-1- $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)$ is a sum of TPC command values in a set $D\_{i}$ of TPC command values with cardinality $C\left(D\_{i}\right)$ that the UE receives between $K\_{PUSCH}\left(i-i\_{0}\right)-1$ symbols before PUSCH transmission occasion $i-i\_{0}$ and $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$ on active UL BWP $b$ of carrier $f$ of serving cell $c$ for PUSCH power control adjustment state $l$, where $i\_{0}>0$ is the smallest integer for which $K\_{PUSCH}(i-i\_{0})$ symbols before PUSCH transmission occasion $i-i\_{0}$ is earlier than $K\_{PUSCH}(i)$ symbols before PUSCH transmission occasion $i$- If the UE is provided *PUSCH-DMRS-Bundling* = ‘enabled’, $K\_{PUSCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ from the first symbol of the nominal time domain window including the transmission occasion *i* and before a first symbol of the transmission occasion *i*, where the nominal time domain window is determined as described in[6, TS 38.214]- If the UE is not provided *PUSCH-DMRS-Bundling* = ‘enabled’,- If a PUSCH transmission is scheduled by a DCI format, $K\_{PUSCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUSCH transmission - If a PUSCH transmission is configured by *ConfiguredGrantConfig*, $K\_{PUSCH}(i)$ is a number of $K\_{PUSCH,min}$ symbols equal to the product of a number of symbols per slot, $N\_{symb}^{slot}$, and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP $b$ of carrier $f$ of serving cell $c$- If the UE has reached maximum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\geq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- If UE has reached minimum power for active UL BWP $b$ of carrier $f$ of serving cell $c$ at PUSCH transmission occasion $i-i\_{0}$ and $\sum\_{m=0}^{C\left(D\_{i}\right)-1}δ\_{PUSCH,b,f,c}(m,l)\leq 0$, then $f\_{b,f,c}\left(i,l\right)=f\_{b,f,c}\left(i-i\_{0},l\right)$- A UE resets accumulation of a PUSCH power control adjustment state $l$ for active UL BWP $b$ of carrier $f$ of serving cell $c$ to $f\_{b,f,c}\left(k,l\right)=0, k=0,1,…,i$- If a configuration for a corresponding $P\_{O\\_UE\\_PUSCH,b,f,c}\left(j\right)$ value is provided by higher layers- If a configuration for a corresponding $α\_{b,f,c}\left(j\right)$ value is provided by higher layerswhere $l$ is determined from the value of $j$ as - If $j>1$ and the UE is provided higher *SRI-PUSCH-PowerControl*, $l$ is the *sri-PUSCH-ClosedLoopIndex* value(s) configured in any *SRI-PUSCH-PowerControl* with the *sri-P0-PUSCH-AlphaSetId* value corresponding to $j$ - If $j>1$ and the UE is not provided *SRI-PUSCH-PowerControl* or $j=0$, $l=0$- If $j=1$, $l$ is provided by the value of *powerControlLoopToUse*- If the UE is provided *PUSCH-DMRS-Bundling* = ‘enabled’ and *tpc-Accumulation,* $f\_{b,f,c}(i,l)$is the PUSCH power control adjustment state *l* for active UL BWP *b* of carrier *f* of serving cell *c* and PUSCH transmission occasion *i*, which is identical for all transmission occasions belonging to a nominal TDW, and equal to the absolute value $δ\_{PUSCH,b,f,c}$ carried by the last TPC command before the first symbol of the nominal TDW including transmission occasion *i,* and provided by DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI- If the UE is not provided *PUSCH-DMRS-Bundling* = ‘enabled’, $f\_{b,f,c}\left(i,l\right)=δ\_{PUSCH,b,f,c}\left(i,l\right)$ is the PUSCH power control adjustment state for active UL BWP $b$ of carrier $f$ of serving cell $c$ and PUSCH transmission occasion  if the UE is provided *tpc-Accumulation*, where- $δ\_{PUSCH,b,f,c}$ absolute values are given in Table 7.1.1-1**\*\*\*Unchanged text is omitted \*\*\*****7.2.1 UE behaviour****\*\*\*Unchanged text is omitted \*\*\***- For the PUCCH power control adjustment state  for active UL BWP  of carrier  of primary cell  and PUCCH transmission occasion -  is a TPC command value included in a DCI format scheduling a PDSCH reception for active UL BWP  of carrier  of the primary cell  that the UE detects for PUCCH transmission occasion , or is jointly coded with other TPC commands in a DCI format 2\_2 with CRC scrambled by TPC-PUCCH-RNTI [5, TS 38.212], as described in clause 11.3-  if the UE is provided *twoPUCCH-PC-AdjustmentStates* and *PUCCH-SpatialRelationInfo* and  if the UE is not provided *twoPUCCH-PC-AdjustmentStates* or *PUCCH-SpatialRelationInfo*- If the UE obtains a TPC command value from a DCI format scheduling a PDSCH reception and if the UE is provided *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by an index provided by *p0-PUCCH-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of values for *closedLoopIndex* that provide the  value(s). If the UE receives an activation command indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the value *closedLoopIndex* that provides the value of  through the link to a corresponding *p0-PUCCH-Id* index - If the UE obtains one TPC command from a DCI format 2\_2 with CRC scrambled by a TPC-PUCCH-RNTI, the  value is provided by the closed loop indicator field in DCI format 2\_2-  is the current PUCCH power control adjustment state  for active UL BWP  of carrier  of primary cell  and PUCCH transmission occasion , where - The  values are given in Table 7.1.2-1-  is a sum of TPC command values in a set  of TPC command values with cardinality  that the UE receives between  symbols before PUCCH transmission occasion  and  symbols before PUCCH transmission occasion  on active UL BWP  of carrier  of primary cell  for PUCCH power control adjustment state, where  is the smallest integer for which  symbols before PUCCH transmission occasion  is earlier than  symbols before PUCCH transmission occasion - If the UE is provided *PUCCH-DMRS-Bundling* = ‘enabled’, $K\_{PUCCH}(i)$ is a number of symbols for active UL BWP $b$ of carrier $f$ of serving cell $c$ from the first symbol of the time domain window including the transmission occasion $i$to the first symbol of the transmission occasion $i$, where the time domain window is determined as described in[6, TS 38.214]- If the UE is not provided *PUCCH-DMRS-Bundling* = ‘enabled’,- If the PUCCH transmission is in response to a detection by the UE of a DCI format,  is a number of symbols for active UL BWP  of carrier  of primary cell  after a last symbol of a corresponding PDCCH reception and before a first symbol of the PUCCH transmission- If the PUCCH transmission is not in response to a detection by the UE of a DCI format,  is a number of  symbols equal to the product of a number of symbols per slot, , and the minimum of the values provided by *k2* in *PUSCH-ConfigCommon* for active UL BWP  of carrier  of primary cell - If the UE has reached maximum power for active UL BWP  of carrier  of primary cell  at PUCCH transmission occasion  and , then - If UE has reached minimum power for active UL BWP  of carrier  of primary cell  at PUCCH transmission occasion  and , then  **\*\*\*Unchanged text is omitted \*\*\*** |

## 3.3 Inter-slot frequency hopping with inter-slot bundling

**FL comments:** This issue is discussed under AI 8.8.2.

## 3.4 RRC parameters

**China Telecom** proposes to update the description of the RRC parameter *PUSCH-Window-Restart* as follows*.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WI code** | **Sub-feature group** | **Parameter name in the spec** | **New or existing?** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** |
| NR\_cov\_enh-Core | DM-RS bundling for PUSCH | *PUSCH-Window-Restart* | new | UE bundles PUSCH DM-RS remaining in a nominal time domain window after dynamic event(s) that violate power consistency and phase continuity requirements | ENUMERATED {enabled, disable } | 　 | in PUSCH-Config | UE-specific |

**China Telecom** proposes to update the description of the RRC parameter *PUCCH-Window-Restart* as follows*.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **WI code** | **Sub-feature group** | **Parameter name in the spec** | **New or existing?** | **Description** | **Value range** | **Default value aspect** | **Per (UE, cell, TRP, …)** | **UE-specific or Cell-specific** |
| NR\_cov\_enh-Core | DM-RS bundling for PUCCH | *PUCCH-Window-Restart* | new | UE bundles PUCCH DM-RS remaining in a nominal time domain window after dynamic event(s) that violate power consistency and phase continuity requirements | ENUMERATED {enabled, disable } | 　 | in PUCCH-Config | UE-specific |

**vivo** proposes to update the following RRC parameter for JCE of PUSCH:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter Name** | **RAN2 Parent IE** | **RAN1** **spec/ section** | **Value range** | **New or existing?** | **UE-specific or Cell-specific** | **Description** |
| PUSCH-TimeDomainWindowLength | PUSCH-config | 38.214 | ~~FFS~~INTEGER {1…32} | new | UE-specific | Length of a nominal time domain window in number of consecutive slots for DMRS bundling for PUSCH. |
| PUSCH-inter-bundlingFrequencyHopping | PUSCH-config | 38.214 | ENUMERATED {enabled, disabled} | new | UE-specific | Enabling/disabling of frequency hopping with DMRS bundling for PUSCH repetitions. |
| PUSCH-inter-bundlingFrequencyHoppingLength | PUSCH-config | 38.214 | INTEGER {1...32} | new | UE-specific | Length (in slots) of a configured frequency hop for PUSCH with DMRS bundling. |

**vivo** proposes to update the following RRC parameter for JCE of PUCCH:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter Name** | **RAN2 Parent IE** | **RAN1** **spec/ section** | **Value range** | **New or existing?** | **UE-specific or Cell-specific** | **Description** |
| PUCCH-DMRS -Bundling | ~~FFS~~PUCCH-format1/2/3/4 | 38.213 | ENUMERATED {enabled, disabled} | new | ~~[~~UE-specific~~]~~ | Enabling/disabling of DM-RS bundling and time domain window for PUCCH repetitions. |
| PUCCH-TimeDomainWindowLength | ~~[in PUCCH-Config]~~PUCCH-format1/2/3/4 | 38.213 | ~~FFS~~INTEGER {1,2,4.8} | new | ~~[~~UE-specific~~]~~ | Length of a ~~[~~nominal~~]~~ time domain window in slots for DMRS bundling for PUCCH. |
| PUCCH-Window-Restart | PUCCH-config | 38.213 | ENUMERATED {enabled, disabled} | new | ~~[~~UE-specific~~]~~ | UE bundles PUCCH DM-RS slots remaining in a bundling nominal time domain window after a slot for which events violate power consistency and phase continuity requirements |

## 3.5 Others

**CA/DC**

**Sharp:** The simultaneous transmissions in multiple cells/carriers should not be supported when DMRS bundling is configured.

**MediaTek:** JCE is not supported for CA/DC cases in R-17.

**LG**: Considering PUSCH/PUCCH with high level of repetition number have lower priority, transmission power of PUSCH/PUCCH can be changed due to the uplink transmission of other carrier within the configured TDW. In such case that transmission power change induced by the other uplink transmission should be an event.

**Autonomous UE Tx power changes**

**MediaTek:** JCE may be affected by UE autonomous Tx power changes due to PL changes and P-MPR changes satisfying SAR requirements. Our preference would be for RAN4 to not restrict the UE’s ability to perform those functions during JCE. Proposal: No restriction on UE autonomous power adjustments (e.g., due to PL changes or P-MPR changes) for JCE.

**Applicability of DMRS Bundling**

**Qualcomm**: Restrict DMRS bundling for PUSCH to only MCS values that correspond to QPSK or lower modulation orders.

**PTRS**

**Qualcomm**: Support different criteria for activation of PTRS or its density for the case of joint channel estimation.

**Huawei**: To support the joint channel estimation in the case of that the phase continuity cannot be maintained by UE, the PT-RS like reference signal can be used to estimate and compensate phase jumps in the future.



Fig. Joint channel estimation can be performed across the phase jumps using PT-RS like reference signal

**TA adjustment**

**LG** observes that some clarification is required for the case where the slot for starting DMRS bundling is a reduced slot due to TA command.

* If the TDRA table of PUSCH repetition type A is not satisfied due to TA command, clarification that PUSCH transmission is not performed is required.
* When a reduced slot occurs due to the TA adjustment, clarification regarding the actual TDW boundary according to whether the actual repetition of PUSCH repetition type B is transmitted or not is necessary.

**LG** proposes to adopt the following TP for clarification that if the TDRA table of PUSCH repetition type A is not satisfied, PUSCH transmission is not performed.

|  |
| --- |
| ================== Start of Text Proposal for TS38.214 ==================**6.1.2.1 Resource allocation in time domain**<Other parts are omitted>For PUSCH repetition Type A, in case *K>1*, - If the PUSCH is scheduled by DCI format 0\_1 or 0\_2- if *AvailableSlotCounting* is enabled, the same symbol allocation is applied across the $N∙K$ slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the $N∙K$slots determined for the PUSCH transmission, applying the same symbol allocation in each slot. If the UE determines that, for a PUSCH transmission in a slot, the number of symbols available for the PUSCH transmission is smaller than the value provided by *SLIV*, the UE does not transmit the PUSCH in the slot.- Otherwise, the same symbol allocation is applied across the $N∙K$ consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the $N∙K$ consecutive slots applying the same symbol allocation in each slot. If the UE determines that, for a PUSCH transmission in a slot, the number of symbols available for the PUSCH transmission is smaller than the value provided by *SLIV*, the UE does not transmit the PUSCH in the slot.- Else if the PUSCH is scheduled by RAR UL grant or by DCI format 0\_0 with CRC scrambled by TC-RNTI, the same symbol allocation is applied across the $N∙K$ slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the $N∙K$ slots determined for the PUSCH transmission, applying the same symbol allocation in each slot. If the UE determines that, for a PUSCH transmission in a slot, the number of symbols available for the PUSCH transmission is smaller than the value provided by *SLIV*, the UE does not transmit the PUSCH in the slot.For TB processing over multiple slots:- For unpaired spectrum, the same symbol allocation is applied across the $N∙K$ slots determined for the PUSCH transmission and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the $N∙K$slots determined for the PUSCH transmission, applying the same symbol allocation in each slot. If the UE determines that, for a PUSCH transmission in a slot, the number of symbols available for the PUSCH transmission is smaller than the value provided by *SLIV*, the UE does not transmit the PUSCH in the slot.- For paired spectrum or supplementary uplink band, the same symbol allocation is applied across the $ N∙K$ consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall transmit the TB across the $N∙K$ consecutive slots applying the same symbol allocation in each slot. If the UE determines that, for a PUSCH transmission in a slot, the number of symbols available for the PUSCH transmission is smaller than the value provided by *SLIV*, the UE does not transmit the PUSCH in the slot.<Other parts are omitted>================== End of Text Proposal for TS38.214 ================== |

**Ericsson:** Specify that if a UE transmits PUSCH or PUCCH with intra-slot frequency hopping, it is not expected to maintain power consistency and phase continuity across PUSCH DMRS or across PUCCH DMRS.

**Panasonic**: To specify that a UE expects to perform the same precoder of precoding cycling within an actual TDW.

**LG**: Enhance the UL power allocation priority rule in terms of PUSCH/PUCCH for coverage enhancement.

**Apple** proposes to adopt the following TP for updating the specification to capture that DMRS building can be applied to Repetition type A defined in Rel-15 /16 /17 and Repetition type B with configured grant(TS 38.214)**:**

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| --- |
| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**For PUSCH transmissions of PUSCH repetition Type A , PUSCH repetition Type B and TB processing over multiple slots, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:- For PUSCH transmissions of repetition Type A, PUSCH repetition Type B and TB processing over multiple slots, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:- Given by *PUSCH-TimeDomainWindowLength*, if configured. |

**Spreadtrum** proposes to adopt the following TP for separate descriptions of dynamic grant and configured grant for bundling DMRS TDW of PUSCH repetition type B and TB processing over multiple slots (TS 38.214):

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| --- |
| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**< Unchanged part is omitted >For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type B with a configured grant, TB processing over multiple slots scheduled by DCI format 0\_1 or 0\_2, and TB processing over multiple slots with a configured grant, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:< Unchanged part is omitted > |

**OPPO** proposes to adopt the following TP for clarification on describing first PUSCH transmission, available slot and downlink monitoring (TS 38.214):

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| \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*Start of the TP\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***6.1.7 UE procedure for determining time domain windows for bundling DM-RS**<text omitted>- For PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and PUSCH repetition Type A with a configured grant, when *AvailableSlotCounting* is enabled, and for TB processing over multiple slots:- The start of the first nominal TDW is the first slot determined for the first PUSCH transmission.- The end of the last nominal TDW is the last slot determined for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot determined for PUSCH transmission after the last slot determined for PUSCH transmission of a previous nominal TDW.- For PUSCH transmissions of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2 and PUSCH repetition Type A with a configured grant, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B:- The start of the first nominal TDW is the first slot scheduled for the first PUSCH transmission.- The end of the last nominal TDW is the last slot scheduled for the last PUSCH transmission.- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.- For PUCCH transmissions of a PUCCH repetition:- The start of the first nominal TDW is the first slot determined for the first PUCCH transmission.- The end of the last nominal TDW is the last slot determined for the last PUCCH transmission.- The start of any other nominal TDWs is the first slot determined for PUCCH transmission after the last slot determined for PUCCH transmission of a previous nominal TDW.For PUSCH transmissions of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, a nominal TDW consists of one or multiple actual TDWs. The UE determines the actual TDWs as follows: - The start of the first actual TDW is the first symbol of the first PUSCH transmission in a slot determined for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW.- The end of an actual TDW is- The last symbol of the last PUSCH transmission in a slot determined for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, if the actual TDW reaches the end of the last PUSCH transmission within the nominal TDW.- The last symbol of a PUSCH transmission before the event, if an event occurs which causes power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, and the PUSCH transmission is in a slot determined for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A ~~wth~~ with a configured grant, or PUSCH repetition type B or TB processing over multiple slots.-<text omitted>Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:- A downlink slot or downlink reception ~~or downlink monitoring~~ based on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* for unpaired spectrum. Or, downlink RS or PDCCH monitoring as descried in clause 5, clause 6 and clause 11 of [6, TS 38.213].- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols.<text omitted>\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*End of the TP\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

1. Email discussion (1st round)

## 4.1 Time domain window

#### Issue #1: The start of configured TDW for CG PUSCH

**Proposal:**

* For CG PUSCH, the first configured TDW should always start from the first physical slot of a CG period.

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| **Companies** | **Comments** |
| QC | While this issue is good to clarify to ensure common understanding, we don’t think a spec change is necessary. When available slot counting is enabled, the current procedure for determining the location of the first nominal TDW is tied to the first slot determined for the first PUSCH transmission. This first slot is the first available slot determined by the UE, and not necessarily the first slot where an actual transmission occurs. Note that the UE must go through this procedure to assign appropriate RV indices to the available slots irrespective of when the actual transmission begins. In short, the procedure to determine available slots is already decoupled from the actual start of transmissions based on RV index being 0.The same applies to the case where counting is based on physical slots.  |
| Nokia/NSB | Do not support the proposal.On the one hand, having the first configured TDW start with the first physical slot of a CG period may lead to performance loss since it may require an artificial and unnecessary increase of the number of configured TDWs across the PUSCH transmission/repetitions. The larger the number of configured TDWs, the more phase and power discontinuity may happen across the configured TDWs.On the other hand, it is unclear why this issue should be solved via specification when it can be handled at gNB with no specification impact. We start by focusing on the UE; according to current specification, no ambiguity can ever occur at the UE for the configured TDW determination, regardless of whether false alarm may happen at gNB or not. Switching the focus on gNB, we observe that gNB would never bundle 2 or more slots blindly, without knowing if phase continuity and power consistency exist across the bundled slots, even if JCE is enabled. Indeed, a meaningful and well-performing JCE can only occur if gNB knows that the bundled slots satisfy the requirements. This is never the case for the blind detection during a CG period, during which gNB would always need to perform a blind detection on a per-slot basis regardless of whether JCE is enabled or not. In other words, any functional gNB would always be able to anticipate that a false alarm may happen and apply the joint channel estimation (or not) accordingly. Finally, the false alarm should be considered as a corner case (otherwise, there is an issue with CG PUSCH in Rel-15/16). In addition, we do not see the “total miss detection” as a valid scenario, since gNB should always know that there is some transmission in the slot, which may or may not be successfully detected, given that the blind detection would always have to be performed per slot.Therefore, supporting this proposal would jeopardize performance of the JCE with no technical need, given that the structure of the blind detection procedure prevent mis-matches between UE and gNB to happen in the first place. |
| vivo | Not support. The first configured TDW should start from the first physical or available slot of the PUSCH repetitions according to previous agreements, and the UE behavior is clear. If UE can start the transmission in any occasion in the CG period, it can be left to NW implementation to determine the starting of the configured TDW for joint channel estimation, e.g. through blind detection of PUSCH DMRS. |
| Intel | We do not support this proposal.Based on the previous agreement, for CG-PUSCH, the first configured TDW is from the first available slot when PUSCH repetition type is counted based on available slot. We do not see the need to revert the agreement.  |
| ZTE | We don’t support this proposal.For CG PUSCH repetition, if the network does not detect the initial transmission correctly, it is most likely that the TB cannot be decoded correctly even based on the correct TDW understanding since incorrect information have been combined into the buffer. In addition, it is contradictory with previous agreement that the configured TDW starts from the first available slot.  |
| Panasonic | Based on the previous agreements, our understanding is shown as follows* PUSCH repetition type A counting based on available slot:
	+ The first configured TDW should always start from the first available slot of a CG period.
* PUSCH repetition type A counting based on physical slots:
	+ The first configured TDW should always start from the first physical slot of a CG period.

Therefore, it is not required to agree the proposal |
| Samsung | Don’t support the proposal. It is unnecessary to support corner cases such as false alarm and miss detection for the first slot. The agreed procedure for determination of TDW is sufficient. |
| Sharp | Support the proposal. However, it is already captured in Rel-17 specification. This is because the UE determines *NK* PUSCH transmissions before applying dropping rule and the start of the first nominal TDW is the first slot for the first PUSCH transmission. |
| LG | Not support. As other companies pointed out, configured TDW determination and actual start of transmission is decoupled not for CG PUSCH. We do not see strong reason why we should convert our agreement. |
| CATT | Not necessary. We prefer to have a unified definition for DG and CG PUSCH.There are several implementation methods to alleviate the false-alarm impact. For example, configuring {0,2,3,1} or {0,3,0,3} as the starting position RV rather than {0,0,0,0}. On the other hand, the performance is unlikely to guarantee only by DMRS bundling, if false alarm really happens. |
| Xiaomi | Not support. There has been an agreement that for CG-PUSCH, the first configured TDW is from the first available slot when PUSCH repetition type is counted based on available slot, which is conflict with the proposal. |
| Lenovo, Motorola Mobility | We don’t support this proposal.As per previous agreement for CG-PUSCH, available slot should be used rather than physical slot |
| Ericsson | Do not see the need for this proposal, as others have explained. |
| Huawei, HiSilicon | As a clarification, we propose to determine the start of the first nominal TDW based on the first slot for the first PUSCH transmission occasion of CG PUSCH, not the first slot where an actual transmission occurs. Otherwise, the repetition window that contains all CG repetitions is misaligned between gNB and UEs in case of false alarm or misdetection, because the repetition window always starts from the actual transmission slot which a gNB cannot accurately determine in case of false alarm or misdetection. |

#### Issue #2: Candidate values of the window length *L* of the configured TDW

Companies are encourage to provide comments on issue #2 summarized in section 3.1.

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| **Companies** | **Comments** |
| QC | Establishing an upper bound of 32 is okay. Value of adding 1 is not clear. Even if the span of all repetitions is less than the value of L, the UE maintains phase coherence for the required duration. Setting L=1 could help cover a scenario where bundling is desired for Type B repetitions but not for Type A repetitions. The motivation for such a case is not clear. |
| Nokia/NSB | Maximum duration should absolutely be one candidate value for configured TDW length. The motivation of configuring configured TDW to be less than maximum duration is unclear to us. Therefore, to avoid RRC overhead, only two candidate values for configured TDW length should be sufficient (only one bit is needed). |
| vivo | According to response LS from RAN4, the impact of the maximum duration up to 32 slots is under research, and the maximum duration beyond 32 slots would not be analyzed. Thus, restricting the window length less than 32 slots seems reasonable enough, and the value range of window length could be revisited if any update is provided based on RAN4 research. Furthermore, it is reasonable for PUSCH repetition type B to configure 1 slot as time domain window length, which has no harm for PUSCH repetition type A. Thus, 1 slot can be also considered as a valid TDW length, which should be excluded.  |
| Intel | We think <= 32 should be supported for window length for configured TDW. A set of values can be defined in the specification and one value can be configured by RRC signaling. We do not see the need to configure L = 1. As we discussed in previous meeting, for coverage enhancement, L = 1 is not typical scenario for the consideration even for repetition type B.  |
| ZTE | We think the existing agreement is sufficient, i.e., any integer value larger than 1 and no larger than the maximum duration can be configured. This can provide better flexibility.  |
| Panasonic  | We are fine to have an upper bound value of L of 32 slots. We do not support to add a candidate value of L of 1 slot because joint CE for PUSCH repetition type B is based on the design concept of joint CE for PUSCH repetition type A, wherein L=1 is not applicable as mentioned in following agreement.**Agreement:**The candidate values of the window length *L* of the configured TDW can be any integer value that is larger than 1 and no larger than the maximum duration.  |
| Samsung | Value range of L can be same as number of repetitions. |
| Apple | The candidate values for L can be [{2, 4, 8, 16, 32} slots], which is no larger than reported maximum duration. |
| LG | The agreement clearly states that the length of configured TDW is any integer larger than 1. We do not see any specific reason why we should convert our decision. |
| CATT | Based on the LS, RAN4 is studying the impact of enabling maximum duration up to 32 slots. It is a little early for RAN1 to specify a fixed value of 32. On the other hand, no matter a single maximum duration value is defined or a maximum duration is reported by UE from multiple candidate values, the maximum duration is a definite number for a specific UE. Hence, it is sufficient to restrict the window length L no larger than the maximum duration. It may be OK to conclude L<=32 (assuming it is the upper bound of maximum duration), and fine to re-visit it if necessary, depending on RAN4’s feedback.For configured TDW L=1 case, it has been discussed in the last meeting but there was no consensus. The use case (e.g. repetition Type B) is limited, and seems no need to support. |
| Xiaomi | We don’t see the necessity to further discuss the candidate value considering the existing agreements:Agreement 1:The candidate values of the window length L of the configured TDW can be any integer value that is larger than 1 and no larger than the maximum duration.Agreement 2:* If L is configured, the maximum value of window length L of the configured TDW should not exceed the maximum duration, which is reported as UE capability as the duration where UE is able to maintain power consistency and phase continuity subject to power consistency and phase continuity requirements.
* If L is not configured, the default value of L = min (maximum duration, duration of all PUSCH repetitions)
 |
| Spreadtrum | The candidate values can be chosen from available repetition numbers, e.g., {2, 4, 8, 16, 32}. Besides, the coverage enhancement is limited for L=1. Thus, L=1 should not be supported. |
| Lenovo, Motorola Mobility | We support having an upper bound of 32. |
| Ericsson | As commented above, RAN4 is still studying the maximum values for maximum duration. If we have to select one now for the value range of L, 32 could be in square brackets. Then given prior agreements, the range can be from 2 to [32].  |

#### Issue #3: Events that violate power consistency and phase continuity

##### Issue #3-1: Events for multi-TRP operations

Companies are encouraged to provide views on whether UL beam switching for multi-TRP operation is regarded as a semi-static event or dynamic event.

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| **Semi-static event** | **Dynamic event** |
| Nokia/NSB | QC |
| vivo | InterDigital |
| Intel | ZTE |
| InterDigital | Panasonic |
| Samsung |  |
| Sharp |  |
| Apple |  |
| LG |  |
| CATT |  |
| Xiaomi |  |
| Spreadtrum |  |
| Lenovo, Motorola Mobility |  |

Additional comments, if any?

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| **Companies** | **Comments** |
| QC | Companies were given two choices on how to categorize these events. (before/after start of PUSCH transmission vs triggering mechanism). We went with DCI/MAC-CE based triggering as constituting dynamic events. To stay consistent, this then needs to be classified as dynamic. We don’t want to create a long list of exceptions. |
| Nokia/NSB | We assume that this is the scenario when one TRP schedules the PUSCH repetitions, and these repetitions are transmitted by both TRPs. In this case, the switching event should be known beforehand and therefore it can be considered as semi-static event. |
| vivo | The beam switching pattern for multiple TRP is known before the PUSCH repetition, hence it can be considered as a semi-static event. |
| Intel | In our view, this is similar to frequency hopping where the enabling/disabling frequency hopping is indicated in the scheduling DCI. For UL beam switching, same design principle should be applied. After the UL beam switching, UE should restart the DMRS bundling in the configured TDW.  |
| InterDigital | Our understanding is that switching patterns can be known in advance in semi static manner or switching can be triggered dynamically. Thus, depending on how switching is triggered, it should be considered either dynamic or semi static-event.  |
| ZTE | We think UL beam switching should be regarded as a dynamic event to follow the previous agreement since UL beam is indicated by DCI for PUSCH transmission in multi-TRP operation according to the agreement shown below.**Agreement(RAN1#104-e)**For single DCI based M-TRP PUSCH repetition schemes, in codebook based PUSCH, * Support two SRI fields corresponding to two SRS resource sets are included in DCI formats 0\_1/0\_2.
	+ Each SRI field indicating SRI per TRP, where the SRI field based on Rel-15/16 framework
* Support dynamic switching between multi-TRP and single-TRP operation
* FFS: Support dynamic switching the order of two TRPs
 |
| Panasonic  | As we have agreed that an event is treated as a dynamic event if it is triggered by a DCI or MAC CE, UL beam switching in multi-TRP operation should be regarded as a dynamic event. |
| Samsung | UL beam switching for m-TRP operation would be configured prior to first PUSCH transmission. Hence, we think UL beam switching for m-TRP can be regarded as a semi-static event. |
| Sharp | UL beam switching for multi-TRP operation is one of semi-static events because it is determined before first PUSCH transmission scheduled by DCI like frequency hopping. |
| Apple | In our view, UL beam switching should be considered as semi-static event. If the triggering is missed, there is no any misunderstanding issue. |
| LG | Same rule with frequency hopping can be applied. |
| NTT DOCOMO | We understand the motivation to make it semi-static event, because this is similar to frequency hopping. However, this should be treated as a dynamic event based on the agreements so far, because multi-TRP PUSCH is triggered by DCI. Hence, even though we are fine with treating UL beam switching by multi-TRP as a semi-static event, we think it should be treated as a dynamic event without any agreement in future.  |
| CATT | The indication field used for UL beam switching is in the UL grant similar as the Frequency Hopping Flag field. The switching event can be classified as a semi-static event since it can be known prior to the first PUSCH transmission.  |
| Xiaomi | The switching event can be classified as a semi-static event because beam switching pattern for multiple TRP is known before the PUSCH repetition. |
| Spreadtrum | UL beam switching is configured via semi-static signalling. It should be considered as a semi-static event. |
| Ericsson | Semi-static seems the correct classification, given that it is triggered by scheduling DCI. |

**vivo** propose that PUCCH repetitions with different sets of power control parameters in multi-TRP operation should be regarded as an event.

Companies are encouraged to provide comments on the above proposal by vivo.

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| **Companies** | **Comments** |
| vivo | This issue is also raised in AI 8.8.2, we are not sure, which AI is the right place to discuss.The two PUCCH repetitions may apply different power control parameter sets with the same spatial settings according to Clause 9.2.6 in TS 38.213 V17.0.0.

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| 9.2.6 PUCCH repetition procedure……When a PUCCH resource used for repetitions of a PUCCH transmission by a UE includes first and second spatial settings, or first and second sets of power control parameters, as described in [11, TS 38.321] and in clause 7.2.1, the UE- uses the first and second spatial settings, or the first and second sets of power control parameters, for first and second repetitions of the PUCCH transmission, respectively, when $N\_{PUCCH}^{repeat}=2$,- alternates between the first and second spatial settings, or between the first and second sets of power control parameters, respectively, per $N\_{PUCCH}^{switch}$ repetitions of the PUCCH transmission, where $N\_{PUCCH}^{switch}=1$ if *mappingPattern* = ‘cyclicMapping’; else, $N\_{PUCCH}^{switch}=2$. |

The typical use case is that mTRP in FR1, UE does not change Tx beam, but only apply different set of power control parameters for different TRPs. For this case, the power consistency will be violated, and it should be regarded as event.  |
| Intel | We are fine with the proposal. This is also discussed in PUCCH enhancement.  |
| ZTE | Seems ok based on the comments from vivo.  |
| Samsung | Although Rel-17 M-TRP supports repetitions, the framework is not same as for Rel-17 coverage enhancements (e.g. for TDW). There is no need to incorporate Rel-17 M-TRP in the Rel-17 as the structure/functionality is not compatible. |
| Apple | It was agreed UL beam switching for multi-TRP operation is an event already. This event could cover the proposed event, setting the different power control parameters itself is not the event. |
| LG | It is our understanding that according to the definition of event, PUCCH repetition with different sets of power control parameters in multi-TRP operation is an event. However same issue is being discussed in AI 8.8.2, we should avoid duplication. |
| CATT | OK. Seems to be a natural adaptation. |
| Xiaomi | Fine with the proposal. |
| Spreadtrum | Fine with vivo’s proposal. |
| Ericsson | Support. Also agree it is consistent with M-TRP beam switching. |

##### Issue #3-2: Dynamic & semi-static events

Companies are encouraged to provide answers to the following two questions:

* Case 1: A semi-static event is triggered after one or multiple dynamic events. Whether a new actual TDW is created after the semi-static event?
* Case 2: A semi-static event overlaps with a dynamic event. Whether a new actual TDW is created after the semi-static event?

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| **Companies** | **Comments** |
| QC | Case 1 & 2: if a UE does not support restarting a window, then the UE is not expected to restart bundling in the rest of the nominal TDW, irrespective of what events occur after the dynamic event. |
| Nokia/NSB | Case 1: yes. This is our understanding from the previous agreement that UE is mandatory to support restarting DM-RS bundling due to semi-static events if DM-RS bundling is supported by the UE.Case 2: yes. Since the UE knows beforehand there is a semi-static event anyway. |
| vivo | The answer for both Case 1 and Case 2 is YES.In our understanding, the behaviour that a new actual TDW is created after a semi-static event is clear, no matter whether there is a dynamic event overlapping with the semi-static event or before the semi-static event.  |
| Intel | Case 1: Yes. Based on existing agreement, UE should restart the DMRS bundling after the semi-static event.Case: Yes. In our view, UE knows that there is semi-static event and then should restart the DMRS bundling.  |
| InterDigital | Case 1 : Yes. It is mandatory for the UE to restart the DM-RS bundling after the semi-static event. Whether the latest event is dynamic/semi-static decides whether it’s up to UE capability or mandatory to restart DM-RS bundling.Case 2 : In this case, what happens to the semi-static event? Is the dynamic event prioritized over the semi-static event? Whether the latest event is dynamic/semi-static decides whether it’s up to UE capability or mandatory to restart DM-RS bundling. |
| ZTE | Yes to both cases. We think Case 1 is reasonable since a semi-static event can trigger a new actual TDW creation and it is a mandatory feature. For the same reason, we think a new actual TDW is created and triggered by the semi-static event for Case 2. |
| Panasonic  | Case 1: Yes as understanding of previous agreement.Case 2: Yes as “UE is mandatory to support restarting DM-RS bundling due to semi-static events” |
| Sharp | Case 1: Yes. When restarting DMRS bundling is disabled, UE determines starting positions of actual TDWs before first transmission based on semi-static events no matter whether dynamic events occur.Case 2: Yes |
| Apple | Our understanding is that Semi-static even could be known before the transmission, thus the semi-static even will be applied first to determine the actual TDW. After that, dynamic event is applied whether to create new actual TDW. |
| LG | Dividing events to two categories, i.e., dynamic and semi-static event, was originated from the potential misalignment of actual TDW boundary between gNB and UE. Therefore, no new actual TDW is created after dynamic event within the configured TDW if the UE has no capability of restarting DMRS bundling after dynamic event.Considering the overlap between semi-static event and dynamic event does not lead misunderstanding of actual TDW boundary, case 2 seems fine to us. |
| NTT DOCOMO | Yes, for both cases.It is mandatory to re-start actual TDW after semi-static event regardless of UE capability. |
| CATT | Case 1&2: Yes to both cases. Anyway, semi-static events are predictable, and we already agreed that a UE shall be able to resume DMRS bundling after the semi-static events, regardless whether it is interrupted by previous dynamic events or not. This will not create ambiguity or mis-alignment between gNB and UE. |
| Xiaomi | Yes for both cases. |
| Spreadtrum | Yes to both cases. |
| Ericsson | Yes for both seems reasonable. |

**China Telecom** proposes to adopt the following TP to capture the agreement ‘UE is mandatory to support restarting DM-RS bundling due to semi-static events’ into the specification (TS 38.214):

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| - A new actual TDW is created when *PUSCH-Window-Restart* is enabled or in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The start of a new actual TDW is the first symbol of the PUSCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, and the PUSCH transmission is in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots.- A new actual TDW is created when *PUCCH-Window-Restart* is enabled or in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The start of a new actual TDW is the first symbol of the PUCCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUCCH transmissions of PUCCH repetition within the nominal TDW, and the PUCCH transmission is in a slot determined for transmission of the PUCCH. |

Companies are encouraged to provide comments on the above TP by China Telecom.

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| **Companies** | **Comments** |
| QC | Seems good to clarify. The description of the RRC parameter also needs to be updated to reflect this.  |
| Nokia/NSB | In our view, ‘UE is mandatory to support restarting DM-RS bundling due to semi-static events’ has been captured in TS 38.214 as follows.“6.1.7 UE procedure for determining time domain windows for bundling DM-RS<<omitted text>>The UE shall maintain power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The UE maintains power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to an event triggered by DCI other than frequency hopping or by MAC-CE, subject to UE capability. <<omitted text>>” |
| Intel | We share similar view as Nokia, and this was already captured in the spec.  |
| ZTE | We have similar understanding with Nokia. But we are also ok to make is more clear as proposed by the TP.  |
| Panasonic  | It seems Nokia’s comment addresses concern of above TP by China Telecom. Hence, this TP is not necessary. |
| Samsung | The current text is sufficient. The text proposed by CT is already captured at the end of 6.1.7 in TS 38.214. Alternatively, adopting the CT proposal and deleting the text at the end of 6.1.7 is also fine. |
| Sharp | We are fine with the proposal. |
| LG | We do not think it is necessary since it is clearly captured in TS 38.214 mentioned by Nokia. |
| CATT | We are fine to adopt the TP. |
| Xiaomi | According to the explanation of Nokia, the TP seems not necessary. |
| Ericsson | As Nokia points out, the proposal already seems covered in 38.214. |

**vivo** proposes that for PUSCH repetition type B, gap with more than 13 OFDM symbols created by invalid symbol pattern is considered as a semi-static event.

Companies are encouraged to provide comments on the above proposal by vivo.

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| **Companies** | **Comments** |
| QC | In light of CT’s TP above and the list of events already captured in the spec, we don’t think any additional clarification is necessary. If a UE has to read and infer a DCI to figure out a certain behaviour it should be treated as a dynamic event without any further exception. |
| Nokia/NSB | Ok if the intention is to clarify that this is a semi-static event. Otherwise, any gap more than 13 OFDM symbols should be an event. |
| vivo | If invalid symbol pattern for PUSCH repetition type B is configured via *invalidSymbolPatternIndicatorDCI-0-1* or *invalidSymbolPatternIndicatorDCI-0-2*, invalid symbol pattern can be enabled by setting ‘invalid symbol pattern indicator’ field to 1 in DCI. Once the duration of invalid symbols exceeds 13 OFDM symbols, invalid symbol pattern would be an event that violate power consistency and phase continuity. In last meeting, frequency hopping, which is configured by RRC but triggered by the hopping flag field in DCI, is considered as the semi-static event as well. The reason to consider the frequency hopping as semi static event is the ‘frequency hopping flag’ is indicated together with the UL grant, which is known prior to the first PUSCH repetition. Hence, the event indicated by the same scheduling DCI can be considered as semi-static events. Following the same logic, the invalid symbols pattern indicated by scheduling DCI for typeB PUSCH repetition should also be considered as a semi-static event. |
| ZTE | There are two kinds of invalid symbols. The first one is configured by *numberOfInvalidSymbolsForDL-UL-Switching*, it should be regarded as a semi-static event. Another is configured by *invalidSymbolPattern*, which may or may not be enabled by DCI depending on whether *invalidSymbolPatternIndicatorDCI-0-1 or invalidSymbolPatternIndicatorDCI-0-2* is configured. So, it can be regarded as a semi-static event if not enabled by DCI or a dynamic event if can be enabled by DCI. Anyway, whether it is a semi-static or dynamic event is clear according to current specification. We don’t see any spec impact here.  |
| Panasonic  | We think that for PUSCH repetition type B, invalid symbol is included in an event of “Dropping/cancellation based on Rel-15/16 collision rules” in previous agreement. Hence, we think it is not necessary to have additional clarification, but we are open if majority see a need. |
| Samsung | We are fine that gap with more than 13 OFDM symbols created by invalid symbol pattern can be regards as a semi-static event. |
| Sharp | We are fine with the proposal.  |
| Apple | It seems the event that transmission gap is more than 13 symbols could cover the proposed case. |
| LG | It is our understanding that it is already included in the event that “the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols” |
| CATT | Current spec has defined whether an event is ‘semi-static’ or not: For semi-static event, it is: ‘in case the actual TDW is created in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE.’, for dynamic event, it is:’ in case the actual TDW is created in response to an event triggered by DCI other than frequency hopping or by MAC-CE, subject to UE capability’. We are generally fine with the spirit. And, if we agree on this proposal, seems necessary to make one more exception other than ‘frequency hopping’ in current 214. |
| Xiaomi | Agree with apple, it has been included in the current events. |
| Spreadtrum | We are fine with the proposal. |
| Ericsson | We are somewhat hesitant to support the proposal, since it begins to diverge from reusing the mechanisms specified for Type A. And again, the use case for coverage seems a bit of a stretch here. However, we can further discuss. |

##### Issue #3-3: Dropping/Collision rules

**LG** proposes to treat dropping/cancellation based on Rel-17 collision rules as an event.

Companies are encouraged to provide comments on the above proposal by LG.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | In light of CT’s TP above and the list of events already captured in the spec, we don’t think any additional clarification is necessary.  |
| vivo | Open to discuss, but prefer the proponents to elaborate more on the detailed cases for R17 collisions. |
| Intel | Share similar view as QC. It was already captured in the spec.  |
| InterDigital | Examples may be helpful for further discussions. |
| ZTE | We are generally fine with this proposal. Similar as vivo, we think it would be better to provide the detailed Rel-17 collision rules if any for discussion so that we can understand whether this are potential specification impacts or not.  |
| Samsung | No need for this agreement now. It is not clear which are the Rel-17 collision rules at this stage. Therefore, we would like to further discuss it.  |
| Sharp | Support. However, it is already captured in Rel-17 specification. |
| Apple | The proposal is not clear, more details will be helpful to understand the proposal better. |
| LG | In the RAN1#106bis-e meeting, the list of events was agreed as follows:**Agreement**Support at least the following events that violate power consistency and phase continuity.‐   Dropping/cancellation based on Rel-15/16 collision rules.‐   FFS: Rel-17 collision rules.‐   DL slot or DL reception/monitoring based on semi-static DL/UL configuration for unpaired spectrum.‐   FFS: Other UL transmission in between PUSCH/PUCCH transmissions.‐   Gap between two PUSCH/PUCCH transmissions exceeds 13 symbols.‐   FFS: Transmission parameters need to be changed due to network-indicated operations, including: Tx power, UL beam/TPMI, and RB allocation.‐   FFS: TPC command.‐   FFS: TA adjustment.‐   FFS: The actual TDW reaches the maximum duration.‐   FFS: Frequency hopping.‐   FFS: Precoder cycling.‐   FFS: other events.‐   FFS: whether events are semi-static events or dynamic events.‐   FFS: the time duration of an event.Considering all of the listed events but Rel-17 collision rules are well discussed. Therefore we brought up the issue to be considered and open to discuss. |
| CATT | We are generally fine with the spirit. But what is the exact rule(s) that should be captured beyond the current spec?  |
| Xiaomi | Open to discuss. |
| Lenovo, Motorola Mobility | Fine, but seems to be already captures in spec |
| Ericsson | Prefer further clarification on what rules are to be specified. |

**Intel** proposes to adopt the following TP to add the case when PUCCH repetition with low priority is dropped when overlapping with PUSCH transmission with high priority, which is defined in Clause 9 in TS38.213, as an event:

|  |
| --- |
| - For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9, clause 9.2.6 and clause 11.1 of [6, TS 38.213]. |

Companies are encouraged to provide comments on the above TP by Intel.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Support |
| Nokia/NSB | We are fine with this clarification. |
| Intel | We are fine with the TP.  |
| ZTE | We are fine with the TP.  |
| Panasonic  | We are fine with the clarification. |
| Samsung | Fine with the TP |
| Sharp | Support |
| Apple | Fine with this TP |
| LG | Fine with proposed TP. |
| CATT | Fine with the TP. |
| Xiaomi | Support |
| Spreadtrum | Support |
| Lenovo, Motorola Mobility | Support |
| Ericsson | Seems OK |

##### Issue #3-4: HD-FDD RedCap UE related issues

**Huawei** proposes that for HD-FDD RedCap UEs, an event is constituted if the scheduled UL symbols overlap with any symbol of an SS/PBCH block provided by *ssb-PositionInBurst*.

**Spreadtrum** proposes that a downlink reception or downlink monitoring based on higher layer singling or DCI format is regarded as an event.

Companies are encouraged to provide comments on the above proposals by Huawei and Spreadtrum.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Regarding Huawei proposal: Clause 11.1 of 38.213 seems to already address this case. Its already reflected in 38.214’s list of events. Don’t see the need to clarify any further.  |
| Nokia/NSB | Agreed with QC’s comment. |
| vivo | Support the proposal by Huawei.  |
| Intel | Share similar view as QC and Nokia.  |
| ZTE | For the first proposal, we share with QC. For the second proposal, we are fine if the intention is to additionally consider the case based on DCI.  |
| Panasonic  | We share same view with QC. |
| Samsung | Share similar view as QC. |
| Apple | For the second proposal, we think this is covered by event, i.e., DL slot or DL reception/monitoring based on semi-static DL/UL configuration for unpaired spectrum |
| LG | Similar view with QC. |
| CATT | The first proposal is reasonable. But as pointed out by QC, it seems already captured in current section 6.1.7 of 38.214, by quoting 38.213 for overlapping case.The second proposal is also reasonable to us. Current definition of event seems limited to that configured by TDD configuration. |
| Xiaomi | Same view with QC and apple |
| Spreadtrum | We are also fine with HW's proposal, actually that is the intention for "higher layer singling" in our proposal. Besides SSB part, downlink reception based on DCI also needs to be treated as an event.  |
| Huawei, HiSilicon | Thank you for the comments. For HD-FDD, within a configured TDW, at least UL symbols overlap with any symbol of an SS/PBCH block provided by *ssb-PositionInBurst* should be regarded as an event in the following two cases:Case 1: the PUSCH transmission overlaps with the symbols provided by *ssb-PositionInBurst*.Case 2: the gap between two PUSCH repetition transmissions (e.g. 7 symbol overlaps with the symbols provided by *ssb-PositionInBurst*.It is good to see and confirm that Case 1 has been reflected in current spec. However, Case 2 has not been reflected. In our understanding, in this case, phase contiguity cannot be maintained. Thus an event is needed for it. |

##### Issue #3-5: Clarifications on the events

**vivo**: For extended CP case, support to define 11 symbols as the maximum gap length to maintain the power consistency and phase continuity.

**Ericsson**: Revise ‘Frequency hopping’ in the list of events in 38.214 to ‘Change in starting RB for inter-slot frequency hopping’.

**LG**: Other UL transmission in between PUSCH/PUCCH transmission is an event only on the same carrier.

Companies are encouraged to provide comments on the above proposals by vivo, Ericsson and LG.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Support vivo’s proposal.Ericsson’s clarification seems unnecessary. Can wait for more progress on inter-slot hopping with DMRS bundling.Don’t agree with LG’s proposal. |
| Nokia/NSB | Vivo’s proposal seems to be straightforward.We do not see the need to revise “frequency hopping” as Ericsson suggested. “Frequency hopping” is what was captured in the agreement. |
| vivo | Considering the slot with extended CP only has 12 symbols, the maximum gap length should be 11 symbols in the extended CP case to maintain the power consistency and phase continuity. |
| Intel | Vivo’s proposal seems okay but may need confirmation from RAN4 as RAN4 defines the requirement for more than 13 symbols.No need to update “frequency hopping” |
| InterDigital | Ok with the proposal from vivo. |
| ZTE | For the first one, we think it should be evaluated and decided by RAN4.For the second one, FH does not always lead to different frequency positions among hops. So, we are fine with the intention. But a more general wording seems better, e.g., “RB position change”. |
| Panasonic  | For vivo’s proposal: it is straightforward, we are fine with it.For Ericsson’s proposal: It is not necessary. For LG’s proposal: We do not support it.  |
| Samsung | We don’t agree on any of these proposals.1- The requirement of 11 symbols should be from RAN4.2- No need to change, current wording is fine. Alternatively, it can be considered “frequency hopping boundary”.3- All agreements in CovEnh are for single carrier. No need for this agreement. |
| Sharp | We are fine with vivo’s proposal. |
| Apple | For vivo’s proposal, it’s fine to be an event.For Ericsson’s clarification, it’s ok with the update.For LG’s proposal, it could be better we agreed whether UL CA is supported first for coverage enhancement. |
| LG | It is our understanding that if the UE performs uplink transmission (e.g., SRS) to another UL carrier between PUSCH transmissions on SUL/non-SUL carrier without RF switching and the gap between PUSCHs does not exceed 13 symbols, it does not harm phase continuity. Therefore the other UL transmission in between PUSCH/PUCCH transmission is an event only on the same carrier. |
| CATT | For vivo’s proposal, OK.For Ericsson’s proposal, ‘frequency hopping’ in the spec is not specifically referring to inter slot hopping.For LG’s proposal, we are not sure what the motivation is. Is it suggesting that Other UL transmission in between PUSCH/PUCCH transmission on other carriers is not an event? But it may be quite hard to guarantee power/phase condition in this scenario. |
| Xiaomi | Fine with VIVO’s proposal LG’s proposal and Ericsson’s proposal seem to be not necessary. |
| Lenovo, Motorola Mobility | Fine with only Vivo’s proposal |
| Ericsson | Vivo’s proposal seems reasonable, but it may be better to have the RAN4 input.Regarding our proposal, in the example case where a UE transmits on two consecutive DMRS bundled repetitions in a first set of PRBs, and then jumps to a second set of PRBs, the hopping should be only considered to have occurred after the first two repetitions. Also, how should intra-slot hopping be handled for PUSCH repetition type A? We have no strong view on the wording, but would like to make sure it’s clear where the actual TDWs are.We can further discuss LGE’s proposal. |

## 4.2 TPC command

**FL comments:** It seems the majority support to confirm the working assumption. Ericsson pointed out that there may be some confusion in RAN1. Ericsson thinks absolute TPC is not supported for DCI format 2\_2 and proposes to remove the second bullet in the working assumption.

Companies are encouraged to provide comments on whether absolute TPC is supported for DCI format 2\_2.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | If the UE is provided *tpc-Accumulation* and receives a TPC update via DCI format 2\_2, how is a UE expected to interpret this update? We think *tpc-accumulation* controls the interpretation. We can’t see how Ericsson came to the conclusion that it is not supported. |
| Nokia/NSB | In our view, at least the timeline on when the absolute TPC with DCI format 2\_2 is applied should be clarified. We are open to see more views from other companies. |
| vivo | Support to confirm the WA with the removal of FFS.  |
| Intel | Although we mentioned in our tdoc not to confirm the working assumption, we are fine to go with majority.  |
| InterDigital | We also support to confirm the WA and remove the FFS. |
| ZTE | Regarding on the view from Ericsson, it would be good if some more detailed clarification could be provided. We support to confirm the WA with the removal of FFS, and also ok to change configured TDW to actual TDW for better performance.  |
| Samsung | Fine to confirm the WA and also discuss the applicability of absolute TPC with DCI format 2\_2 for PUSCH (there is no absolute CLPC for PUCCH). |
| Sharp | In our understanding, mapping of TPC command field in DCI format 2\_2 to absolute $δ$ value is specified as the following:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 38.2137.1.1…1. PUSCH transmission occasion $i$.

**Table 7.1.1-1: Mapping of TPC Command Field in a DCI format scheduling a PUSCH transmission, or in DCI format 2\_2 with CRC scrambled by TPC-PUSCH-RNTI, or in DCI format 2\_3, to absolute and accumulated** $δ\_{PUSCH,b,f,c}$ **values or** $δ\_{SRS,b,f,c}$ **values**

|  |  |  |
| --- | --- | --- |
| **TPC Command Field**  | **Accumulated** $δ\_{PUSCH,b,f,c}$ **or** $δ\_{SRS,b,f,c}$ **[dB]** | **Absolute** $δ\_{PUSCH,b,f,c}$ **or** $δ\_{SRS,b,f,c}$ **[dB]**  |
| * 0
 | * -1
 | * -4
 |
| * 1
 | * 0
 | * -1
 |
| * 2
 | * 1
 | * 1
 |
| * 3
 | * 3
 | * 4
 |

 |

 |
| Apple | Our understanding is the TPC command in DCI format 2\_2 can be applied to absolute power control. This can be checked with 38.213v.15.2.0, and how to interpret the TPC command is showing in Table 7.1.1-1 as well. |
| LG | It is our understanding that whether absolute TPC or accumulated TPC is applied is up to tpc-Accumulation in PUSCH-PowerControl field. According to TS 38.331, it is stated as follows:If enabled, UE applies TPC commands via accumulation. If not enabled, UE applies the TPC command without accumulation. If the field is absent, TPC accumulation is enabled (see TS 38.213 [13], clause 7.1).That means, TPC is accumulated when tpc-Accumulation is enabled or it is absent. Therefore absolute TPC is supported for DCI format 2\_2. |
| NTT DOCOMO | We support confirming WA and remove the FFS. |
| CATT | Although our first preference is to make it an event, we can compromise and confirm the WA. Currently, we do not see explicit restriction that DCI format 2\_2 cannot be combined with absolute TPC control. |
| Xiaomi | Support to confirm the WA with the removal of FFS. |
| Spreadtrum | With the removal of FFS, we can confirm the WA. |
| Ericsson | There are two main reasons we think that absolute TPC is not supported for DCI 2\_2. Firstly, in section 7.1 of 38.213, values for $K\_{PUSCH}\left(i\right)$ are only provided for accumulated TPC, and so the timing for absolute TPC is not given in the specs. Secondly, the power control adjustment state $f\_{b,f,c}\left(i,l\right) $is defined by $δ\_{PUSCH,b,f,c}(i,l)$, and so refers to a particular transmission occasion $i$. Since there is no dependence to prior values of $f\_{b,f,c}\left(i,l\right)$, then $δ\_{PUSCH,b,f,c}(i,l)$ seems to influence only transmission occasion $i$.We would appreciate other companies’ views on this reasoning. |
| Huawei, HiSilicon | In our view, absolute TPC for PUSCH can be carried in DCI format 0\_x and DCI format 2\_2.  |

**FL comments:** The working assumption was not captured into the specification due to the different understandings on the definition of transmission occasion during the Editor’s CR phase in RAN1#107e. Based on the contributions in RAN1#107b-e, it seems the majority support no redefinition of transmission occasion for PUSCH/PUCCH in Rel-17. Therefore, the following proposal is proposed.

**Proposal:**

* No redefinition of transmission occasion for PUSCH/PUCCH in Rel-17.

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Agree |
| Nokia/NSB | Support. |
| vivo | Support the proposal. |
| Intel | Support |
| ZTE | Before agreeing the proposal, we would like to check the proponents what’s the issue of current specification. If no issues, we are fine with re-defining the transmission occasion.  |
| Panasonic  | Support. |
| Samsung | We do not support the proposal as it is an editorial aspect. Given the TPs submitted from companies at this meeting, we understand that none of them includes the above issue. RAN1 may instead discuss the TPs and focus on technical issues. Unlike the comment by the FL below, we do not identify any relevance between the submitted TPs and the above proposal.  |
| Apple | Agree with this proposal |
| LG | Support. To support enhanced TPC command, cardinality can be extended. |
| CATT | Agree. |
| Xiaomi | Support |
| Spreadtrum | Support |
| Ericsson | Support, and do not think this is an editorial issue. |
| Huawei, HiSilicon | Support the proposal. |

**FL comments:** Many companies provided TPs. However, we need to conclude the above issues before discussing TPs.

## 4.3 RRC parameters

**China Telecom** proposes to update the description of the RRC parameters *PUSCH-Window-Restart* and *PUCCH-Window-Restart* as follows*.*

* UE bundles PUSCH DM-RS remaining in a nominal time domain window after dynamic event(s) that violate power consistency and phase continuity requirements
* UE bundles PUCCH DM-RS remaining in a nominal time domain window after dynamic event(s) that violate power consistency and phase continuity requirements

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Can we say “dynamic event(s) (i.e., triggered by DCI or MAC-CE)….” |
| Nokia/NSB | Although we fully understand the motivation from the above modification, we slightly concern that such modification may lead to some misunderstandings that window restart is applied to dynamic events only. |
| Intel | We are fine with the proposal.  |
| InterDigital | We have the same view as Nokia. |
| ZTE | We support this proposal to make the description more clear. |
| Panasonic  | We share same view with Nokia’s comment. |
| Samsung | Is “dynamic” events defined in the specifications? |
| Sharp | We are fine with the proposal. |
| Apple | Ok with the clarification. |
| LG | Since whether the event is dynamic or not is described in TS 38.214 by whether the event is triggered by DCI or MAC-CE rather than using ‘dynamic event’ and ‘semi-static event’ as follows, updating RRC parameter according to above proposal would lead spec change in TS 38.214:“The UE shall maintain power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to frequency hopping or in response to any event not triggered by DCI or MAC-CE. The UE maintains power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to an event triggered by DCI other than frequency hopping or by MAC-CE, subject to UE capability.” |
| NTT DOCOMO | We share the same view as LG and Samsung. As long as a dynamic event is not specified in the draft CR, dynamic events should not be used for RRC parameter description.  |
| CATT | We support the proposal. |
| Spreadtrum | Fine with the clarification. |
| Lenovo, Motorola Mobility | We are fine with the proposal |
| Ericsson | Agree |

**FL comments:** Regarding the proposal from vivo, RRC parameters about frequency hopping and PUCCH are discussed under AI 8.8.2, while the candidate values of the window length *L* of the configured TDW is discussed in issue #2.

Any other comments about RRC parameters?

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| --- | --- |
| **Companies** | **Comments** |
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## 4.4 Others

**FL comments:** Regarding the issues summarized in section 3.5. FL would like to discuss the following issues first since other issues seem not so critical or they have already been discussed in previous meetings. We can discuss them later if we have sufficient time.

Qualcomm proposes to restrict DMRS bundling for PUSCH to only MCS values that correspond to QPSK or lower modulation orders. In addition, RAN4 has agreed to only focus on the modulation orders not higher than QPSK [6].

**Proposal:**

* Restrict DMRS bundling for PUSCH to only MCS values that correspond to QPSK or lower modulation orders.

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| QC | Support. Its not clear to us why a gNB will indicate a high MCS while also configuring PUSCH with repetitions. If there are no benefits to such use cases, its best to preclude it. Else, it adds unnecessary constraints to UE design. |
| Samsung | No need for RAN1 specifications to have such restriction. It is typical for RAN4 to focus on a subset of what is allowed by RAN1 specifications.  |
| LG | We are fine with the proposal following recommendation of RAN4. |
| Ericsson | Prior guidance from RAN4 was that RAN1 could focus on modulation orders not higher than QPSK (R1-2108703). Seems reasonable at this stage.  |

**Apple** proposes to adopt the following TP for updating the specification to capture that DMRS building can be applied to Repetition type A defined in Rel-15 /16 /17 and Repetition type B with configured grant(TS 38.214)**:**

|  |
| --- |
| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**For PUSCH transmissions of PUSCH repetition Type A , PUSCH repetition Type B and TB processing over multiple slots, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:- For PUSCH transmissions of repetition Type A, PUSCH repetition Type B and TB processing over multiple slots, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:- Given by *PUSCH-TimeDomainWindowLength*, if configured. |

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
| ZTE | In current specification, Msg3 repetition is also referred to as PUSCH repetition Type A. So this TP may lead to confusion since here is intended to preclude Msg3 repetition. So, we prefer not to change it. |
| Samsung | OK |
| LG | We would like to understand the intention of the proposal. Is there any other PUSCH repetition type A transmission that is not included in previous version? |

**LG** observes that some clarification is required for the case where the slot for starting DMRS bundling is a reduced slot due to TA command.

* If the TDRA table of PUSCH repetition type A is not satisfied due to TA command, clarification that PUSCH transmission is not performed is required.
* When a reduced slot occurs due to the TA adjustment, clarification regarding the actual TDW boundary according to whether the actual repetition of PUSCH repetition type B is transmitted or not is necessary.

Companies are encouraged to provide comments on the above problem by LG.

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| --- | --- |
| **Companies** | **Comments** |
| ZTE | In our understanding, the reason leading to the proposed issues is that PUSCH transmission duration is reduced due to the overlapping of the actual transmission between two consecutive slots that caused by the uplink timing advance adjustment. However, according to TS38.133, the timing change in one adjustment shall not exceed Tq as shown below, which is much shorter than CP. Therefore, only a very small part of the CP of the first symbol is dropped in this case. In other words, all the symbols can still be transmitted. Therefore, we don’t see any issue here. TS38.133When the transmission timing error between the UE and the reference timing exceeds ±Te then the UE is required to adjust its timing to within ±Te. The reference timing shall be  before the downlink timing of the reference cell. All adjustments made to the UE uplink timing shall follow these rules:1) The maximum amount of the magnitude of the timing change in one adjustment shall be Tq.2) The minimum aggregate adjustment rate shall be Tp per second.3) The maximum aggregate adjustment rate shall be Tq per 200 ms. where the maximum autonomous time adjustment step Tq and the aggregate adjustment rate Tp are specified in Table 7.1.2.1-1.Table 7.1.2.1-1: Tq Maximum Autonomous Time Adjustment Step and Tp Minimum Aggregate Adjustment rate

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency Range | SCS of uplink signals (kHz) | Tq | Tp  |
| 1 | 15 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 30 | 5.5\*64\*Tc | 5.5\*64\*Tc |
|  | 60 | 5.5\*64\*Tc | 5.5\*64\*Tc |
| 2 | 60 | 2.5\*64\*Tc | 2.5\*64\*Tc |
|  | 120 | 2.5\*64\*Tc | 2.5\*64\*Tc |
| NOTE: Tc is the basic timing unit defined in TS 38.211 [6] |

 |
| Samsung | Can be left to UE implementation. |
| LG | @ZTE, Thanks for addressing our concern! Unfortunately what you captured above is only for the UE autonomous TA, not gNB indicated TA adjustment.@Samsung, since this affects the start of actual TDW, we think it should be clearly decided.According to TS 38.213, it is clearly stated that UE does not transmit PUCCH when the number of symbols available for the PUCCH repetition is smaller than the value provided by nrofSymbols. However there is no such statement for PUSCH which could lead misunderstanding of whether PUSCH is transmitted or not when PUSCH is configured to be transmitted on the reduced slot due to the TA adjustment. Moreover it changes the start of actual TDW boundary, as shown in follow figure. Due to align the understanding of actual TDW boundary between gNB and UE, it should be defined whether the PUSCH is transmitted or not in the reduced slot especially when the available symbols for the PUSCH is smaller than the configured symbols for the PUSCH. |

Any other comments?

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| --- | --- |
| **Companies** | **Comments** |
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1. Email discussion (2nd round)

## 5.1 Time domain window

#### Issue #1: The start of configured TDW for CG PUSCH

**FL comments:** It seems the majority do not support the following proposal. Suggest no further discussion in this meeting.

**Proposal:**

* For CG PUSCH, the first configured TDW should always start from the first physical slot of a CG period.

**Support:** Sharp, Huawei, HiSilicon

**Not support:** Qualcomm, Nokia, NSB, vivo, Intel, ZTE, Panasonic, Samsung, LG, CATT, Xiaomi, Lenovo, Motorola Mobility, Ericsson

#### Issue #2: Candidate values of the window length *L* of the configured TDW

**FL comments:** As commented by ZTE, Panasonic, LG, Xiaomi and Ericsson, we have achieved the following agreement. What needs to be determined is the upper bound. Based on LS [5], RAN4 is still studying the maximum value for maximum duration, and RAN4 is studying the impact of enabling up to 32 slots. Other numbers beyond 32 slots are not analyzed in RAN4. The following proposal is proposed with 32 in square brackets. We can revisit them after receiving further information from RAN4.

|  |
| --- |
| **Agreement:*** The candidate values of the window length *L* of the configured TDW can be any integer value that is larger than 1 and no larger than the maximum duration.
 |

**Proposal 1:**

* The value range of *PUSCH-TimeDomainWindowLength* is INTEGER (2..[32]).
* The value range of *PUCCH-TimeDomainWindowLength* is INTEGER (2..[32]).

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
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|  |  |
|  |  |

#### Issue #3: Events that violate power consistency and phase continuity

##### Issue #3-1: Events for multi-TRP operations

**FL comment:** It seems the majority support UL beam switching for multi-TRP operation as a semi-static event.

**Proposal 2:**

* If DMRS bundling and UL beam switching for multi-TRP operation are configured simultaneously, UL beam switching for multi-TRP operation is regarded as a semi-static event.

**Support:** Nokia, NSB, vivo, Intel, InterDigital, Samsung, Sharp, Apple, LG, CATT, Xiaomi, Spreadtrum, Lenovo, Motorola Mobility, Ericsson.

**Not support:** Qualcomm, InterDigital, ZTE, Panasonic, NTT DOCOMO

Companies are encouraged to provide comments on the above proposal.

|  |  |
| --- | --- |
| **Companies** | **Comments** |
|  |  |
|  |  |
|  |  |

##### Issue #3-2: Dynamic & semi-static events

**FL comments:** It seems the majority support a new actual TDW is created for the following cases.

* Case 1: A semi-static event is triggered after one or multiple dynamic events. Whether a new actual TDW is created after the semi-static event?
* Case 2: A semi-static event overlaps with a dynamic event. Whether a new actual TDW is created after the semi-static event?

**Proposal 3:**

* If a semi-static event is triggered after one or multiple dynamic events, a new actual TDW is created after the semi-static event.
* If a semi-static event overlaps with a dynamic event, a new actual TDW is created after the semi-static event.

Companies are encouraged to provide comments on the above proposal.

|  |  |
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| **Companies** | **Comments** |
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##### Issue #3-3: Dropping/Collision rules

**FL comments:** Regardingdropping/cancellation based on Rel-17 collision rules, the proponents are encouraged to provide details

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| **Companies** | **Comments** |
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**FL comments:** It seems the following proposal is stable. Please refrain from any further comments.

**Proposal 4: Adopt the following TP to TS 38.214**

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| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS****< unchanged text omitted>**- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9, clause 9.2.6 and clause 11.1 of [6, TS 38.213].**< unchanged text omitted>** |

##### Issue #3-4: HD-FDD RedCap UE related issues

**FL comments:** It seems more discussion is needed, companies are encouraged to provide further comments, especially on the comments from Huawei in the 1st round.

**Huawei** proposes that for HD-FDD RedCap UEs, an event is constituted if the scheduled UL symbols overlap with any symbol of an SS/PBCH block provided by *ssb-PositionInBurst*.

**Spreadtrum** proposes that a downlink reception or downlink monitoring based on higher layer singling or DCI format is regarded as an event.

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| **Companies** | **Comments** |
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##### Issue #3-5: Clarifications on the events

**FL comments:** For extended CP, it seems the majority support the proposal by vivo, while some companies think it depends on RAN4.

**Proposal 5:** Send an LS to RAN4 asking the following question

* For extended CP, is 11-symbol the maximum length for the non-zero un-scheduled gap in-between the PUSCH transmission or PUCCH repetition, when UE is required to maintain power consistency and phase continuity?

Companies are encouraged to provide comments on the above proposal.

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| **Companies** | **Comments** |
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## 5.2 TPC command

**FL comments:** As discussed during the GTW session, we need to agree on some basic principle. Otherwise if we finally cannot make consensus on the TP, the similar situation could happen during the Editor’s CR phase. If the scope of the original proposal is too large, we can restrict the scope for DMRS bundling only.

**Proposal 6:**

* No redefinition of transmission occasion for PUSCH/PUCCH for DMRS bundling in Rel-17.

**Support:** Qualcomm, Nokia, NSB, vivo, Intel, Panasonic, Apple, LG, CATT, Xiaomi, Spreadtrum, Ericsson, Huawei, HiSilicon

**Not support:** Samsung

Companies are encouraged to provide comments on the above proposal.

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| **Companies** | **Comments** |
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**FL comments:** Regarding absolute TPC commands, the majority think absolute TPC commands is supported for DCI format 2\_2. Before discussing Rel-17 enhancements on power control procedure, I would like to align the understanding among companieson Rel-15/16 legacy power control procedure. Illustration of legacy power control procedure for PUSCH repetitions with configured grant and dynamic grant is shown in the following figures, respectively. Where PDCCH **colored with purple** indicates it carries DCIs format 2\_2 with group common TPC commands, e.g. $PDCCH\_{A}$, $PDCCH\_{B}$ and $PDCCH\_{C}$. $PUSCH\_{1}$ is scheduled by $PDCCH\_{1}$ for both cases, while PUSCH repetitions are scheduled by $PDCCH\_{2}$ for DG-PUSCH.

$PUSCH\_{i}$: PUSCH transmission occasion *i*;

$f\_{i}$: Transmission power control state for $PUSCH\_{i}$;

$δ\_{i}$: TPC command value of $PDCCH\_{i}$;

$D\_{i}$: A set of TPC command values that should be accumulated for $PUSCH\_{i}$;

T(*i*): Time period for TPC accumulation for $PUSCH\_{i}$.



Fig. Illustration of legacy power control procedure for CG-PUSCH



Fig. Illustration of legacy power control procedure for DG-PUSCH

* **CG-PUSCH**

**Accumulate TPC commands**

Based on current spec., T(*i*) is the period of accumulating TPC command value for $PUSCH\_{i}$. Thus, If the UE is provided *PUSCH-DMRS-Bundling = ‘enabled’* and not provided *tpc-Accumulation*,

For $PUSCH\_{2}$, $D\_{2}=\left\{δ\_{A}\right\}$, $f\_{2}=f\_{1}+δ\_{A}$;

For $PUSCH\_{3}$, $D\_{3}=\left\{δ\_{B}\right\}$, $f\_{3}=f\_{2}+δ\_{B}$;

For $PUSCH\_{4}$, $D\_{4}=ϕ$, $f\_{4}=f\_{3}$;

**Absolute TPC commands**

If the UE is provided *PUSCH-DMRS-Bundling = ‘enabled’* and *tpc-Accumulation*,

For $PUSCH\_{2}$, $f\_{2}=δ\_{A}$;

For $PUSCH\_{3}$, $f\_{3}=δ\_{B}$;

For $PUSCH\_{4}$, $f\_{4}=δ\_{B}$;

It can be seen that the values of transmission power for $PUSCH\_{2}$ and $PUSCH\_{3}$ are different, i.e. $f\_{2}\ne f\_{3}$. **Therefore, for Rel-15/16 legacy power control procedure, the action of group common TPC command with DCI format 2\_2 will break the power consistency for CG-PUSCH.**

Companies are encouraged to check whether the above is the correct understanding of Rel-15/16 legacy power control procedure for CG-PUSCH.

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| **Companies** | **Comments** |
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* **DG-PUSCH**

**Accumulate TPC commands**

Based on current spec., T is the period of accumulating TPC command value for all of the PUSCH repetitions.

For $PUSCH\_{2}$, $D\_{2}=\left\{δ\_{A},δ\_{2}\right\}$, $f\_{2}=f\_{1}+δ\_{A}+δ\_{2}$;

For $PUSCH\_{3}$, $D\_{3}=\left\{δ\_{A},δ\_{2}\right\}$, $f\_{3}=f\_{1}+δ\_{A}+δ\_{2}$;

For $PUSCH\_{4}$, $D\_{4}=\left\{δ\_{A},δ\_{2}\right\}$, $f\_{4}=f\_{1}+δ\_{A}+δ\_{2}$;

**Absolute TPC commands**

If the UE is provided *PUSCH-DMRS-Bundling = ‘enabled’* and *tpc-Accumulation*,

For $PUSCH\_{2}$, $f\_{2}=δ\_{2}$;

For $PUSCH\_{3}$, $f\_{3}=δ\_{2}$;

For $PUSCH\_{4}$, $f\_{4}=δ\_{2}$;

It can be seen that for original DG-PUSCH, the group common TPC commands of $δ\_{B}$ and $δ\_{C}$ will not take effect no matter DMRS bundling is enabled or not. **Therefore, for Rel-15/16 legacy power control procedure, it seems the action of group common TPC command with DCI format 2\_2 will NOT break the power consistency for DG-PUSCH.**

Companies are encouraged to check whether the above is the correct understanding of Rel-15/16 legacy power control procedure for DG-PUSCH.

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| **Companies** | **Comments** |
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* **Rel-17 enhancements to support DM-RS bundling**

For CG-PUSCH, the following solutions are proposed by companies:

* **Option 1:** Modify the definition of $K\_{PUSCH}\left(i\right)$, e.g. $K\_{PUSCH}\left(i\right)$ is a number of symbols from the first symbol of the nominal time domain window including the transmission occasion *i* and before a first symbol of the transmission occasion *i*.
* **Option 2:** Modify the TPC command value set $D\_{i}$, e.g. if transmission occasion *i* is not the first transmission occasion within a nominal time domain window, then any TPC command values received via DCI format 2\_2 contained in the set $D\_{i}$ are deleted and added to the set $D\_{j}$ where *j* is a transmission occasion occurring after the end of the nominal time domain window.
* **Option 3:** Modify the behavior for accumulating TPC command value, e.g. ① For a transmission occasion $i$ occurs within a nominal time domain window, $f\_{i}=f\_{ i\_{1}}$, where transmission occasion $i\_{1}$ is a first transmission occasion within the nominal time domain window; ② for the first transmission occasion $i$ occurs after the nominal time domain window, $f\_{i}=f\_{i\_{1}}+\sum\_{}^{}δ\_{i}$, where $δ\_{i}$ is the TPC command values that would take effect between the first symbol of the previous nominal time domain window and the first symbol of current nominal time domain window.

Companies are encouraged to provide comments on the above options for CG-PUSCH.

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| **Companies** | **Comments** |
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For DG-PUSCH, there can be two ways to go:

* **Alt 1: Keep Rel-15/16 legacy power control procedure.**
* **Alt 2: Align with CG-PUSCH.**

Companies are encouraged to provide comments on the above alternatives for DG-PUSCH.

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| **Companies** | **Comments** |
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## 5.3 RRC parameters

**FL comments:** Based on companies’ comments, the proposal is updated as follows:

**Proposal 7:** Update the description of the RRC parameters *PUSCH-Window-Restart* and *PUCCH-Window-Restart* as follows*.*

* UE bundles PUSCH DM-RS remaining in a nominal time domain window after ~~dynamic~~ event(s) triggered by DCI or MAC-CE that violate power consistency and phase continuity requirements
* UE bundles PUCCH DM-RS remaining in a nominal time domain window after ~~dynamic~~ event(s) triggered by DCI or MAC-CE that violate power consistency and phase continuity requirements

Companies are encouraged to provide comments on the above proposal.

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| **Companies** | **Comments** |
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## 5.4 Others

**FL comments:** It seems more inputs are needed for the following issues.

Qualcomm proposes to restrict DMRS bundling for PUSCH to only MCS values that correspond to QPSK or lower modulation orders. In addition, RAN4 has agreed to only focus on the modulation orders not higher than QPSK [6].

**Proposal 8:**

* Restrict DMRS bundling for PUSCH to only MCS values that correspond to QPSK or lower modulation orders.

Companies are encouraged to provide comments on the above proposal.

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| **Companies** | **Comments** |
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**Apple** proposes to adopt the following TP for updating the specification to capture that DMRS building can be applied to Repetition type A defined in Rel-15 /16 /17 and Repetition type B with configured grant(TS 38.214)**:**

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| **6.1.7 UE procedure for determining time domain windows for bundling DM-RS**For PUSCH transmissions of PUSCH repetition Type A , PUSCH repetition Type B and TB processing over multiple slots, when *PUSCH-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:- For PUSCH transmissions of repetition Type A, PUSCH repetition Type B and TB processing over multiple slots, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:- Given by *PUSCH-TimeDomainWindowLength*, if configured. |

Companies are encouraged to provide comments on the above proposal.

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| **Companies** | **Comments** |
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**LG** observes that some clarification is required for the case where the slot for starting DMRS bundling is a reduced slot due to TA command.

* If the TDRA table of PUSCH repetition type A is not satisfied due to TA command, clarification that PUSCH transmission is not performed is required.
* When a reduced slot occurs due to the TA adjustment, clarification regarding the actual TDW boundary according to whether the actual repetition of PUSCH repetition type B is transmitted or not is necessary.

Companies are encouraged to provide comments on the above problem by LG.

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| **Companies** | **Comments** |
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1. Agreements at RAN1#107-e

**Agreement:**

**Support Option 1’-a**

**Option 1’-a:**

* If L is configured, the maximum value of window length L of the configured TDW should not exceed the maximum duration, which is reported as UE capability as the duration where UE is able to maintain power consistency and phase continuity subject to power consistency and phase continuity requirements.
* If L is not configured, the default value of L = min (maximum duration, duration of all PUSCH repetitions)

**Agreement:**

* For non-back-to-back PUSCH/PUCCH transmissions across consecutive slots, the other uplink transmission in the middle of two PUSCH/PUCCH transmissions constitutes an event that violates power consistency and phase continuity.

**Conclusion:**

* Dynamic indication of the window length *L* of the configured TDW by DCI or indicated by TDRA table with one additional entry is not supported.

**Agreement:**

**This working Assumption is confirmed.**

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| **Working assumption:*** The start of the first actual TDW is the first ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for the first PUSCH transmission in an available slot within the configured TDW.
* The end of the actual TDW is
	+ the last ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for the last PUSCH transmission in an available slot within the configured TDW if the actual TDW reaches the end of the last PUSCH transmission within the configured TDW.
	+ the last ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ of the PUSCH transmission right before the event if an event occurs that violates power consistency and phase continuity, and the PUSCH transmission is in an available slot.
* For UE capable of restarting DM-RS bundling, the start of the new actual TDW is the first ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for PUSCH transmission after the event violates power consistency and phase continuity, and the PUSCH transmission is in an available slot.
 |

**Agreement:**

* The action of gNB indicated TA commands constitutes an event that violates power consistency and phase continuity.

**Agreement:**

* If DM-RS bundling is supported, UE is mandatory to support restarting DM-RS bundling due to semi-static events. UE capability of restarting DMRS bundling is applied only to dynamic events.
	+ An event is regarded as a dynamic event if it is triggered by a DCI or MAC-CE, otherwise it is regarded as a semi-static event.
	+ Note: At least frequency hopping event is considered as semi-static event.

**Working assumption:**

* 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.

**Agreement:**

**The following working Assumption is confirmed.**

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| **Working assumption:**For joint channel estimation for PUSCH repetition type A of PUSCH repetitions of the same TB, all the repetitions are covered by one or multiple consecutive/non-consecutive configured TDWs.* Each configured TDW consists of one or multiple consecutive physical slots.
* The window length *L* of the configured TDW(s) can be explicitly configured with a single value ~~and~~ *~~L~~* ~~is no longer than the maximum duration~~.
	+ FFS: The maximum value of *L* ~~is the duration of all repetitions~~
	+ FFS: Solutions to error propagation issue if ~~for~~ *L* is longer than the maximum duration is to be discussed further.
	+ FFS: The window length *L* is configured per UL BWP
* The start of the first configured TDW is the first PUSCH transmission
	+ FFS: The first available slot/symbol, or the first physical slot/symbol for the first PUSCH transmission.
* The start of other configured TDWs can be implicitly determined prior to first repetition.
	+ FFS: The configured TDWs are consecutive for paired spectrum/SUL band
	+ FFS: The start of the configured TDWs for unpaired spectrum is implicitly determined based on semi-static DL/UL configuration.
* The end of the last configured TDW is the end of the last PUSCH transmission.
	+ FFS: The end of the configured TDW is the last available slot/symbol, or the last physical slot/symbol for the last PUSCH transmission.
* Within one configured TDW, one or multiple actual TDWs can be implicitly determined:
	+ The start of the first actual TDW is the first PUSCH transmission within the configured TDW.
		- FFS: The first available slot/symbol, or the first physical slot/symbol for the first PUSCH transmission.
	+ After one actual TDW starts, UE is expected to maintain the power consistency and phase continuity until one of the following conditions is met, then the actual TDW is ended.
		- The actual TDW reaches the end of the last PUSCH transmission within the configured TDW.
			* FFS: The end of the actual TDW is the last available slot/symbol, or the last physical slot/symbol for the last PUSCH transmission.
		- An event occurs that violates power consistency and phase continuity
			* FFS: The events may include e.g., a DL slot based on DL/UL configuration for unpaired spectrum, the actual TDW reaches the maximum duration, DL reception/monitoring occasion for unpaired spectrum, high priority transmission, frequency hopping, precoder cycling.
			* FFS: The end of the actual TDW is the last available slot/symbol of the PUSCH transmission right before an event such that the power consistency and phase continuity are violated.
	+ If the power consistency and phase continuity are violated due to an event, whether a new actual TDW is created is subject to UE capability of supporting restarting DMRS bundling.
		- If UE is capable of restarting DM-RS bundling, one new actual TDW is created after the event,
			* FFS: The start of the new actual TDW is the first available slot/symbol for PUSCH transmission after the event.
		- If UE is not capable of restarting DM-RS bundling, no new actual TDW is created until the end of the configured TDW.
		- FFS: UE capability of restarting DMRS bundling is applied only to dynamic event or not

Note 1: A ‘configured TDW’ refers to a time domain window whose length can be configured to ‘L’ and whose start and end is determined as described above. Note 2: An ‘actual TDW’ refers to a time domain window during whose entire duration the DM-RS bundling is actually applied. An ‘actual TDW’ duration is always less than or equal to the ‘configure TDW’ duration.Note 3: Whether the terms ‘configured TDW’ and ‘actual TDW’ are revised to other terms and if such terminology is used in specifications is to be further discussed. |

**Agreement:**

* The candidate values of the window length *L* of the configured TDW can be any integer value that is larger than 1 and no larger than the maximum duration.

**Agreement:** The following agreement is clarified as follows.

* For PUSCH repetition type A counting based on available slots,
	+ “The configured TDWs are determined based on available slots” in the agreement means “The start of the configured TDWs is determined based on available slots”

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| **Agreement*** For PUSCH repetition type A counting based on physical slots
	+ The configured TDWs are consecutive, where the start of other configured TDWs is the first physical slot right after the last physical slot of a previous configured TDW.
* For PUSCH repetition type A counting based on available slots
	+ The configured TDWs are determined based on available slots, where start of a configured TDWs is the first available slot after the last available slot of a previous configured TDW.
	+ Note: The determination of available slots for PUSCH repetition Type A is defined in AI 8.8.1.1.
 |

**Agreement:**

* UE should not perform UE autonomous TA adjustment during the actual time domain window.

**Agreement:**

* The TDW determination procedure agreed for PUSCH repetition type A is reused, when applicable, for PUSCH repetition type B and TBoMS with or without repetition.
* No additional specification enhancements for PUSCH repetition type B and TBoMS.

**Agreement:**

* If DMRS bundling and UL beam switching for multi-TRP operation are configured simultaneously, UL beam switching for multi-TRP operation constitutes an event that violates power consistency and phase continuity.
	+ FFS: UL beam switching for multi-TRP operation is regarded as a semi-static event.
1. Agreements at RAN1#106b-e

**Agreement:**

* For PUSCH repetition type A counting based on physical slots
	+ The start of the first configured TDW is the first physical slot for the first PUSCH transmission.
	+ The end of the last configured TDW is the last physical slot for the last PUSCH transmission.
* For PUSCH repetition type A counting based on available slots
	+ The start of the first configured TDW is the first available slot for the first PUSCH transmission.
	+ The end of the last configured TDW is the last available slot for the last PUSCH transmission.
	+ Note: The determination of available slots for PUSCH repetition Type A is defined in AI 8.8.1.1.

**Conclusion:**

* Joint channel estimation over PUSCH transmissions across non-consecutive slots is not supported in Rel-17.

**Agreement:**

Down-select one of the following options in this meeting:

**Option 1**:

* The maximum value of window length *L* of the configured TDW should not exceed the maximum duration, which is reported as UE capability as the duration where UE is able to maintain power consistency and phase continuity subject to power consistency and phase continuity requirements.

**Option 1’:**

* The maximum value of window length L of the configured TDW should not exceed the maximum duration, which is reported as UE capability as the duration where UE is able to maintain power consistency and phase continuity subject to power consistency and phase continuity requirements.
	+ - ~~If L is not configured, the configured TDW length is equal to all repetitions~~
		- If L is not configured, default behavior should be defined, e.g., the configured TDW length is equal to all repetitions

**Option 3’**:

* Whether the window length *L* of the configured TDW can be longer than maximum duration is subject to UE capability.
	+ If UE is capable of *L* being longer than maximum duration,
		- The maximum value of the window length *L* of the configured TDW is the duration of all repetitions.
			* FFS: whether *L* cannot be other values other than the duration of all repetitions, if it is longer than the maximum duration.
		- If *L* is longer than the maximum duration, UE does not expect dynamic events.
			* FFS: details of dynamic events

**Agreement**

* For DG-PUSCH, Type1 CG-PUSCH and Type2 CG-PUSCH, the window length L of the configured TDW is at least configured by RRC.
* FFS: For DG-PUSCH and Type2 CG-PUSCH, whether the window length *L* of the configured TDW can be indicated by DCI or indicated by TDRA table with one additional entry.

**Agreement**

* The window length L of the RRC configured TDW is configured separately for PUSCH and PUCCH.
	+ For PUSCH, *L* is configured per BWP.
* FFS whether the window length L can be configured with each row in the TDRA table

**Agreement**

* For PUSCH repetition type A counting based on physical slots
	+ The configured TDWs are consecutive, where the start of other configured TDWs is the first physical slot right after the last physical slot of a previous configured TDW.
* For PUSCH repetition type A counting based on available slots
	+ The configured TDWs are determined based on available slots, where start of a configured TDWs is the ~~next~~ first available slot after the ~~conclusion~~ last available slot of a previous configured TDW.
	+ Note: The determination of available slots for PUSCH repetition Type A is defined in AI 8.8.1.1.

**Working assumption:**

* The start of the first actual TDW is the first ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for the first PUSCH transmission in an available slot within the configured TDW.
* The end of the actual TDW is
	+ the last ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for the last PUSCH transmission in an available slot within the configured TDW if the actual TDW reaches the end of the last PUSCH transmission within the configured TDW.
	+ the last ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ of the PUSCH transmission right before the event if an event occurs that violates power consistency and phase continuity, and the PUSCH transmission is in an available slot.
* For UE capable of restarting DM-RS bundling, the start of the new actual TDW is the first ~~available~~ symbol (at least determined by TDRA table) ~~in available slot~~ for PUSCH transmission after the event violates power consistency and phase continuity, and the PUSCH transmission is in an available slot.

**Agreement**

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following case:
	+ Over back-to-back PUSCH transmissions for one TB processed over multiple slots
		- It’s subject to UE capability
		- if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A

**Agreement**

* For non-back-to-back PUSCH transmissions across consecutive slots (no uplink transmission in the middle of two PUSCH transmissions), support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following case:
	+ Over non-back-to-back PUSCH transmissions for one TB processed over multiple slots
		- It’s subject to UE capability
		- if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A

**Agreement**

Down-select one of the following options:

* **Option 1:** If DM-RS bundling is supported, UE is mandatory to support restarting DM-RS bundling due to semi-static events. UE capability of restarting DMRS bundling is applied only to dynamic events.
* **Option 2:** UE capability of restarting DMRS bundling is applied to both semi-static events and dynamic events.

**Agreement**

* Support at least the following events that violate power consistency and phase continuity.
	+ Dropping/cancellation based on Rel-15/16 collision rules.
	+ FFS: Rel-17 collision rules.
	+ DL slot or DL reception/monitoring based on semi-static DL/UL configuration for unpaired spectrum.
	+ FFS: Other UL transmission in between PUSCH/PUCCH transmissions.
	+ Gap between two PUSCH/PUCCH transmissions exceeds 13 symbols.
	+ FFS: Transmission parameters need to be changed due to network-indicated operations, including: Tx power, UL beam/TPMI, and RB allocation.
	+ FFS: TPC command.
	+ FFS: TA adjustment.
	+ FFS: The actual TDW reaches the maximum duration.
	+ FFS: Frequency hopping.
	+ FFS: Precoder cycling.
	+ FFS: other events.
	+ FFS: whether events are semi-static events or dynamic events.
	+ FFS: the time duration of an event.

**Agreement**

* Introduce two RRC parameters to indicate enabling of DM-RS bundling and the window length of the configured TDW respectively.

**Agreement**

* Introduce a new RRC parameter for when UE restarts a PUSCH bundling window
1. Agreements at RAN1#106-e

**Agreement: Confirm the following working assumption.**

**Working assumption:**

* For non-back-to-back PUSCH transmissions (at least for the case of the same TB) across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following cases:
	+ Over non-back-to-back PUSCH transmissions (of the same TB) for repetition type A scheduled by dynamic grant or configured grant.
	+ Over non-back-to-back PUSCH transmissions (of the same TB) for repetition type B scheduled by dynamic grant or configured grant, if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A.
		- FFS: additional specification enhancements on top of that defined to support repetition Type A
		- Only for single layer transmissions
		- Subject to UE capability
	+ FFS: Over non-back-to-back PUSCH transmissions with different TBs
	+ FFS: Over non-back-to-back PUSCH transmissions for TBoMS
	+ For the non-back-to-back PUSCH transmissions, it is defined as at least when there is no UL transmission between the two successive PUSCH transmissions
	+ Subject to UE capability with details FFS (e.g., separate vs. joint capability for type A & type B, w.r.t. OFF power requirements, etc.)
* FFS: Joint channel estimation over non-back-to-back PUSCH transmissions with other uplink transmissions between the two successive PUSCH transmissions across consecutive slot.

**Conclusion**

* Optimization of DMRS location in time domain for PUSCH is not considered for joint channel estimation in Rel-17.

**Agreement**

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

**Agreement**

**Make down-selection between the following two alternatives:**

* Alt 1: UE is not expected to receive TPC commands during the current time domain window.
* Alt 2: UE receives and accumulates TPC commands without taking effect during the current time domain window.

**Agreement**

* UE should not perform TA adjustment during the time domain window.
	+ FFS: UE does not expect to receive TA command to indicate TA adjustment during the TDW.
	+ FFS: UE ignores any TA command which indicates TA adjustment during the TDW.
	+ FFS: UE performs TA adjustment after the TDW if it receives any TA command indicating TA adjustment during the TDW.

**Working assumption:**

For joint channel estimation for PUSCH repetition type A of PUSCH repetitions of the same TB, all the repetitions are covered by one or multiple consecutive/non-consecutive configured TDWs.

* Each configured TDW consists of one or multiple consecutive physical slots.
* The window length *L* of the configured TDW(s) can be explicitly configured with a single value ~~and~~ *~~L~~* ~~is no longer than the maximum duration~~.
	+ FFS: The maximum value of *L* ~~is the duration of all repetitions~~
	+ FFS: Solutions to error propagation issue if ~~for~~ *L* is longer than the maximum duration is to be discussed further.
	+ FFS: The window length *L* is configured per UL BWP
* The start of the first configured TDW is the first PUSCH transmission
	+ FFS: The first available slot/symbol, or the first physical slot/symbol for the first PUSCH transmission.
* The start of other configured TDWs can be implicitly determined prior to first repetition.
	+ FFS: The configured TDWs are consecutive for paired spectrum/SUL band
	+ FFS: The start of the configured TDWs for unpaired spectrum is implicitly determined based on semi-static DL/UL configuration.
* The end of the last configured TDW is the end of the last PUSCH transmission.
	+ FFS: The end of the configured TDW is the last available slot/symbol, or the last physical slot/symbol for the last PUSCH transmission.
* Within one configured TDW, one or multiple actual TDWs can be implicitly determined:
	+ The start of the first actual TDW is the first PUSCH transmission within the configured TDW.
		- FFS: The first available slot/symbol, or the first physical slot/symbol for the first PUSCH transmission.
	+ After one actual TDW starts, UE is expected to maintain the power consistency and phase continuity until one of the following conditions is met, then the actual TDW is ended.
		- The actual TDW reaches the end of the last PUSCH transmission within the configured TDW.
			* FFS: The end of the actual TDW is the last available slot/symbol, or the last physical slot/symbol for the last PUSCH transmission.
		- An event occurs that violates power consistency and phase continuity
			* FFS: The events may include e.g., a DL slot based on DL/UL configuration for unpaired spectrum, the actual TDW reaches the maximum duration, DL reception/monitoring occasion for unpaired spectrum, high priority transmission, frequency hopping, precoder cycling.
			* FFS: The end of the actual TDW is the last available slot/symbol of the PUSCH transmission right before an event such that the power consistency and phase continuity are violated.
	+ If the power consistency and phase continuity are violated due to an event, whether a new actual TDW is created is subject to UE capability of supporting restarting DMRS bundling.
		- If UE is capable of restarting DM-RS bundling, one new actual TDW is created after the event,
			* FFS: The start of the new actual TDW is the first available slot/symbol for PUSCH transmission after the event.
		- If UE is not capable of restarting DM-RS bundling, no new actual TDW is created until the end of the configured TDW.
		- FFS: UE capability of restarting DMRS bundling is applied only to dynamic event or not

Note 1: A ‘configured TDW’ refers to a time domain window whose length can be configured to ‘L’ and whose start and end is determined as described above.

Note 2: An ‘actual TDW’ refers to a time domain window during whose entire duration the DM-RS bundling is actually applied. An ‘actual TDW’ duration is always less than or equal to the ‘configure TDW’ duration.

Note 3: Whether the terms ‘configured TDW’ and ‘actual TDW’ are revised to other terms and if such terminology is used in specifications is to be further discussed.

1. Agreements at RAN1#105-e

Agreement**:**

* Joint channel estimation over non-back-to-back PUSCH transmissions within one slot is not supported.

Agreement:

* Definition of **the maximum duration**: a maximum time duration during which **UE is able to** maintain power consistency and phase continuity subject to power consistency and phase continuity requirements.
* FFS whether or not such a definition is necessary for RAN1 specifications.
	+ Note: whether such a definition is to be specified in RAN4 specifications is up to RAN4.
* FFS the maximum duration may be reported by UE.
* Note: it is understood that for a UE, the maximum duration is no less than the time domain window duration

Agreement:Send LS to RAN4 asking the following questions

* For joint channel estimation, is there a maximum duration during which UE is able to maintain power consistency and phase continuity under certain tolerance level? If any, how long is it?
	+ What factors determine the maximum duration?
	+ Whether the maximum duration should be the same for different cases for both PUSCH and PUCCH?
	+ Whether the maximum duration is dependent on the modulation order of transmission, e.g., QPSK, 16QAM, 64QAM?
	+ Whether the maximum duration is dependent on UL waveform (DFT-s-OFDM vs. OFDM)?
	+ Whether the maximum duration is band specific?
	+ Besides the factors listed above, whether or not the maximum duration is further dependent on UE capabilities (e.g., multiple possible values for a given set of factor(s)), and if so, whether the UE should report such a duration

Agreement:

* Optimization of DMRS granularity in time domain for PUSCH is not considered for joint channel estimation in Rel-17.

Agreement:

* For back-to-back PUSCH transmissions within one slot, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following cases:
	+ Over back-to-back PUSCH transmissions (of the same TB) for repetition type B scheduled by dynamic grant or configured grant, if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A with consecutive slots
		- FFS: additional specification enhancements on top of that defined to support repetition Type A
		- Only for single layer transmissions
		- Subject to UE capability
* Joint channel estimation over back-to-back PUSCH transmissions with different TBs within one slot is not supported.

**Working assumption:**

* For non-back-to-back PUSCH transmissions (at least for the case of the same TB) across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following cases:
	+ Over non-back-to-back PUSCH transmissions (of the same TB) for repetition type A scheduled by dynamic grant or configured grant.
	+ Over non-back-to-back PUSCH transmissions (of the same TB) for repetition type B scheduled by dynamic grant or configured grant, if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A.
		- FFS: additional specification enhancements on top of that defined to support repetition Type A
		- Only for single layer transmissions
		- Subject to UE capability
	+ FFS: Over non-back-to-back PUSCH transmissions with different TBs
	+ FFS: Over non-back-to-back PUSCH transmissions for TBoMS
	+ For the non-back-to-back PUSCH transmissions, it is defined as at least when there is no UL transmission between the two successive PUSCH transmissions
	+ Subject to UE capability with details FFS (e.g., separate vs. joint capability for type A & type B, w.r.t. OFF power requirements, etc.)
* FFS: Joint channel estimation over non-back-to-back PUSCH transmissions with other uplink transmissions between the two successive PUSCH transmissions across consecutive slot.

Agreement:

* Joint channel estimation for PUSCH transmissions is enabled or disabled via RRC configuration for a UE
	+ FFS: whether additional dynamic signaling is needed to enable/disable joint channel estimation for PUSCH transmissions
	+ Note: the enabling of such a feature is subject to certain prerequisites
	+ FFS RRC parameter details (including explicit vs. implicit configuration)
* FFS For joint channel estimation for PUSCH, the time domain window is not explicitly enabled or disabled separately from joint channel estimation.

Note: Enabling/disabling of joint channel estimation for PUSCH transmissions means enabling/disabling of DMRS bundling for PUSCH transmissions under the condition of power consistency and phase continuity.

Agreement:

For joint channel estimation for PUSCH repetition type A of PUSCH repetitions of the same TB, down select one of the following alternatives for the time domain window.

* Alt 1: All the repetitions are covered by one single time domain window
	+ The start of the window is the first PUSCH transmission
	+ FFS: how to handle non-consecutive physical slots for UL transmission, e.g., due to DL/UL configuration for unpaired spectrum
	+ FFS: frequency hopping and precoder cycling
* Alt 2: All the repetitions are covered by one or multiple time domain windows
	+ For the start of each window,
		- The start of the first window is the first PUSCH transmission.
		- FFS: how to determine the start of other windows, e.g., whether multiple windows are consecutive or non-consecutive, whether the start of the window depends on DL/UL configuration for unpaired spectrum
	+ For the length of each window,
		- FFS Each window consists of at least two adjacent physical slots for UL transmission.
		- The length of each window is no longer than the maximum duration.
		- FFS: how to determine the length of each window
		- FFS: whether the length of each window depends on DL/UL configuration for unpaired spectrum
	+ FFS: how to handle non-consecutive physical slots for UL transmission, e.g., due to DL/UL configuration for unpaired spectrum.
	+ FFS: frequency hopping and precoder cycling
* Other alternatives are not precluded.
1. Agreements at RAN1#104b-e

Agreements:

* For joint channel estimation, specify a time domain window during which a UE is expected to maintain power consistency and phase continuity among PUSCH transmissions subject to power consistency and phase continuity requirements.
	+ FFS how the time domain window is determined (e.g., via explicit configuration and/or implicitly derived) and whether or not to have the possibility of enabling/disabling the time domain window
	+ FFS the units the time domain window (e.g. repetitions, slots, and/or symbols)
		- FFS : association between the potential use case(s) and units of the time window
	+ FFS: single or multiple time domain windows
* FFS: relation with UE capability
* FFS: whether the term "time domain window" is used in the specification or replaced by other technical terms
* FFS whether or not to further consider impacting of timing advance

**Agreements:**

* A new DMRS pattern equally spaced among PUSCH transmissions is not considered for joint channel estimation in Rel-17.

**Agreements:**

* For inter-slot frequency hopping with inter-slot bundling, down select on the following two options:
	+ Option 1: The bundle size (time domain hopping interval) equals to the time domain window size.
	+ Option 2: The bundle size (time domain hopping interval) can be different from the time domain window size.
		- FFS: Whether the bundle size (time domain hopping interval) is explicitly configured or implicitly determined.
		- FFS: Whether/How the bundle size (time domain hopping interval) is defined separately for FDD and TDD.
		- FFS: relation between the bundle size (time domain hopping interval) and the time domain window size

**Conclusion:**

* For optimization of DMRS granularity in time domain with joint channel estimation, the proponents are encouraged to provide more simulation results in next meeting

**Agreements:**

* For the time domain window for joint channel estimation, down select on the following two options:
	+ Option 1: The unit of the time domain window is defined separately for the following PUSCH transmissions:
		- PUSCH repetition type A
		- PUSCH repetition type B, if agreed
		- TBoMS, if agreed
		- Different TB, if agreed
	+ Option 2: The unit of the time domain window is the same for the following PUSCH transmission:
		- PUSCH repetition type A
		- PUSCH repetition type B, if agreed
		- TBoMS, if agreed
		- Different TB, if agreed

**Agreement:**

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following cases:
	+ Over back-to-back PUSCH transmissions (of the same TB) for repetition type B scheduled by dynamic grant or configured grant, if it reuses only those joint channel estimation specification enhancements defined to support repetition Type A.
		- FFS: additional specification enhancements on top of that defined to support repetition Type A
		- Only for single layer transmissions
		- Subject to UE capability
	+ FFS: Over back-to-back PUSCH transmissions with different TBs
1. Agreements at RAN1#104e

**Agreements**:

* Following potential use cases are considered for joint channel estimation for PUSCH:
	+ Use case 1: back-to-back PUSCH transmissions within one slot.
	+ Use case 2: non-back-to-back PUSCH transmissions within one slot.
	+ Use case 3: back-to-back PUSCH transmissions across consecutive slots.
	+ Use case 4: non-back-to-back PUSCH transmissions across consecutive slots.
	+ Use case 5: PUSCH transmissions across non-consecutive slots.

Note: RAN1 assumes “back-to-back PUSCH transmission” has zero gap in-between adjacent PUSCH transmissions.

Agreements:

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation at least for the following case:
	+ Over back-to-back PUSCH transmissions (of the same TB) for repetition type A scheduled by dynamic grant or configured grant
	+ FFS details (including possible other cases)

Agreements:

* For joint channel estimation, ~~define~~ a time domain window is introduced to facilitate further discussion, during which UE is expected to maintain power consistency and phase continuity among PUSCH transmissions subject to power consistency and phase continuity requirements.
	+ FFS: whether the window should be specified
	+ FFS: the length of the time domain window is defined by a set of repetitions/slots/symbols
	+ FFS: single or multiple time domain windows
* FFS: relation with UE capability
* FFS: the time domain window may or may not be configured ~~or specified~~.
* FFS: whether the term "time domain window" is used in the specification or replaced by other technical terms
* FFS: Whether the window is determined by the power consistency and phase continuity requirements and/or by other factors is to be decided.

Agreements:

* Companies are encouraged to study optimization of DMRS granularity in time domain with joint channel estimation, including:
	+ Use cases
	+ Simulations results
	+ Enhanced schemes, e.g.,
		- Different DMRS density for different PUSCH transmissions
		- No DMRS for some PUSCH transmissions
	+ If applicable, impact of dynamic changes, e.g., cancellation of a repetition and companies report the evaluation method.
* Companies are encouraged to study optimization of DMRS location in time domain with joint channel estimation, including:
	+ Use cases
	+ Simulations results
	+ Enhanced schemes, e.g.,
		- DMRS equally spaced among PUSCH transmissions
		- DMRS located in special slots
		- Orphan symbol上 used for DMRS
	+ If applicable, impact of dynamic changes, e.g., cancellation of a repetition and companies report the evaluation method.
* Note: the simulation assumptions for DM-RS in TR 38.830 are used as baseline for performance evaluation on optimization of DMRS location/granularity in time domain.
	+ Take into account impairments such as frequency offset, and report corresponding parametrization together with the results. Further discuss impairment details.

**Working assumption:**

* For back-to-back PUSCH transmissions across consecutive slots, support necessary design aspects (under the condition of power consistency and phase continuity) to enable joint channel estimation for the following case:
	+ Over back-to-back PUSCH transmissions for ~~TB processing~~ one TB processed over multiple slots
		- It’s subject to UE capability

Agreements:

* For joint channel estimation.
	+ Take into account the residual frequency error, e.g., +/- 0.1 ppm as upper bound.
	+ Companies can report other values and frequency error model.
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13. R1-2200238 Joint channel estimation for PUSCH NTT DOCOMO, INC.
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25. R1-2200590 Remaining issues on joint channel estimation for PUSCH CMCC
26. R1-2200613 Discussions on joint channel estimation for PUSCH LG Electronics
27. R1-2200657 Remaining Issues for Joint Channel Estimation for PUSCH Ericsson