#### **Issue 1-3: CA capability for DMRS bundling**

* ***Background:*** *Updated RAN1 UE feature list in LS [R4-2211513](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211513.zip)/R1-2205609*
  + *Per band granularity was agreed for FG30-4*
  + *The granularities for FG30-4a/b/…./h are still in []*

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| *Features* | *Index* | *Feature group* | *Components* | *Type* |
| *30. NR\_cov\_enh* | *30-4* | *The maximum duration for DM-RS bundling* | *The maximum duration during which UE is able to maintain power consisitency and phase continuity to support DM-RS bundling for PUSCH/PUCCH* | *Per band* |
| *30. NR\_cov\_enh* | *30-4a* | *DM-RS bundling for PUSCH repetition type A* | *Support DM-RS bundling for PUSCH repetition type A* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4b* | *DM-RS bundling for PUSCH repetition type B* | *Support DM-RS bundling for PUSCH repetition type B* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4c* | *DM-RS bundling for TB processing over multi-slot PUSCH* | *Support DM-RS bundling for TB processing over multi-slot PUSCH* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4d* | *DMRS bunding for PUCCH repetitions* | *Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4e* | *Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH* | *Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4f* | *Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling* | *Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4g* | *[Restart DM-RS bundling after the events that violate power consistency and phase continuity]* | *[Support restarting DM-RS bundling after the events that violate power consistency and phase continuity]* | *[Per UE]* |
| *30. NR\_cov\_enh* | *30-4h* | *DM-RS bundling for non-back-to-back transmission* | *Support DM-RS bundling for [non-back-to-back transmission for consecutive slots] for PUSCH and PUCCH only for [corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d)]* | *[Per UE]* |

* **Proposals**
  + Option 1: DMRS bundling capabilities are per band per band combination. (QC)
* **Recommended WF**
  + Discuss in GTW

**Discussion:**

Huawei: granularity should be decided by RAN1. From 30-4x, they are RAN1 capability.

ZTE: tend to agree with Huawei. Some capability comes from RAN1. If we have the agreement in RAN4, we can send them to RAN1. We see the intention to leave more flexibility for UE to implement.

Qualcomm: we recognize the capability is initiated by RAN1. If RAN4 identifies some difficulty to implement, RAN4 can give the feedback. There is implementation and challenge.

Apple: question to Qualcomm to clarify the motivation. Is the intention to enable DL CA or UL&DL CA?

China Telecom: to Qualcomm, is the proposal for 30-4 or 30-4a/b/c? We cannot reach any agreement for 30-4a/b/c. When RAN1 starts their work, they can take our input. To Apple, this proposal can be applied to DL CA or DL&UL CA.

Mediatek: we need be careful not to confuse RAN1. We should not send LS based on the LS sent in the last meeting. We should wait for RAN1 decision.

Qualcomm: LS does not say RAN4 has concluded. It is open item. To CTC, our view, 30-4 and 30-4a/b/d should be per band per band combination. To Apple it is for future release.

Samsung: we agree with Huawei and Mediatek.

#### **Issue 1-2: Pcmax reference time**

* ***Background:***
  + *In TS 38.214 v17.1.0 section 6.1.7 it states that “The UE shall maintain power consistency and phase continuity within an actual TDW…”.*
* **Proposals**
  + Option 1: Define Pcmax reference time as “Actual TDW” for DMRS bundling. (QC)
    - QC: TS 38.214 and TS 38.101-1 are not aligned for the power control timing parts.
* **Recommended WF**
  + Discuss in GTW

**Discussion:**

Huawei: we would like to better understand the intention for the change. It is clearly defined in RAN1 and RAN4 during actual TDW as long as the feature is activated UE needs to maintain the phase continuity. No need to clarify.

Apple: 38.213 has already defined what transmission occasion is.

Mediatek: last meeting we asked the question about the ambiguity. We should wait for RAN1 response and discussion.

Qualcomm: To Huawei, we do not agree on the actual spec. Physical channel length last for a number of OFDM symbols. If 38.214 is not aligned with TS38.101-1, 214 says that UE needs to maintain in the whole bundling. To Apple, why is there LS to ask the alignment if transmission occasion is well defined? Maybe the 38.101-1 is misaligned with UE behaviour. To MTK, we do not think RAN1 will discuss. We can wait for the next meeting.

Ericsson: our view is that in the test we only test UE capability which is the maximum time for UE to keep to consistent. That is not specified from power perspective. We do not see the need to update the Pcmax. If the actual TDW really needs be updated, we need further discuss how we should reflect this.

Qualcomm: It just means removing the whole Pcmax section.

#### **Issue 1-1: FR1 inter-band CA and SUL with DMRS bundling**

* *Background: RAN4 LS to RAN1 in R4-2211225*

*RAN4 discussed whether applying DMRS bundle to FR1 inter-band UL CA would have any RAN1 spec impacts, and would appreciate RAN1 feedback before making further decision:*

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| *Considering DL CA with “additional” UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured) with the following conditions:*   * *For carrier switching back and forth between UL carrier and SRS carrier, if the switching happens within the DMRS bundling duration, then the phase continuity is not maintained by the UE.*   *Considering FR1 inter-band UL CA with DMRS bundling with following conditions:*   * *UE shall only have ongoing transmissions on a single uplink carrier at the same time. If overlapping transmissions of PUSCH, PUCCH, and/or SRS are erroneously scheduled/configured by the gNB on more than one carrier, then the phase continuity of DMRS bundling will be broken.* * *Only configuration of a single TAG is supported.* * *If there is any carrier switching back and forth between two carriers and the switching happens within the DMRS bundling duration, then the phase continuity is not maintained by the UE.* * *Can only one band can be configured with DMRS bundling at a time?* |

*RAN4 also discussed whether applying DMRS bundle to SUL would have any RAN1 spec impacts, and would appreciate RAN1 feedback before making further decision:*

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| *Considering SUL with DMRS bundling with following conditions:*   * *Can only one band can be configured with DMRS bundling at a time?* * *If there is any carrier switching back and forth between SUL and NUL carriers and the switching happens within the bundling duration, then the phase continuity is not maintained by the UE.* |

* **Proposals** 
  + Proposal 1: Ran4 to define DMRS bundling requirement applicability to cover FR1 inter-band UL CA with the restriction that UE is not schedule to transmit simultaneously on two bands (Qualcomm)
  + Proposal 2: Ran4 to define DMRS bundling requirement applicability to cover SUL band (Huawei)
* **Moderator’s Recommendation**
  + From RAN4 perspective, it is feasible to define DMRS bundling requirement applicability to cover the following 3 scenarios:
    - FR1 inter-band UL CA with the restriction that UE is not schedule to transmit simultaneously on two bands
    - SUL band
    - DL CA with “additional” UL carrier configured with SRS only
  + RAN4 CRs on DMRS bundling requirements applicability for the above 3 scenarios can be agreed ONLY if:
    - it is also confirmed as feasible from RAN1 perspective, and,
    - based on the conditions stated in the RAN4 LS to RAN1 in R4-2211225 as well as other conditions (if any) introduced in RAN1

Discussions:

Apple: our view is quite clear that we do not consider UL CA and SUL. They are not the scope of physical layer design. It is premature. We do see the benefit for UL-CA scenario. This work is definitely worthy to see in Rel-18. Strongly urge proponents to propose them for Rel-18.

Ericsson: it seems like inter-band UL CA has already been agreed in the latest spec. There are something that need be clarified here. For the detailed analysis, we need wait for RAN1.

ZTE: for inter-band UL CA, it should be supported. The consistence can be maintained in one carrier.

Huawei: in last meeting, we agreed that we should wait for RAN1 decision.

China Telecom: firstly, we support the scenarios here. The use of SUL is to extend the coverage. SUL+DMRS bundling would be beneficial. We would like to clarify RAN1 meeting starts next week. We are OK to postpone the discussion. Regarding Ericsson discussion on the UL-CA, actually the CR for UL-CA has been agreed in the merged final.

Mediatek: we should wait for RAN1. Last meeting we agree the DL CA with one uplink configured. We should wait.

Qualcomm: to Apple, how feasible to propose them for Rel-18. Can Apple comment? Is there any activity in RAN1?

Apple: In Rel-17 RAN1 will discuss the LS we sent. From our side, we think the physical layer design cannot be adapted to UL-CA.

#### **Issue 1-1A: RAN4 specfication for FR1 CA DMRS bundling**

* *Background:*

*The CR in R4-2207659 (content shown below) was marked as agreed in the RAN4 #103e final EOM report and already implemented in v17.6.0 of TS 38.101-1.*

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| 6.4A.2.3 Transmit modulation quality for inter-band CA For inter-band carrier aggregation with one uplink carrier assigned to one NR band, the transmit modulation quality requirements in subclause 6.4.2 apply including phase continuity requirements for DMRS bundling [IE name].  For inter-band carrier aggregation with two contiguous carriers assigned to one NR band, the transmit modulation quality requirements in subclause 6.4A.2.1 apply for those carriers.  For inter-band carrier aggregation with two uplink non-contiguous carrier assigned to one NR band, the transmit modulation quality requirements in subclause 6.4A.2.2 apply for those carriers.  For inter-band carrier aggregation with uplink assigned to two NR bands, the transmit modulation quality requirements shall apply on each component carrier as defined in clause 6.4.2 with all component carriers active: PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured. For DMRS bundling [ IE name], requirements for phase continuity in clause 6.4.2.5 apply for PCC when SCC has no UL allocation for the duration of the bundle on PCC.  For combinations of intra-band and inter-band carrier aggregation with three uplink component carriers (up to two contiguously aggregated carriers per operating band), the transmit modulation quality requirements specified in subclause 6.4.2 apply for the NR band supporting one component carrier, and for the NR band supporting two contiguous component carriers the requirements specified in subclause 6.4A.2.1 apply. |

* **Recommended WF**
  + Discuss in GTW

#### **Issue 1-4: Clarificaiton on the phase coherence exemption when switching period happened**

* **Proposals**
  + Option 1: It is not expected for a UE that switches a carrier to comply with phase coherence within the switching period if the switch-to carrier is the NR carrier configured with DMRS bundling. (E///)
    - E///: There could be a carrier switching delay / OFF period on the NR carrier configured for DMRS bundling for some band combinations with 3 carriers during which UE phase coherence may not be guaranteed.
* **Recommended WF**
  + Discuss in GTW