3GPP TSG-RAN WG1 Meeting #119 Tdoc R1- 2410670

Orlando, US, November 18th – 22nd, 2024

Agenda Item: 8.1

Source: Moderator (Ericsson)

Title: Summary of NR Rel-18 Maintenance Discussion on STxMP with DMRS Bundling

Document for: Discussion, Decision

# 1 Introduction

In the understanding of [1], simultaneous transmission on multiple panels (‘STxMP’) can be configured with DMRS bundling if the UE supports both features according to the current specifications, although STxMP discussions did not specifically take DMRS bundling into account during the design process. Therefore, it may not be clear that configuring STxMP with DMRS bundling will function properly in all cases. The operation of various modes of STxMP with DMRS bundling and which of the modes can be supported with STxMP given the design principles of DMRS bundling and STxMP was therefore discussed, and an LS requesting clarification from RAN4 on the supported combinations of DMRS bundling and STxMP modes was proposed.

In this contribution, we consider issues raised in [1], and whether RAN4 input should be sought on which STxMP modes are supported with DMRS bundling.

Further comments for the initial discussion are invited in section 2. Responses are summarized after first round discussion in section 3 and a proposal is given for convenience; please make further comments in section 2.

Note that delegates participating in this topic are invited to provide their contact information in section 6 to facilitate offline discussions.

# 2 Discussion

One of the fundamental constraints for a UE to support Rel-17 DMRS bundling is that the transmission is homogenous over time, such that the same PRBs, modulation, power, beam are used for the entirety of a (repeated) PUSCH or PUCCH transmission, as can be seen in RAN4’s reply to RAN1 on the conditions for phase continuity for PUCCH or PUSCH DMRS bundling [2]:

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| * Question 1: Under what conditions UE can keep phase continuity cross PUCCH or PUSCH repetitions
* RAN4 Answer for question 1: If the following conditions are met
	+ Modulation order does not change.
	+ RB allocation in terms of length and frequency position should not be changed, and intra-slot and inter-slot frequency hopping is not enabled within a repetition bundle.
	+ No change on transmission power level of its own CC, i.e., no change on the power control parameters specified in TS 38.213, and also when own CC is not impacted by other concurrent CC(s) that are configured for inter-band CA or DC for same UE with dynamic power sharing and no change in any configured CC s that are part of configured intra-band uplink CA or DC.
	+ No UL beam switching for FR2 UE occurs
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Similarly, RAN4 identified a number of constraints on UE capability for DMRS bundling that are captured in 38.306 [3]:

| ***dmrs-BundlingPUSCH-RepTypeAPerBC-r17***Indicates whether the UE supports DM-RS bundling for PUSCH repetition type A over consecutive symbols.UE indicating support of this feature shall also indicate support of *maxDurationDMRS-Bundling-r17* in at least one of the bands in the band combination and at least one of *type1-PUSCH-RepetitionMultiSlots*, *type2-PUSCH-RepetitionMultiSlots* or *pusch-RepetitionMultiSlots*.This feature is applicable to following multiple carrier scenarios in addition to single carrier scenarios:- FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time.- FR1 inter-band DL CA with a "single" uplink band configured, meaning no switching to transmit SRS on another carrier.- DL CA with "additional" UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured)- FR1 inter-band UL CA with DMRS bundling- SUL with DMRS bundlingFor the last three scenarios listed above, DMRS bundling can be applied with the following conditions:- Concurrent transmissions scheduled/configured over multiple carriers are not expected by UE- Only configuration of a single TAG- Only applicable for the back-to-back case (i.e., zero gap between two transmissions within an actual TDW)- Only one band can be configured with DMRS bundling at a timeNOTE 1: Under the above conditions, phase continuity and power consistency within any actual TDW on one carrier is not impacted by operations on a different carrier.NOTE 2: Under the above conditions, the events defined in clause 6.1.7 of TS 38.214 [12] for the carrier with DMRS bundling are not triggered by any transmission within any actual TDW on the other carrier.NOTE 3: If the modulation scheme higher than QPSK is scheduled for transmission on any carrier configured with DMRS bundling, DMRS bundling is not applicable (i.e., the error case and up to UE implementation). |
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One aspect that stands out for STxMP operation is the requirement ‘No change on transmission power level of its own CC’, which addresses the relation of different CCs in different bands, and therefore different transmit chains. This at least in part led to the UE capability constraints for FR1 CA in Moderator’s understanding. However, whether similar limitations could apply to when different panels use different transmit chains for STxMP in FR2 may not be obvious.

1. Based on RAN4 inputs, DMRS bundling operation is constrained for some multiple transmit chain cases, including carrier aggregation. One motivation, at least for FR1, is that the power on a transmit chain should not be affected by other transmit chains. Whether similar limitations could apply to STxMP in FR2 should be discussed.

DMRS bundling only applies to where PUSCH/PUCCH repetition or transport block over multiple slots (TBoMS) is used. When considering STxMP operation, it should be noted that when PUSCH is repeated or TBoMS is used, a single layer is transmitted. Then in the understanding of [1], since the number of PUSCH repetitions can be indicated dynamically, a UE configured for multiple SRS ports can switch between PUSCH repetition and multi-layer uplink MIMO transmission, including STxMP.

1. DMRS bundling can be used with any mode of STxMP according to current RAN1 specifications.

Before proceeding further, Moderator would like to check if Observation 2 is the common understanding. Therefore, please provide your view in Question 2.1. If a mode of STxMP can’t be used with DMRS bundling, please explain where this is precluded in the specifications.

**Question 2.1**

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| Can DMRS bundling can be used with any mode of STxMP according to current RAN1 specifications? |
| **Company** | **Y/N** | **Comments** |
| ZTE | N | Basically, it should be noted that DMRS bundling **can only be used for the case of single transmission layer** for both PUSCH repetition and PUCCH repetition, i.e.,* For PUSCH repetition A, it is inherently limited to single transmission layer, no matter DMRS bundling is used or not.
* For PUSCH repetition B, when DMRS bundling is used, it is limited to single transmission layer by the description in TS 38.214, i.e., “*For PUSCH repetition Type B: If pusch-DMRS-Bundling is enabled, the PUSCH is limited to a single transmission layer.*”.
* For PUCCH repetition, it is inherently limited to single transmission layer, no matter DMRS bundling is used or not.

Consequently, we think the following cases of STxMP mode can be enabled with DMRS bundling upon the current RAN1 specs.* Case-1: Single DCI based STxMP PUSCH with SFN scheme when rank=1 only
* Case-2: MDCI based STxMP PUSCH+PUSCH when rank=1 only
* Case-3: Single DCI based STxMP PUCCH with SFN scheme
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| Moderator |  | To clarify my thinking on SDM: I agree that DMRS bundling only applies to the single layer case. So the issue for SDM would be to confirm if UEs configured for SDM STxMP and that repeat a rank 1 PUSCH transmission can use DMRS bundling for that repeated PUSCH transmission. Please also see Q2.2. |
| Docomo |  | We share similar views as ZTE. If UE is configured for SDM STxMP, if a PUSCH is multi panel tx, the transmission is at least two-layer, while if SDM STxMP is configured but the PUSCH tx is single panel tx, then DMRS bundling may be applied.  |
| Sharp | N | In our understanding, any mode of STxMP does not work when the cyclic mapping is configured. For the DMRS bundling, multiple repetitions are configured (i.e., K>1). In this case, and when the SDM or SFN STxMP is configured, the cyclic mapping or sequential mapping is applied according to the following spec. For the cyclic mapping, the UL beam/Tx chain is switched at every slot, so the phase coherency and power consistency cannot be maintained.Therefore, only when the sequential mapping is configured, DMRS bundling can be used with some mode ZTE mentioned.

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| TS38.214When neither *multipanelSchemeSDM* nor *multipanelSchemeSFN* is configured and 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', for PUSCH repetition Type A, in case *K>1,* the same symbol allocation is applied across the *K* consecutive slots and the PUSCH is limited to a single transmission layer. The UE shall repeat the TB across the *K* consecutive slots applying the same symbol allocation in each slot, and the association of the first and second SRS resource set in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* toeach slot is determined as follows:- if a DCI format 0\_1 or DCI format 0\_2 indicates codepoint "00" for the *SRS resource set indicator*, the first SRS resource set is associated with all K consecutive slots,- if a DCI format 0\_1 or DCI format 0\_2 indicates codepoint "01" for the *SRS resource set indicator*, the second SRS resource set is associated with all K consecutive slots,- if a DCI format 0\_1 or DCI format 0\_2 indicates codepoint "10" for the *SRS resource set indicator*, the first and second SRS resource set association to K consecutive slots is determined as follows: - When K = 2, the first and second SRS resource sets are applied to the first and second slot of 2 consecutive slots, respectively. - When K > 2 and *cyclicMapping* in *PUSCH-Config* is enabled, the first and second SRS resource sets are applied to the first and second slot of K consecutive slots, respectively, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots. - When K > 2 and *sequentialMapping* in *PUSCH-Config* is enabled, first SRS resource set is applied to the first and second slots of K consecutive slots, and the second SRS resource set is applied to the third and fourth slot of K consecutive slots, and the same SRS resource set mapping pattern continues to the remaining slots of K consecutive slots.…When a UE is configured with *dl-OrJointTCI-StateList* or *TCI-UL-State* and is having two indicated TCI-States or TCI-UL-States, and 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', for PUSCH repetition Type A or Type B as described above, or for PUSCH transmission when the higher layer parameter *multipanelScheme* is set to 'SDMscheme' or 'SFNscheme', the association of the first and second indicated joint/UL TCI states to PUSCH transmission occasions or to corresponding PUSCH antenna ports is determined as follows:- if a DCI format 0\_1 or DCI format 0\_2 indicates codepoint “00” or “01” for the *SRS resource set indicator*, the first or second indicated joint/UL TCI state is applied to all PUSCH transmission occasions, respectively. - if a DCI format 0\_1 or DCI format 0\_2 indicates codepoint “10” or “11” for the *SRS resource set indicator*, and the *multipanelScheme* is not configured,- the first indicated joint/UL TCI state is applied to the PUSCH transmission occasion(s) associated with the first SRS resource set and the second indicated joint/UL TCI state is applied to the PUSCH transmission occasion(s) associated with the second SRS resource set, where the association of PUSCH transmission occasions to SRS resource sets is determined for K = 2 and K > 2, and depending on whether *cyclicMapping* or *sequentialMapping* in *PUSCH-Config* is enabled, based on the above description in this Clause. |

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| Google |  | Based on our understanding, current spec does not preclude DMRS bundling on STXMP for SFN mode and mDCI mode |
| Moderator2 |  | @Sharp: Thanks for the careful checking and comment.In my understanding the cases where cyclic mapping can be used are with two SRS resource sets where neither multipanelSchemeSDM nor multipanelSchemeSFN is configured or multipanelScheme is not configured, and so are Rel-17 M-TRP PUSCH repetition and not STxMP. @All: given the comments above, I’d like to check if the following is the common understanding:**RAN1 specifications support where pusch-DMRS-Bundling and/or pucch-DMRS-Bundling is configured with multipanelSchemeSDM, multipanelSchemeSFN, or sTx-2Panel.** |

Aspects of the various modes of STxMP relevant to STxMP are described in [1], and copied below, which are used to draw observations on their level of compatibility with DMRS bundling.

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| STxMP supports various modes of operation, each of which may have different behaviors with respect to power and allocated resources when PUSCH/PUCCH repetition is used:* Single DCI SDM PUSCH transmission, supporting where each panel transmits a set of layers different than the other panel
	+ One layer is transmitted according to one SRS resource (on one panel) with PUSCH repetition, with constant power and resources over the repetitions
* Single DCI SFN PUSCH transmission, supporting where layers are combined across panels.
	+ One layer is transmitted according to one or two SRS resources (on one or both panels) with PUSCH repetition, with constant power and resources over the repetitions
	+ The panels are not required to transmit coherently, and whether phase continuity would be maintained is not obvious.
* Single DCI SFN PUCCH transmission, supporting where a PUCCH is combined across panels.
	+ One PUCCH is transmitted with PUCCH repetition, with constant power and resources over the repetitions
	+ The panels are not required to transmit coherently, and whether phase continuity would be maintained is not obvious.
* Multi-DCI PUSCH transmission, where one or two PUSCHs can be scheduled by a different DCI, supporting where a distinct PUSCH can be transmitted on each panel.
	+ One or two single layer PUSCHs are transmitted according to one or two SRS resources (on one or two panels) with PUSCH repetition, possibly in different PRBs and in non-overlapping OFDM symbols with time varying total power. However, the power of a PUSCH transmission on a panel should be constant over time.
		- As discussed above, whether a variation in total power over time would affect STxMP FR2 operation is not obvious.

We make the following observations:**Observation 1 Single DCI SDM PUSCH STxMP is compatible with DMRS bundling, given its constant power and occupied PRBs and the presumption of single panel at a time transmission for PUSCH repetition.****Observation 2 Single DCI SFN PUSCH or PUCCH STxMP with repetition has constant power and occupied PRBs, but it is not clear if multi-panel non-coherent transmission would limit phase continuity.** **Observation 3 The PUSCHs of multi-DCI STxMP with PUSCH repetition may be in different PRBs and in non-overlapping OFDM symbols with varying power, although the power of each PUSCH transmission should be constant over time. If this variability affects the ability of a UE to perform PUSCH and/or PUCCH DMRS bundling should be determined.** |

Whether the highlighted observations above are the common understanding in RAN1 should be verified. Please provide your views, including their rationale.

**Question 2.2**

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| Is single DCI SDM PUSCH STxMP compatible with DMRS bundling? |
| **Company** | **Y/N** | **Comments** |
| ZTE | N | Based on our comment in Q2.1, DMRS bundling can NOT be compatible with STxMP PUSCH with SDM scheme, due to the transmission layers need to be at least two (i.e., 1+1). |
| Moderator |  | @ZTE: Thanks much for the answer. To clarify the question: When a UE is configured for SDM STxMP, but transmits with repetition, the UE will transmit rank 1, and in this case the transmission might be seen as single panel transmission. So I’d like to rephrase the question as :**Q2.2a: When a UE is configured for single DCI SDM PUSCH STxMP and DMRS bundling, when it repeats a rank 1 PUSCH transmission, can the UE maintain phase continuity (and power consistency)?** |
| Docomo |  | We feel DMRS bundling can be applied when UE is configured single DCI SDM PUSCH scheme but a PUSCH is single panel tx with rank 1.  |
| Sharp | N | If pusch-DMRS-Bundling is enabled, the PUSCH is limited to a single transmission layer (i.e., v=1). For single DCI SDM PUSCH STxMP, the first TPMI is used to indicate precoder to be applied over layers {0…v1-1} and the second TPMI is used to indicate the precoder to be applied over layers {v1…v1+v2-1}, where v = v1+v2. |
| Google | N | SDM requires rank>1 transmission |

**Question 2.3**

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| Are single DCI SFN PUSCH and PUCCH STxMP compatible with DMRS bundling? |
| **Company** | **Y/N** | **Comments** |
| ZTE |  | Based on our comment in Q2.1, DMRS bundling can be compatible with STxMP SFN PUSCH when rank=1 only and STxMP SFN PUCCH. |
| Docomo | Y |   |
| Sharp | Y |  |
| Google | Y |  |

**Question 2.4**

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| Is multi-DCI PUSCH STxMP compatible with DMRS bundling? |
| **Company** | **Y/N** | **Comments** |
| ZTE |  | Based on our comment in Q2.1, DMRS bundling can be compatible with MDCI based STxMP PUSCH+PUSCH when rank=1 only. |
| Docomo | Y |   |
| Sharp | Y |  |
| Google | Y |  |

If RAN1’s views in Questions 2.2-2.4 align with the highlighted observations, then given that RAN4 drove the constraints on conditions for DMRS bundling, in Moderator’s view RAN4 should decide on any further constraints for STxMP with DMRS bundling. Assuming such a consensus is present, it may be expedient to already discuss if an LS to RAN4 should be sent. Potential content for the LS was given in [1].

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| RAN1 have considered the use of DMRS bundling with the simultaneous transmission on multiple panels (STxMP) feature. RAN1 would appreciate RAN4’s view on the support of DMRS bundling with SFN STxMP transmission, specifically: 1. If a UE can maintain power consistency and phase continuity when configured with *multipanelSchemeSFN* and *pusch-DMRS-Bundling* when transmitting PUSCH repetitions.
2. If a UE can maintain power consistency and phase continuity when configured with *multipanelSFN-Scheme* and *pucch-DMRS-Bundling* when transmitting PUCCH repetitions.
3. If a UE can maintain power consistency and phase continuity when configured with *sTx-2Panel* and *pusch-DMRS-Bundling* when transmitting PUSCH repetitions.
4. If a UE can maintain power consistency and phase continuity when configured with *sTx-2Panel* and *pucch-DMRS-Bundling* when transmitting PUCCH repetitions.
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**Question 2.5**

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| Should an LS to RAN4 be sent asking if single DCI STxMP and if multi-DCI STxMP transmission support the use of DMRS bundling for PUSCH and PUCCH? |
| **Company** | **Y/N** | **Comments** |
| ZTE | N | We think joint channel estimation enabled by DMRS bundling for PUSCH/PUCCH repetition in case of STxMP mode was already supported without extra UE capability according to the following highlighted excerpts in TS 38.214. As it specified that power consistency and phase continuity cannot be maintained in TDW for PUSCH/PUCCH repetition across different panels,rather than PUSCH/PUCCH repetition in the same panel. Consequently, * If PUSCH/PUCCH repetitions in TDW are proceeded per panel in gNB side, joint channel estimation can be naturally performed with the assumption of power consistency and phase continuity by DMRS bundling.
* If PUSCH/PUCCH repetitions is proceeded jointly across two panels in gNB side, joint channel estimation still can be performed. More precisely, if assume power consistency of PUSCH/PUCCH repetitions from panel 1 and panel 2 is C1 and C2 respectively, the combined power of PUSCH/PUCCH repetitions across two panels in gNB side is C3 = C1 + C2, which is still consistent. if assume phase continuity of PUSCH/PUCCH repetitions from panel 1 and panel 2 is L1 and L2 respectively, the combined phase of PUSCH/PUCCH repetitions across two panels in gNB side is L3 = L1 + L2, which is still continued.

As a result, we don’t see extra UE capability for supporting DMRS bundling of STxMP PUSCH/PUCCH with repetition.

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| 6.1.7 UE procedure for determining time domain windows for bundling DM-RS...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, 0\_2 or 0\_3, 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.- For the UE indicating the capability *dmrs-BundlingNonBackToBackTX* or *dmrs-BundlingNonBackToBackTX-PerBC* in [13, TS 38.306], the gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols for normal cyclic prefix or exceeds 11 symbols for extended cyclic prefix.- For the UE not indicating either of the capabilities *dmrs-BundlingNonBackToBackTX* or *dmrs-BundlingNonBackToBackTX-PerBC* in [13, TS 38.306], a non-zero symbol gap is scheduled between any two consecutive PUSCH transmissions or between any two consecutive PUCCH transmissions.- 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] or due to cell DRX operation.- 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] or due to cell DRX operation.- For any two consecutive PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, and when neither *multipanelSchemeSDM* nor *multipanelSchemeSFN* is configured and 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 [10, TS 38.321] and in clause 7.2.1 of [6, 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.- For reduced capability half-duplex UEs, - a dropping or cancellation of a PUSCH or PUCCH transmission according to clause 17.2 of [6, TS 38.213] or- an overlapping of the gap between two consecutive PUSCH or two consecutive PUCCH transmissions and any symbol of downlink reception or downlink monitoring |

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| Docomo |  | Based on our understanding, with current RAN1 spec., DMRS bundling can be applied together with STxMP. But we are also fine to send LS to RAN4 to check RAN4’s understanding on whether power and phase continuity can be maintained in STxMP. |
| Google |  | OK to send the LS |
| Moderator2 |  | Moderator shares ZTE’s observation that there are no UE features defined for the use of DMRS bundling with STxMP.During offline discussions one company mentioned that UE capabilities could be defined for the combination of DMRS bundling and STxMP. In moderator’s view, this would best be done soon as a Rel-18 UE capability, since if it is done in Rel-19, the behavior from a Rel-18 perspective would be that there is no UE capability needed for the combination of DMRS bundling and STxMP.So far, 3 companies (including proponent) support sending an LS, one company does not. In case there is a concern for workload in RAN4, the definition of UE features may simplify RAN4’s effort. Furthermore, RAN1 could ask RAN4 to either provide their view on UE feature definitions that RAN1 suggests, or for RAN4 to define the features themselves. Therefore, Moderator would solicit feedback on the following. The brackets around [multipanelSchemeSDM] are because it is Moderator’s understanding that there should be no issue for SDM STxMP, but this should be confirmed.* + **Consult RAN4 on if UE features for the support of pusch-DMRS-Bundling or pucch-DMRS-Bundling conditioned on the support of [multipanelSchemeSDM], multipanelSchemeSFN, or sTx-2Panel need to be defined.**
		- **FFS: if RAN1 defines candidate UE features for RAN4’s comment vs. if RAN1 asks RAN4 to define any needed UE features**
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# 3 Summary of discussion so far and way forward

## 3.1 First round summary

**[Note that this section is provided for convenience to see the current complete proposal. Please comment in the Questions in section 2; this section will be updated to reflect the discussion as it changes]**

From comments so far, there seems to be agreement that there are no constraints on the combination of DMRS bundling and STxMP in the RAN1 specifications, nor are there UE features defined for the support of DMRS bundling conditioned on the support of STxMP.

It was commented offline that defining UE features could be a way forward if there is some doubt that all combinations can be supported by UEs. In moderator’s view, this would best be done soon as a Rel-18 UE capability, since if it is done in Rel-19, the behavior from a Rel-18 perspective would be that there is no UE capability needed for the combination of DMRS bundling and STxMP.

So far, 3 companies (including proponent) support sending an LS, one company does not. In case there is a concern for workload in RAN4, the definition of UE features might be a way to simplify RAN4’s effort. Furthermore, RAN1 could ask RAN4 to either provide their view on UE feature definitions that RAN1 suggests, or for RAN4 to define the features themselves. Therefore, the following is proposed, where it should be discussed online if multipanelSchemeSDM is kept or removed, based on if the group understands that there is no need for a UE feature for the combination of multipanelSchemeSDM and DMRS bundling. The intention would be to try to resolve the FFS bullet in RAN1#119.

**Proposal:**

* Take the following as conclusions:
	+ RAN1 specifications support where pusch-DMRS-Bundling and/or pucch-DMRS-Bundling is configured with multipanelSchemeSDM, multipanelSchemeSFN, or sTx-2Panel.
	+ UE features have not been defined for the support of pusch-DMRS-Bundling or pucch-DMRS-Bundling conditioned on the support of multipanelSchemeSDM, multipanelSchemeSFN, or sTx-2Panel.
* Further discuss the following:
	+ Consult RAN4 on if UE features for the support of pusch-DMRS-Bundling or pucch-DMRS-Bundling conditioned on the support of [multipanelSchemeSDM], multipanelSchemeSFN, or sTx-2Panel need to be defined.
		- FFS: if RAN1 defines candidate UE features for RAN4’s comment vs. if RAN1 asks RAN4 to define any needed UE features

## 3.2 First round outcome

TBD

# 4 Conclusion

TBD

# 5 References

1. Ericsson, “R1-2410625, STxMP Operation with DMRS Bundling”, Orlando, US, November 18th – 22nd, 2024.
2. RAN4 (Qualcomm), “R1-2102298, Reply on LS on PUCCH and PUSCH repetition”, 3GPP TSG RAN WG1 #104bis-e, e-Meeting, April 12th – 20th, 2021.
3. 3GPP TS 38.214 V18.3.0, “NR; User Equipment (UE) radio access capabilities (Release 18)”, September 2024.

# 6 Contact info

Please provide your contact information below in order to facilitate offline discussion.

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| Company name | Delegate name | Email address |
| Ericsson | Mark Harrison | mark.h.harrison@ericsson.com  |
| ZTE | Yang Zhang | zhang.yang220@zte.com.cn |
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