

**end of discussions**  
**Variant of [97e-32-R17-CovEnh] Version 0.0.7**  
**RAN**

**3GPP TSG RAN Meeting #97e**

**Electronic Meeting, September 12 - 16, 2022**

**Source: RAN1 Chair (Samsung)**

**Title: Moderator's summary for discussion [97e-32-R17-CovEnh]**

**Document for: Discussion and Decision**

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## 1 Introduction

This email thread covers the discussion on the following tdocs submitted to RAN1#97e on Rel-17 maintenance for NR coverage enhancement:

- [1] RP-222065: Views on Rel-17 NR coverage enhancement open issues (Qualcomm)
- [2] RP-222153: Discussion on remaining issues on Rel-17 coverage enhancement (vivo)
- [3] RP-222154: CR on PUSCH frequency hopping with DMRS bundling (vivo)
- [4] RP-222181: On remaining open issues in the Rel-17 coverage enhancement work item (Apple)
- [5] RP-222446: Discussion on inter-slot frequency hopping for PUSCH repetition with DMRS bundling (ZTE, Sanechips)
- [6] RP-222487: Rel-17 UL coverage enhancements - late new configs and cross-WG issues (MediaTek)

After review of the above tdocs, the following issues are identified for discussion in RAN#97e:

- Issue#1: Support of DMRS bundling in case of UL operation over multiple carriers (e.g. CA, SUL, SRS switching) in [1], [4], [6] from Qualcomm, Apple, and MediaTek.
- Issue#2: Determination of frequency hopping pattern for PUSCH with DMRS bundling in [2], [3], [5] from two sources from vivo and ZTE.
- Issue#3: UE behavior of restarting DMRS bundling in [2] from vivo.

**For Issue#1**, RAN1 received an LS from RAN4 [7] on Issue#1 and responded that “*RAN1 has been evaluating the feasibility and conditions supposing there is no RAN1 spec impact. RAN1 will inform RAN4 the updates in the next RAN1 meeting.*” [8]. The LS response from RAN1 was sent to RAN4 in RAN1#110 (August, 2022).

**For Issue#2**, there has been discussion in RAN1 for multiple meetings without resolution. The two diverging views are

- Alt1: Frequency hopping pattern for PUSCH with DMRS bundling determined by BOTH the physical slot index and system frame number (SFN)
- Alt2: Frequency hopping pattern for PUSCH with DMRS bundling determined by ONLY the physical slot index and is independent from system frame number (SFN)

Two companies (vivo and ZTE) have submitted text proposals in [3] and [5].

**For Issue#3**, there has been discussion in RAN1 for multiple meetings without resolution.

## 2 Initial Round

### 2.1 Issue#1: Support of DMRS bundling in case of UL operation over multiple carriers

As mentioned in the Introduction section, RAN1 received an LS from RAN4 [7] on Issue#1 and responded that “*RAN1 has been evaluating the feasibility and conditions supposing there is no RAN1 spec impact. RAN1 will inform RAN4 the updates in the next RAN1 meeting.*” [8]. The LS response from RAN1 was sent to RAN4 in RAN1#110 (August, 2022).

Considering the relevant WGs are under discussion on how to resolve the issue (RAN1 has indicated plans to evaluate and respond by the next RAN1 meeting in October), recommendation from the moderator is to let the WGs continue their work for the time being. RAN can intervene in RAN#98e if there is no WG-level resolution on how to handle the issue.

**Moderator recommendation: WGs are to continue with their work to resolve Issue#1 before RAN#98.**

#### Feedback Form 1:

##### 1 – vivo Communication Technology

Agree with with moderator recommendation

##### 2 – HUAWEI TECHNOLOGIES Co. Ltd.

Agree with the moderator recommendation.

If any discussion is needed, we would like to suggest to discuss **ONLY** the UE capability signaling for DMRS bundling (FG 30-4a/4b/4c/4d) for the following reasons,

- 1) It has ASN.1 impact and is supposed to be closed as soon as possible for Rel-17 DMRS bundling.
- 2) The remaining issues for those FG 30-4x are only about the granularity of UE capabilities and are independent of the decision on whether or not the support of DMRS bundling for UL-CA because they are all about ”back-to-back” DMRS-bundling (rather than FG 30-4h) and thus the scenario of interlaced UL transmission on different UL carriers of UL-CA is not allowed. As a result, per-band granularity is sufficient for those FG 30-4x.
- 3) In the RAN4 LS, concurrent transmissions between any two UL carriers of UL-CA have been precluded. Therefore, there is no coupling between UL carriers for DMRS bundling and per-band granularity is sufficient.

If any discussion for issue#1, we suggest to only conclude the following for the sake of ASN.1,

**Proposal:**

*For FG 30-4a/4b/4c/4d, the granularity of UE capability is per-band.*

**3 – Nokia Corporation**

We agree with the moderator recommendation.

Regarding Huawei's attempt to help with ASN.1, it is important to note that the FG type is intrinsically related to how we resolve issue#1 itself. If we do a partial resolution this meeting on the issue, it means we will still have FFS points on the UE capability signaling, meaning that RAN2 will not add those to ASN.1 anyway. Hence we believe it is important to take the discussion in RAN1 to have a complete view, as proposed by the moderator.

**4 – CATT**

We agree with moderator recommendation.

**5 – China Mobile Com. Corporation**

Agree with the moderator recommendation.

**6 – Panasonic Corporation**

We agree the recommendation.

**7 – VODAFONE Group Plc**

Agree with the moderator recommendation.

**8 – Samsung Research America**

Moderator recommendation is aligned with the recent RAN1 LS response to RAN4. However a guidance from RAN is helpful to limit ongoing back-and-forth LSs between RAN4 and RAN1, and allow RAN1 to focus in completing the UE features. Since RAN1 work on DM-RS bundling feature is complete, RAN4 should finalize its work based on the RAN1 specifications. Thus, we suggest that RAN notes that RAN1 work on DM-RS bundling feature is complete and that RAN4 should finalize its work based on the RAN1 specifications.

**9 – Qualcomm Incorporated**

We don't agree with the moderator's recommendation. We think a RAN decision would save a lot of WG time, hence we propose to target achieving a Plenary recommendation this week. The decision point in our view is whether DM-RS bundling in an UL CA band combination on any CC(s) can be supported under the condition of no overlapping UL transmissions. The Plenary should be able to give a yes/no answer, especially in light of the fact the RAN4 specification already supports this for FR1-FR2 CA.

**10 – Spreadtrum Communications**

We agree with moderator recommendation.

**11 – Intel Deutschland GmbH**

We agree with the moderator recommendation

**12 – ZTE Corporation**

The issue has impacts on the reporting type of UE FGs related to DMRS bundling. A RAN decision would be helpful for WG discussion, especially for UE capability discussion. We suggest RAN to conclude on support of DMRS bundling in case of UL operation over multiple carriers, which is the majority view in WG discussion, and task RAN1 to finalize the related FGs and RAN4 for corresponding work.

**13 – China Telecommunications**

Although RAN1 sent LS to RAN4 that “*RAN1 will inform RAN4 the updates in the next RAN1 meeting*”, we tend to share the similar view with Qualcomm that RAN decision would save a lot of WG time as we have already discussed this issue for several rounds between RAN4 and RAN1. In addition, UE feature discussion in RAN1 also depends on the outcome of this issue.

In our understanding, from RAN1 specification, it does not preclude DMRS bundling for multiple carriers.

In RAN4 discussion, no technical issue has been raised for the scenarios of FR1 inter-band UL CA with the restriction that UE shall only have ongoing transmissions on a single uplink carrier at the same time.

Therefore, DMRS bundling can be supported for multiple carriers without additional RAN1 specification impact, and with one more clarification sentence added in RAN4 specification.

**14 – NTT DOCOMO INC.**

We also prefer a RAN decision to save a lot of WG time as the current RAN1 spec description supports UL CA.

**15 – WILUS Inc.**

We agree with the moderator recommendation

**16 – Xiaomi Communications**

We agree with the moderator recommendation

**17 – SHARP Corporation**

We have the similar view with Qualcomm that a RAN decision save a lot of WG time.

**18 – MediaTek Inc.**

Firstly, we would like clarification that the discussion would not extend more broadly than the radio configurations already been indicated by RAN4 to RAN1, and that discussion on this issue would not extend beyond the next quarter.

Secondly, given that RAN1 itself was not able to conclude on the impacts in the last WG meeting, this seems to suggest that RAN1 experts should actually agree this first. Given that these new radio configurations were actually only proposed in May 2022, we think it is far for RAN1 to have one more meeting to do a

diligent job, and to indicate the impacts as requested by RAN4. It would be worse to come back later and realise that errors were made in the decision-making which de-stabilise the RAN1 specs.

Thirdly, given that there was so much discussion in the last RAN4 meeting even on the DL CA CRs for this feature, we think that any proposed CRs for additional configurations should be diligently checked by RAN4 experts. Note that in the past meetings there were errors in CRs that were approved, and in other CRs it was later claimed that there were ambiguities about which configs were included.

So we think that it is feasible and most appropriate to finalise this discussion and implement relevant CRs diligently in the impacted WGs in the next quarter.

#### 19 – Ericsson LM

Agree with moderator that the WGs should continue their work until RAN#98. However, work in RAN4 during the August meeting seemed to be held up while RAN4 was waiting for a response from RAN1. Given the answer to RAN4 in the new RAN1 LS, we suggest to update the recommendation above to clarify that RAN4 can continue their work assuming there is no RAN1 spec impact, for example:

**Moderator recommendation:** WGs are to continue with their work to resolve Issue#1 before RAN#98.

- RAN4 maintenance work should continue assuming that there is no RAN1 spec impact on cases agreed in LS from RAN4 to RAN1 (e.g FR1+ FR2) and
- **For cases raised in RAN4 LS to RAN1 and involving the RAN1 response**, RAN1 should work on solution on possible limitation on UE capability/configuration where there is no RAN1 spec impact for these cases

#### 20 – Apple Italia S.R.L.

We are OK with the moderator's suggestion, especially considering that this is emerging as the majority view. On the other hand, we don't see how the concerns we raised in RP-222181 would be addressed by the WGs taking one more meeting cycle to resolve Issue #1. We would like to highlight that further discussion and decision is anticipated in RAN1, with the outcome to be communicated via LS to RAN4. This implies that efforts on defining requirements for the resolution of Issue #1 could start as late as RAN4 #105 in November, which is a full 8 months after the work item reached 100% completion level according to the SR. Our concern is that the risk to implementation schedules is not considered with such a drawn-out discussion. Is there any scope of this effort which could be transferred to Rel-18?

#### 21 – MediaTek Inc.

@Ericsson, by "agreed cases in LS" you mean the configurations that RAN4 indicated that it had agreed to support?

## 2.2 Issue#2: Determination of frequency hopping pattern for PUSCH with DMRS bundling

RAN1 has been discussing between the following two alternatives for multiple meetings without resolution.

- Alt1: Frequency hopping pattern for PUSCH with DMRS bundling determined by **BOTH** the physical slot index and system frame number (SFN)
- Alt2: Frequency hopping pattern for PUSCH with DMRS bundling determined by **ONLY** the physical slot index and is independent from system frame number (SFN)

RAN1 made the following agreement in RAN1#108-e:

- *Inter-slot frequency hopping pattern for PUSCH repetitions with DMRS bundling is determined **based on physical slot index**. (from RAN1#108, February, 2022)*

The agreement is clear on the use of physical slot index to determine frequency hopping pattern for PUSCH. What is not captured is the use of system frame number (SFN).

In RAN1#110, there were sustained objections for both alternatives although Alt1 did receive majority support. For companies supporting Alt2, their argument is that Alt1 violates the above existing RAN1 agreement. The supporting companies of Alt1 disagree that Alt2 violates the above existing RAN1 agreement.

From RAN1 chair's perspective, it seems that while Alt1 does not violate the existing agreement, an additional agreement or revision of the existing agreement is needed to additionally use SFN. From procedural point of view, if there is no consensus to additionally use SFN, Alt2 should be taken. In any case, it is clear that a decision needs to be made between the two alternatives to support DMRS bundling for frequency hopping in Rel-17. And it is doubtful whether additional discussions in RAN1 will help make progress on the matter. Considering these aspects as well as the recent RAN1 discussions, the following is recommended.

**Moderator recommendation: Take Alt2. Endorse the company CR in RP-222154.**

**Feedback Form 2:**

<p><b>1 – vivo Communication Technology</b> Agree with moderator recommendation</p>
<p><b>2 – HUAWEI TECHNOLOGIES Co. Ltd.</b> Agree with moderator recommendation.</p>
<p><b>3 – Nokia Corporation</b> Agree with the moderator recommendation.</p>
<p><b>4 – CATT</b> We agree with moderator recommendation.</p>
<p><b>5 – China Mobile Com. Corporation</b> Agree with the moderator recommendation.</p>

**6 – Panasonic Corporation**

Our interpretation of the past agreement is no explicit mention of SFN does not necessary mean not to take into account SFN at all. That's why we understand alt 1 is majority in the past discussion. Therefore, our view is to take Alt 1. On the other hand, we agree additional discussions in RAN1 would not help make progress on the matter. Our preference is to take majority view as it can work either of the option in spite that to take alt 1 can reduce the gNB scheduler complexity.

**7 – VODAFONE Group Plc**

We are OK with the moderator recommendation.

**8 – Samsung Research America**

We support to finalize this issue in RAN because it has not been possible to reach consensus in RAN1 after many meetings, and both solutions can work. We are fine with the moderator's recommendation based on the lack of consensus in amending an existing agreement (as attempted by FL until RAN1#110).

**9 – Qualcomm Incorporated**

We are ok with the moderator's proposal.

If this issue still remains controversial though, we suggest considering a 40ms reset period as a compromise between Alt.1 and Alt.2.

**10 – Spreadtrum Communications**

We are supportive with the proposal.

**11 – Intel Deutschland GmbH**

We agree with the moderator recommendation

**12 – ZTE Corporation**

As stated in our contribution, we slightly prefer Alt 1 considering it is technically better. In our view, it is arguable to say whether Alt 1 contradicts with previous RAN1 agreement or not.

**13 – China Telecommunications**

In our understanding, Alt 1 does not violate the existing agreement since SFN can also be regarded as kind of physical slot index. And Alt 1 was supported by the majority companies in RAN1. In this RAN plenary, it seems most companies are fine with Alt 2. For the sake of progress, we can live with Alt 2.

**14 – NTT DOCOMO INC.**

We share the same view with China Telecom and others for Alt.1. And also to avoid missing specification, we can live with moderator recommendation.

**15 – WILUS Inc.**

Agree with the moderator recommendation.

**16 – Xiaomi Communications**

Agree with the moderator recommendation

**17 – SHARP Corporation**

Our interpretation of the previous agreement is the same with Panasonic and China Telecom. It would be unfortunate if selecting the technically better solution (i.e., Alt 1 which is supported by the majority) would be prevented by the overly restrictive interpretation of the previous agreement.

Having said that, we also understand the current deadlock situation as mentioned by Moderator, and the 1st priority is to make this feature workable. Therefore, we can live with Moderator recommendation.

**18 – Ericsson LM**

Agree with the moderator deciding at the plenary level can be helpful. The position of companies seemed well entrenched during RAN1#110, and unless guidance is given to RAN1, the situation is unlikely to change.

We (and the majority of companies in RAN1#110, as the moderator points out) however have a different view than the recommendation. The use of SFN is appropriate given the large number of repetitions supported that can exceed the length of a frame, and since it simplifies the hopping pattern and therefore the gNB scheduler. Furthermore, the current specification already includes the SFN (in square bracketed text), and this should therefore be the default assumption.

Regarding the agreement, it says ‘based on physical slot index’, not ‘using only physical slot index’. Therefore, we agree with the moderator that the agreement at least does not preclude SFN. The question of whether an additional agreement is needed for SFN then seems the point of debate. Our interpretation of ‘based upon physical slot index’ is that it is completely open on how slots are accounted for in the hopping equation, and that this is a design decision. Therefore, we do not agree with the moderator that some additional agreement is needed for SFN, but think the decision should be based on the merits of the design alternatives.

Since using SFN should improve performance and simplify scheduling, and given that it is captured in current specifications we support Alt 1 rather than Alt 2. However, if proponents of Alt 2 can offer a technical benefit of Alt 2 over Alt 1, we are open to considering Alt 2.

**19 – Apple Computer Trading Co. Ltd**

Agree with the moderator recommendation.

**20 – MediaTek Inc.**

Agree with the moderator recommendation.

## 2.3 Issue#3: UE behavior of restarting DMRS bundling

Multiple companies have indicated in RAN1 that current RAN1 specifications require clarification on UE behavior for restarting DMRS bundling with respect to multiple semi-static and dynamic events. RAN1 spent more than one meeting discussing the relevant cases and possible changes to RAN1 specification to address the issue. However, at this point, RAN1 was not able to converge on a resolution.

Moderator's recommendation is to handle the discussion on Issue#3 in RAN1 considering the following:

- There is only one company input for Issue#3
- Relevant discussions are more adequate for RAN1 rather than RAN
- While there might be performance degradation due to different assumptions at UE and gNB, it is not clear whether any specification change is absolutely necessary

**Moderator recommendation: Close discussions on Issue#3 in RAN#97e. Continue discussions in RAN1.**

### Feedback Form 3:

<b>1 – vivo Communication Technology</b> Agree with moderator recommendation
<b>2 – HUAWEI TECHNOLOGIES Co. Ltd.</b> Agree with moderator recommendation.
<b>3 – Nokia Corporation</b> Agree with the moderator's recommendation.
<b>4 – CATT</b> We agree with moderator recommendation.
<b>5 – China Mobile Com. Corporation</b> Agree with the moderator recommendation.
<b>6 – Panasonic Corporation</b> We are ok to continue the discussion in RAN1.
<b>7 – VODAFONE Group Plc</b> Agree with the moderator recommendation and continue the discussion in RAN1

**8 – Samsung Research America**

It seems sufficient to conclude no discussion in RAN for this issue without RAN suggesting to continue the discussion in RAN1.

**9 – Qualcomm Incorporated**

We agree with the moderator’s proposal.

**10 – Spreadtrum Communications**

We agree with moderator recommendation.

**11 – Intel Deutschland GmbH**

We agree with the moderator recommendation

**12 – ZTE Corporation**

We share similar view as Samsung that it’s sufficient to conclude no discussion in RAN, and leave RAN1 to decide whether/how to proceed in RAN1.

**13 – China Telecommunications**

As the moderator of the discussion in RAN1, I’m afraid it would not be helpful to continue the discussion in RAN1 considering we have already spent much time on this issue in past RAN1 meetings. It would be very much helpful if RAN plenary could give some guidance. Following options can be considered.

Option 1: Make decision in RAN#97e.

Option 2: No further discussion on this issue in RAN1.

Option 3: Discuss this issue only in UE feature session in RAN1.

**14 – NTT DOCOMO INC.**

Agree with the moderator’s recommendation.

**15 – WILUS Inc.**

We agree with the moderator recommendation.

**16 – Xiaomi Communications**

Agree with moderator recommendation.

**17 – SHARP Corporation**

Agree with the moderator recommendation.

**18 – Ericsson LM**

Support moderator recommendation. This is indeed a detailed technical debate, and difficult to resolve at the plenary level. We also wonder if the potential performance impacts merit Rel-17 specification changes at this late stage of Rel-17.

**19 – Apple Computer Trading Co. Ltd**

Agree with the moderator recommendation.

**20 – MediaTek Inc.**

Agree with the moderator recommendation.

## 2.4 Summary and Proposals After Initial Round

**Issue#1: Support of DMRS bundling in case of UL operation over multiple carriers**

Moderator's recommendation was to have relevant WGs continue their work to resolve Issue#1 in Q4. There were inputs from 20 companies. Except for 5 companies (Qualcomm, China Telecom, ZTE, DOCOMO, Sharp), all other companies indicated they can accept the moderator's recommendation. On the other hand, Qualcomm, China Telecom, ZTE, DOCOMO, Sharp preferred to make a decision on Issue#1 in RAN#97e.

It is clear that majority (75%) of companies are fine with the initial round recommendation. However, since there are different views and this is only initial round, the moderator would like to check company preferences among the following alternatives.

On Issue#1 (Support of DMRS bundling in case of UL operation over multiple carriers):

- Alt1: (Moderator's modified recommendation) WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 under the assumption of no RAN1 specification change
- Alt2: DMRS bundling in case of UL operation over multiple carriers is supported without RAN1 specification change
  - Applicable only under the condition of non-overlapping UL transmissions

Note that Alt1 has been modified from the original moderator's recommendation by taking into account the comments from Ericsson and MediaTek.

**Issue#2: Determination of frequency hopping pattern for PUSCH with DMRS bundling**

There were inputs from 20 companies. Except for 1 company (Ericsson), all other companies (95%) indicated that they can accept the moderator's recommendation. The issue has been discussed for multiple RAN1 meetings and it is time to decide. From moderator's view, additional round of discussions does not seem

necessary or helpful. Moderator will report the situation to RAN chair and propose the following for endorsement by email or in Wednesday GTW session.

**Proposal for endorsement on Issue#2:**

- Alt2: Frequency hopping pattern for PUSCH with DMRS bundling is determined by ONLY the physical slot index and is independent from system frame number (SFN).
- Endorse the company CR in RP-222609.

Note that the company CR has been revised from RP-222154 to RP-222609. The revision is the removal of “Draft” in the CR cover page.

**Issue#3: UE behavior of restarting DMRS bundling**

There were inputs from 20 companies. Except for 1 company (China Telecom), all other companies (95% of companies) indicated that they can accept the moderator’s recommendation to have RAN1 continue discussions. Multiple companies agreed with the moderator that the issue would be better handled in RAN1. From moderator’s view, additional discussion does not seem helpful. Moderator will report the situation to RAN chair and suggest to stop the discussion on Issue#3 in RAN#97e.

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## 3 Intermediate Round

Based on the company views from the initial round, intermediate round will only handle Issue#1. For Issue#2 and Issue#3, moderator will report the situation to RAN chair.

### 3.1 Issue#1: Support of DMRS bundling in case of UL operation over multiple carriers

Companies are requested to provide their preferences or comments on one of the following alternatives

*On Issue#1 (Support of DMRS bundling in case of UL operation over multiple carriers):*

- *Alt1: (Moderator’s modified recommendation) WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 under the assumption of no RAN1 specification change*
- *Alt2: DMRS bundling in case of UL operation over multiple carriers is supported without RAN1 specification change*
  - *Applicable only under the condition of non-overlapping UL transmissions*

## Feedback Form 4:

### 1 – HUAWEI TECHNOLOGIES Co. Ltd.

OK with Alt1.

There are still technical details missing in the Alt 2 which have been raised during last RAN1 meeting but not resolved yet before the RAN1 LS reply endorsement, for example,

1) whether interlaced UL transmissions between two carriers are allowed, e.g., one DMRS bundling window last for two slots but with a gap of several symbols on one UL carrier and in the exact gap one symbol is scheduled on the other carrier.

2) The most time-critical part is missing, i.e. the UE capability should be on per-band granularity.

3) It should be clear to confirm that the events of creating new time domain window specified in current TS 38.214 is not applicable to this case because the events are surely not applicable to FR1+FR2 UL-CA, neither to FR1+FR1 UL-CA. During the last RAN1 meeting, there is no consensus to interpret the applicability of the specified events for UL-CA yet which will cost further RAN1 discussion and its outcome could be not in line with the claim "without RAN1 specification change".

### 2 – MediaTek Inc.

Alt-1 goes in the right direction, but the key point seems to be that it is still unclear if RAN1 spec changes are needed or not, and this is what RAN1 was still planning to evaluate. If RAN1 spec changes are needed, we would not like them to be "ignored" if they are actually needed to make the feature work. So we would propose the following update:

*Alt1: (Moderator's modified recommendation) WGs are to continue with their work to ~~resolve~~ conclude on Issue#1 (for radio configurations included in R4-2211225) before RAN#98, ~~under the assumption of no RAN1 specification change~~ and RAN1 to identify and inform RAN4 of any necessary RAN1 specification impact as part of this process*

### 3 – Panasonic Corporation

Although we are ok with either of the alternatives, slight preference is alt1 for allowing more technical checking in working groups.

### 4 – vivo Communication Technology

We are fine with alt1, we propose a slight revision, as it is not yet clear how to resolve issue#1.

Alt1: (Moderator's modified recommendation) WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 and decide whether/how DMRS bundling can be supported in DC/CA/SUL cases under the assumption of no RAN1 specification change

### 5 – vivo Communication Technology

We are fine with alt1, we propose a slight revision, as it is not yet clear how to resolve issue#1.

Alt1: (Moderator's modified recommendation) WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 and decide whether/how DMRS bundling can be supported in DC/CA/SUL cases under the assumption of no RAN1 specification change

**6 – Spreadtrum Communications**

We support Alt 1. Further discussion can be taken in RAN1. Alt 2 is obviously against the status during last RAN1 meeting.

**7 – Spreadtrum Communications**

We support Alt 1. Further discussion can be taken in RAN1. Alt 2 is obviously against the status during last RAN1 meeting.

**8 – Xiaomi Communications**

Support Alt.1. Further discussion in RAN1 is needed.

**9 – Intel Deutschland GmbH**

We slightly prefer Alt 2 as it shows clearer scope and less works required. As commented by other companies, after a clear guidance/decision from RAN, RAN1 can continue the discussion for UE capability on the support of DMRS bundling.

**10 – Qualcomm Incorporated**

We prefer Alt.2.

Agreeing with Intel that Alt.2 reduces time needed in RAN1 while Alt.1 increases it.

Regarding Huawei's comment (1), it is not supported, comment (2), yes the capability needs to be finalized, which is exactly the task at hand.

Regarding the Spreadtrum's comment, it is not against the status during a RAN1 meeting or during any RAN1 meeting for the Plenary to make a decision.

**11 – China Telecommunications**

We prefer Alt 2. We can accept the modified Alt 1 as follows:

*Modified Alt1: Task RAN4 to work on support of DMRS bundling in case of UL operation over multiple carriers (for radio configurations included in R4-2211225) before RAN#98e under the assumption of no RAN1 specification change.*

**12 – Nokia Corporation**

We prefer Alt 2 as well, as it gives a guidance from RAN that helps with the finalization of the work in RAN1, including the UE capabilities that are still pending. If that remains controversial, then Alt 1 is the natural fallback.

**13 – Samsung Electronics Co.**

We are fine with Alt.1. It would help to progress the RAN4 work and to complete the UE features in RAN1. Also it appears as a default choice so it may be easier to converge.

**14 – Lenovo (Beijing) Ltd**

Support Alt1. Further discussion is needed in RAN1.

**15 – ZTE Corporation**

We prefer Alt. 2 which could facilitate the UE capability discussion in RAN1. Alt 1 is in general also acceptable by tasking all related WGs to continue their work.

**16 – VODAFONE Group Plc**

Alt.1 seems inline with what was already stated in the LS from RAN1 so it looks like the default conclusion. If there is a common understanding that no RAN1 specification change is needed (not only an assumption) then Alt.2 may facilitate the discussion in the WGs

**17 – Ericsson LM**

Our first preference is Alt 2, if our understanding is correct that existing UE features for DMRS bundling may be amended by RAN1 to take into account any constraints needed by Rel-17 UEs to support DMRS bundling with UL operation over multiple carriers, such as those identified by RAN4 in their LS to RAN1 R4-2211225. **Can the moderator confirm this understanding?**

Alt 1 is acceptable to us, but (as other companies pointed out) agreeing that UL operation over multiple carriers is supported without RAN1 specification change would save quite a bit of debate in RAN1 and RAN4.

**18 – Samsung Electronics Co.**

**(moderator response to Ericsson)**

Whether UE feature will be amended or not can be part of the follow up work on Issue#1. As long as there is consensus, I don't see why UE feature cannot be amended. However, it is not clear at this point on the details of the amendment.

### 3.2 Issue#2: Determination of frequency hopping pattern for PUSCH with DMRS bundling

From moderator's view, additional round of discussions does not seem necessary or helpful. Moderator will report the situation to RAN chair and propose the following for endorsement by email or in Wednesday GTW session.

**Proposal for endorsement on Issue#2:**

- Alt2: Frequency hopping pattern for PUSCH with DMRS bundling is determined by ONLY the physical slot index and is independent from system frame number (SFN).
- Endorse the company CR in RP-222609.

### 3.3 Issue#3: UE behavior of restarting DMRS bundling

From moderator's view, additional round of discussions does not seem necessary or helpful. Moderator will report the situation to RAN chair and propose to close the discussions on Issue#3 in RAN#97e.

### 3.4 Summary and Proposal After Intermediate Round

For the intermediate round, companies were requested to indicate preferences among the following two alternatives:

*On Issue#1 (Support of DMRS bundling in case of UL operation over multiple carriers):*

- *Alt1: (Moderator's modified recommendation) WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 under the assumption of no RAN1 specification change*
- *Alt2: DMRS bundling in case of UL operation over multiple carriers is supported without RAN1 specification change*
  - *Applicable only under the condition of non-overlapping UL transmissions*

16 companies provided inputs. From the company inputs, it is clear that the views are divided. Roughly half of the companies preferred to continue discussions in WGs before making decision to support while the other half of the companies preferred to make decision to support the feature.

Given the divided views, moderator recommendation is to take Alt1. Although it is taking a smaller step in terms of progress, moderator view is that it does help the WGs to resolve Issue#1. Taking Alt1 will provide guidance to the WGs to resolve the issue in 2022.Q4 under specific conditions (for radio configurations included in R4-2211225, no RAN1 specification change). If the above is not agreeable, the moderator will propose to close the discussions in RAN#97e in which case WGs will continue with the work without any RAN guidance.

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## 4 Final Round

Moderator recommendation is to take the following for the final round:

***Proposal for Issue#1 (Support of DMRS bundling in case of UL operation over multiple carriers):***

- ***Alt1: WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 under the assumption of no RAN1 specification change***

Although Alt1 is taking a smaller step in terms of progress compared to Alt2, moderator view is that it does help the WGs to resolve Issue#1. Taking Alt1 will provide guidance to the WGs to resolve the issue in 2022.Q4 under specific conditions (for radio configurations included in R4-2211225, no RAN1 specification change). If the above is not agreeable, the moderator will propose to close the discussions in RAN#97e in which case WGs will continue with the work without any RAN guidance.

Companies are requested to provide their views on the above proposal **only if there is strong concern.**

## Feedback Form 5:

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### 4.1 Summary of Final Round

No concerns were raised for the following moderator recommendation

***Proposal for Issue#1 (Support of DMRS bundling in case of UL operation over multiple carriers):***

- Alt1: WGs are to continue with their work to resolve Issue#1 (for radio configurations included in R4-2211225) before RAN#98 under the assumption of no RAN1 specification change***

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## 5 References

- [1] RP-222065, Views on Rel-17 NR coverage enhancement open issues, Qualcomm
- [2] RP-222153, Discussion on remaining issues on Rel-17 coverage enhancement, vivo
- [3] RP-222154, CR on PUSCH frequency hopping with DMRS bundling, vivo
- [4] RP-222181, On remaining open issues in the Rel-17 coverage enhancement work item, Apple
- [5] RP-222446, Discussion on inter-slot frequency hopping for PUSCH repetition with DMRS bundling, ZTE, Sanechips
- [6] RP-222487, Rel-17 UL coverage enhancements - late new configs and cross-WG issues, MediaTek
- [7] R4-2211225, Reply LS to RAN1/RAN2 on DMRS bundling, RAN4, RAN4#103-e (May 2022)
- [8] R1-2208212, Reply LS to RAN4 on DMRS bundling, RAN1, RAN1#110 (August, 2022)