

[94e-13-R18-CAEnh] - Version 0.0.8

RAN

3GPP TSG RAN#94e

RP-213578

Electronic Meeting, December 6 - 17, 2021

Agenda Item: 8.6.1

Type: report

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Title: Moderator's summary for discussion [94e-13-R18-CAEnh]

The discussion in this thread covers the topic #13 in RAN Chair's email in [94e-01-Organizational]. The proposed scope for this item in RP-213469 from RAN/RAN1/RAN2/RAN3/RAN4 Chairs is shown below.

Table 1: Proposed objectives for Rel-18 CA Enhancements in RP-213469

Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI [RAN1] Identify the maximum number of cells that can be scheduled simultaneously Consider both intra-band and inter-band CA operation Consider both FR1 and FR2 The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling Study and if necessary specify following enhancements for multi-carrier UL operation

- UL Tx switching schemes across [3 or 4] bands with restriction of 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1)
- Switching time and other RF aspects for above UL Tx switching schemes across [3 or 4] bands (RAN4)

~~Introduce support for Scells without SSB in inter-band CA (so that an SSB in one band can provide DL timing/ frequency synchronization for an Scell in a different band), via the following steps: identify for which bands this is feasible and the related UE requirements [RAN4] introduce the related UE capability and signalling support [RAN2] Note: This aspect is expected to be implicitly/explicitly considered as part of network energy savings~~

Accordingly, the justification part of the draft WID can be updated by moderator as below.

Table 2: Updated justification proposed by the moderator

NR supports a wide range of spectrum in different frequency ranges. It is expected that there will be increasing availability of spectrum in the market for 5G Advanced possibly due to re-farming from the bands originally used for previous cellular generation networks. Especially for low frequency FR1 bands, the available spectrum blocks tend to be more fragmented and scattered with narrower bandwidth. To meet different spectrum needs, it is important to ensure that these scattered spectrum bands can be utilized in a more efficient and flexible manner, thus providing higher throughput and decent coverage in the network.

One motivation is to increase flexibility and efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells. The current scheduling mechanism only allows scheduling of single cell PUSCH/PDSCH per a scheduling DCI. With more available scattered spectrum bands, the need of simultaneous scheduling of multiple cells is expected to be increasing. To reduce the control overhead, it is beneficial to extend from single-cell scheduling to multi-cell PUSCH/PDSCH scheduling with a single scheduling DCI. Meanwhile, trade-off between overhead saving and scheduling restriction has to be taken into account. For multi-carrier UL operation, there are some limitations of current specification, e.g. 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration, and UL Tx switching can be only performed between 2 UL bands for 2Tx UE. Dynamically selecting carriers with UL Tx switching based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration, will lead to higher UL data rate, spectrum utilization and UL capacity.

~~Starting from Rel-15, SCell without SSB is supported for intra-band CA case. By extending similar feature to the inter-band CA case, DL time/frequency can be synchronized among cells in different bands without requiring SSB in each band. This allows UEs to utilize the DL time/frequency synchronization from one band for SCells in another band, which reduces the system overhead by reducing the SSB/SIB transmission on each band. Consequently, the UEs in connected mode may reduce SCell activation/deactivation time without performing the time/frequency synchronization for each band.~~

~~[For UEs in idle and inactive mode, there might be potential benefits if SSB/SIB in one cell can be used to provide information (including e.g. RACH configuration) to allow Idle/Inactive UEs to perform initial access in another (intra-band or inter-band) cell. A study would be helpful to understand the feasibility and benefits.]~~

In RP-213469, TU reservation for this item is also provided as “ 1 TU for 9 months”.

In this email discussion, above objectives and justifications as well as other parts of draft WID can be further discussed and finalized for approval.

1 Initial Round

Companies are encouraged to provide their feedbacks on following points of the draft WID.

- Necessary update for justification description if any
- Necessary update for objective 1 “Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI” if any
- Necessary update for objective 2 “Study and if necessary specify following enhancements for multi-carrier UL operation” (at least regarding “[3 or 4] bands”)
- Necessary update for other part of the draft WID if any
- Necessary update for TU reservations if any (requesting more TU would cause problems on overall project management)

1.1 Collection of company views

1.1.1 Necessary update for justification description if any

Companies are encouraged to provide feedback if any on the moderator's updated justification shown above.

Updates were made based on following points.

- Justification description for the objective 1 "Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI [RAN1]" is kept as it is.
- Justification description for added objective 2 "Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN4]" is added based on that from RP-212702.
- Justification description for removed objectives are removed.

Feedback Form 1: Necessary update for justification description if any

1 – Futurewei Technologies

We are fine with the proposed justification text.

2 – Samsung Electronics Co.

Suggest to remove the very first paragraph. It relates with the removed objectives.

3 – China Telecom Corporation Ltd.

We would like to keep the justification for SSB-less as it is (not removed), as we propose to keep parts of objectives for SSB-less in 1.1.4.

Regarding the justification in bracket for [~~For UEs in idle and inactive mode...~~], which is not relevant to our proposal, we are ok to remove it.

4 – vivo Communication Technology

The descriptions (for both the justification and objective) are not clear on whether the multi-cell scheduling is applicable to the Rel-17 SCell scheduling PCell feature or not, e.g., whether a SCell can simultaneously schedule the PCell, the scheduling SCell, and/or other SCells. This aspect should be clarified.

5 – ZTE Corporation

We have some comments with the description for multi-carrier UL operation. We are not sure whether this feature can provide any further gain compared to dynamic Tx switching between two bands, it is too premature to say that it **will** ('may' is more appropriate wording) lead to higher UL data rate, spectrum utilization and UL capacity. In addition to that, "Dynamically selecting carriers with UL Tx switching based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration" may open up the study on UE performing Tx switching based on some implicit rules or autonomously, which is not desirable from both network and UE vendor perspective since it will be difficult for network and UE to be aligned with the current status.

Also, this WI is for CA. The current wording "multi-carrier UL operation" is not accurate, the enhancement for single cell operation should be precluded.

Thus, we propose the following update.

For multi-carrier UL operation for CA, there are some limitations of current specification, e.g. 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration, and UL Tx switching can be only performed between 2 UL bands for 2Tx UE. Dynamically selecting carriers with UL Tx switching based on the data traffic, TDD-DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration. It is worth studying whether extension of UL Tx switching to more than 2 bands may will lead to higher UL data rate, spectrum utilization and UL capacity.

6 – Lenovo (Beijing) Ltd

We are OK with the update.

7 – QUALCOMM JAPAN LLC.

Since the objective 1 includes (1) both intra-band and inter-band CA operation and (2) both FR1 and FR2 as the scenarios, we consider justification should be updated to include aspects regarding intra-band CA operation and FR2. Our suggestion (underlined text) is as follows.

NR supports a wide range of spectrum in different frequency ranges. It is expected that there will be increasing availability of spectrum in the market for 5G Advanced possibly due to re-farming from the bands originally used for previous cellular generation networks. Especially for low frequency FR1 bands, the available spectrum blocks tend to be more fragmented and scattered with narrower bandwidth. For FR2 bands and some FR1 bands, the available spectrum can be wider such that intra-band multi-carrier operation is necessary. To meet different spectrum needs, it is important to ensure that these scattered spectrum bands or wideband spectrum can be utilized in a more spectral/power efficient and flexible manner, thus providing higher throughput and decent coverage in the network.

One motivation is to increase flexibility and spectral/power efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells. The current scheduling mechanism only allows scheduling of single cell PUSCH/PDSCH per a scheduling DCI. With more available scattered spectrum bands or wider bandwidth spectrum, the need of simultaneous scheduling of multiple cells is expected to be increasing. To reduce the control overhead, it is beneficial to extend from single-cell scheduling to multi-cell PUSCH/PDSCH scheduling with a single scheduling DCI. Meanwhile, trade-off between overhead saving and scheduling restriction has to be taken into account.

8 – Guangdong OPPO Mobile Telecom.

We are fine with the proposed justification.

9 – LG Electronics Inc.

We are fine with the proposed justification.

10 – SHARP Corporation

We are OK with the proposed justification description.

11 – China Mobile Com. Corporation

We also think the support for Scells without SSB should be kept, including the justification part and objective part, and we can accept to remove corresponding description related to the original objective 3 and 4, corresponding to the controversial and not too controversial one. But the support for Scells without SSB

in inter-band CA has got lot of support during previous email discussion, and the expected spec work will be limited.

With SSB in one band providing DL timing/ frequency synchronization for a Scell in a different bands, the overhead can be reduced, which is aligned with justification part that the scattered spectrum bands can be utilized in a more efficient and flexible manner. So we propose to keep it.

12 – Beijing Xiaomi Electronics

We are fine with the update.

13 – Nokia Corporation

- Support Qualcomm update on the multi-cell PDSCH/PUSCH objective justification
- Support ZTE update on multicarrier UL objective justification
- If SCells without SSBs is moved to another WID, then it should be removed from this one

14 – MediaTek Inc.

For the justification of objective 1, we see the benefit in reduced physical control channel, PDCCH, resource overhead. In addition, the reduced scheduling PDCCH number also bring the benefit of reduced UE blind decoding complexity by virtue of reduced PDCCH multiplexing compared with cross-carrier scheduling. Since the benefit are all related to PDCCH (resource and multiplexing), we would like to suggest revise "scheduling DCI" to "scheduling PDCCH" for better reflecting the fundamental connection. It is also noticed that, in R17, there is proposal of single scheduling PDCCH with 2-stage DCI that shows better flexibility to support 3 or more SCells. The suggested revision also avoids preclusion of the R17 candidate solution. By the above, the following revision to the corresponding justification paragraph is suggested:

- One motivation is to increase flexibility and efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells. The current scheduling mechanism only allows scheduling of single cell PUSCH/PDSCH per a scheduling-~~DCI~~ PDCCH. With more available scattered spectrum bands, the need of simultaneous scheduling of multiple cells is expected to be increasing. To reduce the control overhead **and UE blind decoding complexity**, it is beneficial to extend from single-cell scheduling to multi-cell PUSCH/PDSCH scheduling with a single scheduling-~~DCI~~ PDCCH. Meanwhile, trade-off between overhead saving and scheduling restriction has to be taken into account.

For objective 2, it is still subject to study. Before there is firm evaluation results and agreed conclusions, it is too early to say "it will lead to higher UL data rate, spectrum utilization and UL capacity." In this regard, we suggest to following revision to the corresponding justification paragraph to avoid making conclusion on the potential benefits before the study:

- For multi-carrier UL operation, there are some limitations of current specification, e.g. 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration, and UL Tx switching can be only performed between 2 UL bands for 2Tx UE. Dynamically selecting carriers with UL Tx switching based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration, ~~will~~ **may potentially** lead to higher UL data rate, spectrum utilization and UL capacity.

15 – Intel Belgium SA/NV

We are fine with the proposed justification text.

1.1.2 Necessary update for objective 1 “Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI” if any

Companies are encouraged to provide feedback if any on the objective 1 in RP-213469 shown below.

1. Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI [RANI]

- Identify the maximum number of cells that can be scheduled simultaneously
- Consider both intra-band and inter-band CA operation
- Consider both FR1 and FR2
- The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling

For example, following proposals are made in RP-213285.

Proposal 1: Unlicensed spectrum is supported in Rel-18 CA enhancement.

Proposal 2: Existing “3+1” DCI size budget should be maintained when designing the DCI format for multi-carrier scheduling in Rel-18 CA enhancement.

Feedback Form 2: Necessary update for objective 1 “Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI” if any

1 – Futurewei Technologies

Objective 1 in RP-213469 looks ok to us. About proposal 1 in RP-213285, though we are not against including unlicensed spectrum, it is not clear if there is any additional impact from DCI design perspective. The proponents can clarify.

2 – CATT

We are in general fine with the objective but would like to clarify the following bullet. It can be interpreted as that the DCI is not optimized for 2-CC PUSCH/PDSCH scheduling case but be optimized for >2 CC cases only. What is the intention of the bullet?

- The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling

For inclusion of unlicensed spectrum, we also would like to understand what the additional specification efforts would be.

3 – SoftBank Corp.

We are fine with the proposal.

4 – Samsung Electronics Co.

- Fine with objective 1.
- Regarding the optimization for 3 or more cells, we understand it is to avoid the repeated discussion during Rel-17 DSS (which focused on 2 cells)

- As for unlicensed spectrum, we have the same comment as others.

5 – DOCOMO Communications Lab.

We are fine with objective 1.

Regarding the support of unlicensed spectrum, we don't see the necessity to include as an objective in WID since we understand that all functions are applied to unlicensed spectrum as default in Rel-17 UE feature unless it is clarified not to be applied. If it would be included, it should be clearly noted that the optimization for operation in unlicensed spectrum is out of scope.

6 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree with the objective 1 provided by the moderator, since it was non-controversial during the previous email discussions, and the objective itself as well as the corresponding overhead benefits are clear. In addition, in our understanding, "3 or more cells" in the last bullet in the objective 1 is the maximum number of cells to be scheduled by single DCI, i.e. single DCI can schedule 2 cells also.

7 – vivo Communication Technology

- Proposal-1: We would like to be clarified what additional impact is considered for unlicensed bands, and what scenarios are considered (e.g., only unlicensed+unlicensed carriers, or also including licensed+unlicensed carriers).
- Proposal-2: We don't support this proposal. Currently the "3+1" budget is defined per scheduled cell. It is not clear whether/how to define the budget for multi-cell scheduling, which should be discussed in RAN1.
- Additionally, as commented in 1.1.1, it is not clear on whether the multi-cell scheduling is applicable to the Rel-17 SCell scheduling PCell feature or not, e.g., whether a SCell can simultaneously schedule the PCell, the scheduling SCell, and/or other SCells. This aspect should be clarified.

8 – ZTE Corporation

We are fine with the above objective 1.

Regarding the proposal 1, we don't understand the motivation to include unlicensed band here. Also, proposal 1 may imply that RAN1 design has to do optimization specific for unlicensed bands, this may require a new study phase. We suggest not to add proposal 1 here.

Regarding the proposal 2, we share similar view as other companies. The previous "3+1" budget is defined per serving cell, with one DCI scheduling multiple cells, how to define the DCI budget needs more discussion, which can be carried out in the working group discussion. We suggest not to add proposal 2 here.

9 – Apple Computer Trading Co. Ltd

One clarification question on second sub-bullet, i.e., consider both FR1 and FR2, does it mean the scheduling cell and scheduled cells are in the same frequency range, or scheduling cell is in FR1 and scheduled cell in FR2 is allowed? Based on previous discussion, SCell in FR2 scheduling Pcell in FR1 is controversial. It's better to make this bullet clearer.

10 – Lenovo (Beijing) Ltd

We support the two proposals to make the objective more clearer.

11 – QUALCOMM JAPAN LLC.

We do not see the need of update for objective 1.

12 – Spreadtrum Communications

For the part of “*The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling*”, we think it is too early to separate two cell and more than two cells cases. So this sentence can be removed.

According to proposal 1, we prefer to give more clear definition of the scope, such as: Not include unlicensed band.

13 – Guangdong OPPO Mobile Telecom.

Generally fine with the objective 1. Regarding optimization for 3 or more cells, we share view as HUAWEI and single DCI scheduling 2 cells should be included in this WID.

For proposal 1, we’d like to understand what additional spec impact would be.

14 – SHARP Corporation

Clarification on support for NR-U in WID is good to reduce potential discussion on UE capability signaling. If necessary, WID can clarify that to strive minimum specification impact for unlicensed/licensed spectrum.

15 – LG Electronics Inc.

We are fine with the objective 1, with clarification to include the case of two cell scheduling by single DCI. Regarding the proposals 1 and 2, we have similar view with others, it seems no need to include them in WID.

16 – China Mobile Com. Corporation

We are general fine with the objective1 part. And for the “The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling” part, we also think it may be necessary to also optimize 2 cells case.

As the unlicensed spectrum proposal, we want to understand more about the additional specification efforts.

For the DCI size budget proposal, we share similar with vivo and ZTE, since the DCI size budget is a per cell limit, whether it should be modified can be part of the study.

17 – Beijing Xiaomi Electronics

We are generally fine with the objective with the following comments:

Regarding to proposal 1, we share the same views with companies that we don’t quite understand the motivation of including unlicensed spectrum into this WID.

For proposal 2, we support this proposal. Regarding to the comments that the DCI budget is defined per cell, we don’t think proposal 2 break this rule. Indeed it maintains the current mechanism and avoid additional standard efforts as the 3+1 DCI budget is the same as the current specification for each scheduled cell.

Regarding to the question from CATT, we share the same view with HW that 2 cell case is naturally covered by the current wording, i.e. 3 or more cells is the maximum number of scheduled cells.

18 – Nokia Corporation

In principle OK with the objective.

Wrt. Proposal 1 on NR-U, we'd be OK with the proposal, although it maybe more appropriate to say that the design is aimed at licensed spectrum, and no optimization or specific work is to be done for allow or optimize towards unlicensed band support.

Wrt. Proposal 2 on the DCI size budget. We can agree with the proposal to avoid having to debate this in RAN1

19 – MediaTek Inc.

For Objective 1, there is already considerable work in R17 DSS WI that evaluated and identified candidate solutions for 2-cell scheduling case. For efficient work of this WI, it is beneficial to extend and down-select from the candidate solutions. Since there is one proposal utilizing one scheduling PDCCH with 2-stage DCI (where only 1st-stage DCI requires UE blind decoding) that shows better flexibility in support more than 2 cell scheduling, we also suggest to revise "single DCI" to "single PDCCH" so as to avoid precluding a useful R17 candidate solution without any evaluation for 3 or more cell scheduling case. By the above the following revision to Objective 1 is suggested:

*1. Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single **DCI PDCCH** [RAN1]*

- Identify the maximum number of cells that can be scheduled simultaneously
- Consider both intra-band and inter-band CA operation
- Consider both FR1 and FR2
- The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling
- **Extend and down-select from the candidate solutions evaluated in R17 DSS WI**

For Proposal 1 and Proposal 2, we can support Proposal 1 but suggest to make Proposal 2 more precise. Since the DCI size budget is to avoid increasing UE blind decoding complexity, the following revision is suggested to make clear the logical connection between DCI size budget and UE blind decoding:

- Proposal 2: Existing "3+1" DCI size budget **for UE blind decoding** should be maintained when designing the DCI format for multi-carrier scheduling in Rel-18 CA enhancement

20 – Intel Belgium SA/NV

We are OK with proposed objective 1. About the two proposals in RP-213285, we prefer to limit the objective to licensed operation. Unlicensed operation can be considered in later release after the basic design on multi-cell PDSCH/PUSCH scheduling is completed. On the other hand, it is generally desirable to keep existing '3+1' DCI size budget.

Further, we prefer to clarify that both FR2-1 and FR2-2 are included by FR2 in the 3rd bullet.

21 – TELECOM ITALIA S.p.A.

We do not support to indicate unlicensed bands explicitly (see also comment from DOCOMO)

22 – VODAFONE Group Plc

We support objective 1 and also to reuse part of the work done during R17 DSS work item if necessary. We're fine with both Proposal and Proposal 2

23 – Ericsson LM

FR2 SCell scheduling FR1 PCell was considered together with this objective in Oct discussions, but as discussed in RP-212945, it is better to capture FR2 SCell scheduling FR1 PCell explicitly as a separate objective to avoid confusion. We provide further comments on this part in 1.1.3. For Proposal 1 and 2 mentioned above – DCI size budget details can be handled by WG. Also, do not see need to call out unlicensed operation specifically for this enhancement.

1.1.3 Necessary update for objective 2 “Study and if necessary specify following enhancements for multi-carrier UL operation” (at least regarding “[3 or 4] bands”)

Companies are encouraged to provide feedback on the objective 2 (at least regarding [3 or 4] part) in RP-213469 shown below.

2. Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN4]

- UL Tx switching schemes across **[3 or 4]** bands with restriction of 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1)
- Switching time and other RF aspects for above UL Tx switching schemes across **[3 or 4]** bands (RAN4)

Feedback Form 3: Necessary update for objective 2 “Study and if necessary specify following enhancements for multi-carrier UL operation” (at least regarding “[3 or 4] bands”)

1 – Futurewei Technologies

We support the proposed objective 2 and prefer to change to ”regarding up to 4 bands”.

2 – CATT

- 1) We think RAN2 should be added for this objective;
- 2) Between 3 or 4 bands, we support 4 bands.

3 – SoftBank Corp.

We are fine with the proposal. No preference on the number of bands: we can accept the majority view.

4 – Samsung Electronics Co.

According to previous discussion [RAN94e-R18Prep-02], the moderator suggested further discussion in RAN#94e. Instead of adding this objective from the beginning, the controversial discussion point should be resolved first.

5 – DOCOMO Communications Lab.

We are fine with objective 2. Regarding the number of supported bands, we prefer to support 4 bands.

6 – HUAWEI TECHNOLOGIES Co. Ltd.

Agree to include this objective in the WID. Besides, we have the following comments

- o As justified in RP-212151, the benefits of multi-carrier UL operation are significant. Therefore, we prefer to specify this objective directly, i.e., update it as *Study and if necessary specify*. If anything need to be studied, whether to support 3, 4 or more bands is the only thing in our understanding. Even for this point, it seems not really necessary to be studied.
- o From RAN1 and RAN2 perspective, the number of bands to be supported is not critical at least for RAN1/RAN2, since the work in RAN1/RAN2 would be agnostic to the number of bands over which Tx switching is performed. If really need to pick one, we think 4 is more appropriate. In addition, if there is any operator who has 4 available bands or even more, the enhancements here should not preclude the corresponding applicable scenarios.
- o RAN2 should be added as the secondary working group for this objective, as it will introduce new UE capability reporting and RRC configuration, especially for UE capability RAN2 needs to take time to discuss and come up with the structure to support this feature.

7 – vivo Communication Technology

We are fine for the objective 2, and fine to add RAN2 as the secondary WG considering the necessary higher layer signaling impacts.

8 – ZTE Corporation

As we commented above, this objective is for CA, the enhancement for single cell operation should be preclude. Thus, we propose to update the main bullet as following.

2. Study and if necessary specify following enhancements for multi-carrier UL operation for CA [RAN1, RAN4]

Regarding the “3 or 4” in brackets, we prefer 3 bands at this stage. Supporting up to 4 UL bands will complicate the RAN1 and RAN4 specification work, e.g., more switching cases among different bands, which may require more TUs. In addition to that, the incremental gain of supporting up to 4 UL bands compared with up to 3 bands is limited.

9 – Apple Computer Trading Co. Ltd

In general, we are fine with this objective, we also consider RAN2 should be involved for this objective.

10 – Lenovo (Beijing) Ltd

We are OK with the objective and prefer 3 bands considering the commercial requirements.

11 – China Unicom

We support the multi-carrier UL operation with TX switching for up to 4 bands, and considering the specification impacts, we don't think supporting 4 bands will introduce significant efforts than support the less bands.

During the GTW session, RAN2 TU for this topic should be reserved as there are obviously RAN2 work captured in the scope. And we suggest the moderator to update the TU spreadsheet and request for RAN2 TUs(at least 0.5 TU/meeting).

<p>12 – Spreadtrum Communications</p> <p>We are fine for the objective 2.</p>
<p>13 – CAICT</p> <p>We share the similar view from China Unicom. Upto 4 bands should be considered and RAN2 TU should be reserved.</p>
<p>14 – Guangdong OPPO Mobile Telecom.</p> <p>Generally fine with objective 2 and RAN2 should be involved. Between 3 or 4 bands, up to 4 bands should be considered</p>
<p>15 – SHARP Corporation</p> <p>we are fine with objective 2.</p>
<p>16 – LG Electronics Inc.</p> <p>We are fine with the objective 2.</p>
<p>17 – Orange</p> <p>We support a proposal to specify UL Tx switching up to 4 bands.</p>
<p>18 – China Mobile Com. Corporation</p> <p>In general, we are fine with the objective. We also think RAN2 should be involved since RRC reconfiguration and UE capability reporting will be introduced.</p> <p>As for the number of supported bands, the extension to only 3 bands seems not bring sufficient flexibility and advantages over the 2 frequency bands which has been supported in the Rel-17. Actually, we suggest to not to limit the number now. We can leave it to RAN 4 discussion□based on operator’s input and realistic implementation.</p>
<p>19 – Beijing Xiaomi Electronics</p> <p>We are fine with the objective 2 and agree with CATT that RAN2 should be added.</p>
<p>20 – LG Uplus</p> <p>We are supportive for this objective 2. Regarding the number of bands, also it does not need to have the limitation at this stage. Last but not least, as many commented, for this capability, related works in RAN2 are required.</p>
<p>21 – Nokia Corporation</p> <p>Agree with Samsung, the objective was to be discussed first, and we are not automatically convinced that a 3rd release in a row on the same feature is automatically justified. The Rel-16 and Rel-17 work on the feature has taken some effort, and on UE capability front the range of different UE implementation alternatives allowed is not making 3GPP look like capable of specifying a standard, but rather allowing any and all implementations and leaving it up to the network to decide which of those end up actually being supported. This is not a good basis for yet another round of extension on its own right.</p>

If we decide to proceed, with it, agree with ZTE comment on CA and number of bands, Adding RAN2 for RRC configuration and capability reporting would seem like an overkill.

22 – Asia Pacific Telecom co. Ltd

We support the objective 2 and also suggest RAN2 should be involved for configuration and capability related procedure.

23 – MediaTek Inc.

We CANNOT support Objective 2 with 4 bands. The study should start from justifying that 3-band extension can indeed provide meaningful benefit than 2-band baseline before any extension to support 4-band. Currently we are not convinced with 3-band extension. But, given the support for Objective 2, we can compromise to study 3-band first.

2. Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN4]

- UL Tx switching schemes across ~~[3 or 4]~~ bands with restriction of 2 Tx simultaneous transmission for FRI UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1)
- Switching time and other RF aspects for above UL Tx switching schemes across ~~[3 or 4]~~ bands (RAN4)

24 – VODAFONE Group Plc

We support Objective 2 and we're OK with adding RAN as secondary WG

25 – VODAFONE Group Plc

Regarding number of bands we prefer 4, apologies for the separate comment

26 – Intel Belgium SA/NV

The leading WG for objective 2 should be RAN4 as UL TX switching in Rel-16/17. In addition to switching time and other RF aspects, we prefer to explicitly capture the RRM requirements, e.g. DL interruptions due to UL Tx switching. Regarding the number of bands, we prefer to limit it to 3 to reduce the workload since only one TU is assigned for CA enhancement.

- Specify switching time and other RF aspects, and RRM requirement including DL interruption time for above UL Tx switching schemes across ~~[3 or 4]~~ bands (RAN4)

27 – Ericsson LM

First bullet also has impact for RAN2 (and possibly RAN4). The “*mechanisms to enable more configured UL bands than its simultaneous transmission capability*” requires significant specification efforts for UE capability signaling in RAN2 and possibly impact to band-combination definitions in RAN4. It is also difficult to progress on first bullet without RAN4 inputs on second bullet. We are in general not supportive of this and prefer to use the limited time for other CA enhancements. Compared to two carrier case, not much benefit is expected due to UL switching with [3 or 4 bands] and the required standardization work is significant.

Moreover, RAN4 objective on core part should also include RRM impact:

- UE RF requirements (e.g. switching time and other RF aspects) and RRM requirements for above UL Tx switching schemes across [3 or 4] bands (RAN4)

RAN4 objective on performance part should be include:

1. *Specify RRM test cases related to core requirements on UL Tx switching schemes across [3 or 4] bands [RAN4]*

Following RAN4 specs are also needed:

- 38.133 NR; Requirements for support of radio resource management; RAN#100; Core part
- 38.133 NR; Requirements for support of radio resource management; RAN#102; Performance part

1.1.4 Necessary update for other part of the draft WID if any

Companies are encouraged to provide feedback on other part of the draft WID if any.

For example, following potential new objective is proposed in RP-212945.

Proposal 1: Agree on the above proposal for update of the objective multi-cell PUSCH/PDSCH scheduling to explicitly include FR2 SCell scheduling for PUSCH on FR1 PCell

Feedback Form 4: Necessary update for other part of the draft WID if any

1 – China Telecom Corporation Ltd.

We propose to keep SSB-less support in this WI, as SSB-less mechanism will benefit overhead cost for CA with little specification impact. Furthermore, the objectives outcome from Oct. email discussion such as SCell fast activation and deactivation, UL/DL decoupling are on the condition of SSB-less supporting for CA, which we think at least the enhancement for SCell (de)activation could be captured into the scope. Thus, it is suggested to reconsider objectives for SSB-less as following.

-Introduce support for Scells without SSB in inter-band CA (so that an SSB in one band can provide DL timing/frequency synchronization for a Scell in a different band), via the following steps:

>identify for which bands this is feasible and the related UE requirements [RAN4]

>introduce the related UE capability and signalling support [RAN2]

>Based on SSB in one band providing DL timing/frequency synchronization for another band, specify solutions for latency improvement (not requiring temporary RS) on SCell (de)activation procedure for non-contiguous frequency resources in different bands, e.g. BWP switching/ (de)activation, SCell (de)activation [RAN2][RAN1].

2 – Samsung Electronics Co.

FR2 SCell scheduling for PUSCH on FR1 PCell

As discussed in [RAN94e-R18Prep-27], it is questionable whether FR2 coverage to be sufficient to help with FR1 scheduling.

3 – DOCOMO Communications Lab.

As for CSS from FR2 SCell to FR1 PCell, it can be precluded from the objective considering the limited TU.

Regarding SSB less SCell for inter-band CA, we are fine that it would be considered as a part of NW energy saving since it is necessary to study the energy saving gain, required synchronization accuracy for inter-band or etc. In addition, it is not preferable to expand the scope considering the limited TU.

4 – ZTE Corporation

From our perspective, the previous 2nd and 3rd objective can also be supported. The objectives can be listed as following.

2. Introduce support for Scells without SSB in inter-band CA (so that an SSB in one band can provide DL timing/ frequency synchronization for a Scell in a different band), via the following steps:

- *identify for which bands this is feasible and the related UE requirements [RAN4]*
- *introduce the related UE capability and signalling support [RAN2]*
- *~~3. [controversial]~~ Based on SSB in one band providing DL timing/frequency synchronization for another band, specify requirements ~~solutions~~ for latency improvement (not requiring temporary RS) on SCell (de)activation procedure for non-contiguous frequency resources in different bands, e.g. BWP switching/ (de)activation, SCell (de)activation [RAN4].*

The motivation can be summarized as following.

- Regarding the previous 2nd objective, i.e., introduce support for SCells without SSB in inter-band CA, this is beneficial to reduce the overhead of always-on signalling overhead. In fact, SCell without SSB has been supported for intra-band CA since Rel-15, the Rel-18 work can be regarded as an extension of the legacy Rel-15 mechanism.
- Regarding the previous 3rd objective, i.e., specify solutions for latency improvement on (de)activation procedure for non-contiguous frequency resources in different bands, this objective can be applied to SCell activation/deactivation, but not for BWP switching. Since this is a very straightforward aspect for enhancement if the previous 2nd objective is supported, the previous 3rd objective can be included as one sub-bullet for objective 2. The main work would be to specify corresponding requirements in RAN4.

5 – Apple Computer Trading Co. Ltd

As we commented in RA#94 preparation phase, we don't see the benefits for Scell in FR2 scheduling FR1 Pcell.

6 – HUAWEI TECHNOLOGIES Co. Ltd.

On the objectives not included in the current WID (i.e. SSB-less SCell for inter-band CA and latency reduction), we would like to see those accommodated in Rel-18.

7 – Guangdong OPPO Mobile Telecom.

The intention to explicitly include FR2 SCell scheduling for PUSCH on FR1 PCell is not clear. We'd like to understand what additional spec impact would be.

8 – China Mobile Com. Corporation

We propose to keep the objective about support for Scells without SSB as explained in answer of 1.1. And for FR2 SCell scheduling for PUSCH on FR1 PCell, we share similar view as other companies that the motivation is not clear since the coverage of FR2 is much poorer than FR1.

9 – Beijing Xiaomi Electronics

We also don't see the motivation of supporting CCS from FR2 SCell to FR1 PCell.

10 – Nokia Corporation

CCS from FR2 SCell to FR1 PCell: As is the case with number of other commenters, don't see the motivation of this.

SSB-less SCell support: we'd be fine into looking at what is missing. Whether that is done in this WID, or under network energy saving WID should be reflected in the TU planning, but we tend to agree that this is a potentially helpful solution for saving network energy.

11 – MediaTek Inc.

Given the approved TU budget for this CA enhancement WI, it is not practical to add more work load to RAN1. On the other hand, the feasibility check in RAN4 may be possible, subject to a careful work time plan:

Feasibility of support Scells without SSB in inter-band CA [RAN4]

- Identify the feasible band combinations and the related UE requirements

12 – Intel Belgium SA/NV

We are supportive to Proposal 1 in RP212945. We would like to clarify that multi-cell PDSCH/PUSCH scheduling is supported when PCell is included as scheduled cell.

13 – Ericsson LM

We support CCS from FR2 SCell to FR1 P(S)Cell. This provides similar benefits as the Rel17 solution. E.g., the PUSCH for A-CSI requests, TCP ACKs etc. corresponding to traffic on FR2 cells (when they are in coverage) can be scheduled using PCell UL using FR2 SCell PDCCH instead of requiring the PCell PDCCH to handle this load. As discussed in our contribution RP-212945, this is natural extension of Rel17 SCell to PCell CCS functionality (from which FR2 is missing) and can be supported with minimal specification effort.

1.1.5 Necessary update for TU reservations if any

Companies are encouraged to provide feedback on the TU reservations proposed in RP-213469 if any.

Feedback Form 5: Necessary update for TU reservations if any

1 – China Telecom Corporation Ltd.

We suggest to reserve RAN2 TU for this WI. As the objectives we propose to add in 1.1.4 need RAN2 effort.

2 – Samsung Electronics Co.

Fine with current TU reservations (total three TUs during Rel-18). In other words, having objective 1 only is already good enough.

3 – HUAWEI TECHNOLOGIES Co. Ltd.

RAN2 needs to be added as the impacted WG, and RAN2 work should start from Q3, with 0.5 TU per

RAN2 meeting till Q2 2023. According to the current plan, RAN1 will be finished in Q4 2022, it is better to allow RAN2 to start in Q3 2022, in case any coordination between the two working groups are needed.

4 – ZTE Corporation

We are ok with the current RAN1 TU allocation. If the following objective is introduced in the WI, then some RAN2 and RAN4 TU (very little) may be needed.

2. *Introduce support for Scells without SSB in inter-band CA (so that an SSB in one band can provide DL timing/frequency synchronization for a Scell in a different band), via the following steps:*

- *identify for which bands this is feasible and the related UE requirements [RAN4]*
- *introduce the related UE capability and signalling support [RAN2]*
- *~~3. [controversial]~~ Based on SSB in one band providing DL timing/frequency synchronization for another band, specify requirements ~~solutions~~ for latency improvement (not requiring temporary RS) on SCell (de)activation procedure for non-contiguous frequency resources in different bands, e.g. BWP switching/(de)activation, SCell (de)activation [RAN4].*

5 – Lenovo (Beijing) Ltd

We think one TU is sufficient for this WI.

6 – CAICT

Some RAN2 TU should be reserved.

7 – Guangdong OPPO Mobile Telecom.

It's better to involve RAN2 and reserve TU for RAN2.

8 – China Mobile Com. Corporation

According to above discussion, RAN2 TU may be needed.

9 – CATT

We also think RAN2 TU is needed.

10 – Nokia Corporation

If SSB-less SCells is kept in this WID, that may call or additional TUs to relevant WGs (RAN4, RAN2)

11 – MediaTek Inc.

RAN2 TU requirement will depend on the study outcome of Objective 2. We suggest to keep current TU plan as is, but open to review the needed RAN2 work scope after the study on Objective 2 is concluded.

12 – Intel Belgium SA/NV

Multi-cell scheduling via a single DCI may impact multiple other aspects, e.g. HARQ transmission, PD-CCH blind detection, as well as the design of each field in the DCI format. Therefore, it is expected relatively more efforts are required for the specification. Enhancement on UL TX switching is included as a separate objective too. In conclusion, we wonder if 3 TUs in total are sufficient to complete all the listed objectives.

13 – TELECOM ITALIA S.p.A.

impact on RAN4 workload need to be clarified

1.1.6 Any other comment (including general ones)

Companies are encouraged to provide any other comment including general ones if any.

Feedback Form 6: Any other comment (including general ones)

1 – HUAWEI TECHNOLOGIES Co. Ltd.

Given the current scope of this item, we think it is more proper to name the item as “Multi-carrier enhancements”. It is noted that there was good discussion and strong operator support on “multi-carrier enhancement” in past email and GTW discussion, including the objectives that are currently captured in the WID. It is also noted that current CA framework does not support switching among UL bands more than what the UE supports, thus a generalized naming is more proper for this item.

2 – CAICT

As Huawei mentioned, ”Multi-carrier enhancements” reflects the objectives better than CA enhancements.

3 – Beijing Xiaomi Electronics

Based on the previous discussion and updated objectives, we agree with Huawei that ”Multi-carrier enhancements” is more proper.

1.2 Moderator Summary and recommendation for further discussion

Necessary update for justification description

Thank you very much for valuable inputs from many companies. Based on the feedbacks in the initial round, we could observe following potential further updates for justification description, while there are number of companies fine with the current justification description.

- Regarding the 1st paragraph, there is one company suggesting to remove it, and there are two companies suggesting to include aspects regarding intra-band CA operation and FR2.
- Regarding the 2nd paragraph, there are two companies suggesting to include aspects regarding intra-band CA operation and FR2, there is one company suggesting to clarify whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, and there is one company suggesting to change from “DCI” to “PDCCH”.
- Regarding the 3rd paragraph, there are three companies suggesting to change from “will” to “may” regarding the gain, and there are two companies suggesting to add “for CA”.
- Regarding the potential 4th paragraph regarding SCell without SSB, there are two companies suggesting to add it (i.e., not removed it), while there is one company commenting that it should be removed if it is moved to another SID (NW energy saving).

Based on the above situation, following is the moderator's suggestion for further discussion in intermediate round.

- Regarding the 1st and 2nd paragraphs, it is suggested to keep them, and the moderator would like to check whether the suggested updates from Qualcomm regarding intra-band CA and FR2 are ok for other companies (the moderator thinks it is reasonable and should not be controversial).
- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS or not and whether “DCI” should be updated to “PDCCH” or not, further discussion on objective 1 should be done first, and if there is some update on objective 1 description, it can be reflected to justification description as well.
- Regarding the 3rd paragraph, as there are several companies not convinced to skip the study phase for objective 2, the suggested update from MediaTek would be a good compromise although there are larger number of companies supporting objective 2. Therefore, the moderator suggests adopting it. Further updates suggested by ZTE can also be checked if other companies are also ok or better wording to solve ZTE's concern (since the moderator assumes there is no intention to allow autonomous switching by the text on “dynamically selecting carriers ...”).

Necessary update for objective 1

Thank you very much for valuable inputs from many companies. Based on the feedbacks in the initial round, we could observe the following potential further updates for objective 1, while there are large number of companies fine with the current objective 1.

- Regarding the proposal 1 in RP-213285, there are number of companies wondering whether/what is additional specification efforts for unlicensed spectrum, and hence there are seven companies not to add the proposed bullet and there are three companies to clarify no additional effort for unlicensed spectrum even if unlicensed spectrum is also covered.
- Regarding the proposal 2 in RP-213285, there are five companies suggesting the discussion on it in the WG, while there are other five companies supporting to add the proposed bullet to avoid such discussion in the WG.
- There is one company suggesting the clarification on whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature.
- There are two companies suggesting the clarification on the meaning of “both FR1 and FR2”, i.e., whether scheduling and scheduled cells are in the same frequency range or can be in the different frequency ranges, and whether both FR2-1 and FR2-2 are included by “FR2”.
- There are two companies suggesting the reuse of Rel-17 DSS work for down-selection of candidate solutions.
- There are five companies suggesting the clarification of the meaning of “optimized for 3 or more cells”, while some other companies clarify that it intends to cover the case of scheduling 2 cells as well.

Based on the above situation, following is the moderator's suggestion for further discussion in intermediate round.

- Based on the situation, both proposal 1 and proposal 2 in RP-213285 should not be further discussed here, and it can be discussed in the WI.
- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, the moderator thinks it is not necessary to clarify each of such detailed aspects in the WID (i.e., it can be discussed in the WI). But the moderator would like to check if majority of companies prefer to clarify it in the WID (either it should be covered or should be precluded).
- Regarding the meaning of “both FR1 and FR2”, i.e., whether scheduling and scheduled cells are in the same frequency range or can be in the different frequency ranges, and whether both FR2-1 and FR2-2 are included by “FR2”, the moderator thinks it can also be discussed in the WI as well. But the moderator would like to check if majority of companies prefer to clarify it in the WID.
- Regarding the suggested updates from MediaTek, the moderator thinks it is reasonable to reuse the work done in Rel-17 DSS but not sure whether it is necessary to explicitly capture it in the WID. But the moderator would like to check if majority of companies prefer to adopt the suggested updates in the WID.
- Regarding the meaning of “optimized for 3 or more cells”, the moderator suggests keeping the bullet as it is since companies already clarified the meaning. But the moderator would like to check if companies are fine with it or have any suggestion for wording update.

Necessary update for objective 2

Thank you very much for valuable inputs from many companies. Based on the feedbacks in the initial round, we could observe the following potential further updates for objective 2.

- There is one company suggesting the removal of study phase, while there are four companies not supportive of this objective but may be able to accept this objective with study phase and limiting the scope to up to 3 bands in CA.
- There are eight companies prefer to support up to 4 bands, there are five companies prefer to support up to 3 bands, and there are two companies prefer to not limit the number in the WID, i.e., it can be discussed in the WI.
- There are large number of companies suggesting the addition of RAN2 as secondary WG for this objective specifically for RRC and UE capability signaling design, while there is one company considering that adding RAN2 for RRC and UE capability would not be necessary.
- There are two companies suggesting the addition of RRM related RAN4 work in the objective, and there is one company suggesting that the leading WG for this objective is RAN4 as in Rel-16/17.

Based on the above situation, following is the moderator’s suggestion for further discussion in intermediate round.

- Based on the situation, the moderator suggests proceeding this objective with study phase. The primary target should be up to 3 bands for now considering the concern on workload with limited TU. It may be possible to update the WID to support up to 4 bands in future plenary meeting depending on the progress of the WI, real demand from operators and necessary workload especially in RAN4.

- RAN2 can be added as secondary WG once the study phase outcome is derived and if it is decided to specify the mechanism. Anyway, only RAN1 can work on this WI in Q2 2022 and the necessary RAN2 work can also be discussed and identified in the study phase.
- The moderator would like to check if majority of companies are fine to add RRM related RAN4 work for objective 2 (the moderator thinks it is reasonable and should not be controversial, and note that RAN4 TU reservation in RP-213469 already has some RD TU for both core and perf parts).

Necessary update for other part of the draft WID

Thank you very much for valuable inputs from many companies. Based on the feedbacks in the initial round, we could observe the following potential further updates for other part of the draft WID.

- There are four companies suggesting the addition of the objective regarding the support of SCells without SSB in inter-band CA in this WI, while there is one company concerning the addition due to workload with limited TU (i.e., suggesting to handle it in NW energy saving SI as suggested in RP-213469 Appendix 2). There is one company suggesting the possibility to have only feasibility check in RAN4 on the SCells without SSB in inter-band CA.
- There are two companies suggesting the addition of the objective regarding FR2 SCell scheduling to FR1 PCell, while there are seven companies concerning the addition due to unclear use-case and limited TU.
- According to the discussion on the objective 1, Rel-17 DSS WI can be added in 2.3 “other related WIs and dependencies”.
- According to the discussion on the objective 2, 38.133 can be added in 5 “expected output and time scale”.

Based on the above situation, following is the moderator’s suggestion for further discussion in intermediate round.

- Due to limited TU and suggesting the objective 1 and 2 already according to RP-213469 from chairs, the moderator suggests to not add any other objective for this WI. SCells without SSB can be covered by NW energy saving SI as suggested in RP-213469.
- The moderator would like to check if companies are fine to add Rel-17 DSS WI in 2.3 and 38.133 in 5 (the moderator thinks it is reasonable and should not be controversial).

Necessary update for TU reservations

Thank you very much for valuable inputs from many companies. Based on the feedbacks in the initial round, we could observe the followings.

- There are two companies fine with the current TU reservations in RP-213469, while there is one company concerning that 3 TUs in total for RAN1 may not be sufficient for objective 1 and 2, and there is one company considering that the current TU reservations is sufficient only for objective 1.

- There are six companies suggesting the addition of RAN2 TU for objective 2, e.g., 0.5 TU from Q3 2022 to Q2 2023.
- There are two companies suggesting the addition of RAN2/4 TU if SCells without SSB is added as third objective for this WI.
- There is one company suggesting the clarification on RAN4 workload.

Based on the above situation, following is the moderator’s suggestion for further discussion in intermediate round.

- As suggested for the objective 2, RAN2 TU can be added once the study phase outcome is derived and if it is decided to specify the mechanism. This situation can be informed to RAN2 chair.
- The moderator would like to check again if companies are fine with current RAN1/4 TU reservations in RP-213469 based on the above suggestions from the moderator on objective 1 and 2.

Other general comments

There are three companies suggesting the update of the WI name to “Multi-carrier enhancements” as generalized naming. The moderator would like to check if majority of companies are fine to update the WI name.

2 Intermediate Round

2.1 Correction of company views

2.1.1 Necessary update for justification description

Companies are encouraged to provide feedback if any on the moderator’s updated justification shown in the updated draft WID in draft folder, based on the following moderator’s suggestions.

- Regarding the 1st and 2nd paragraphs, it is suggested to keep them, and the moderator would like to check whether the suggested updates from Qualcomm regarding intra-band CA and FR2 are ok for other companies (the moderator thinks it is reasonable and should not be controversial).
- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS or not and whether “DCI” should be updated to “PDCCH” or not, further discussion on objective 1 should be done first, and if there is some update on objective 1 description, it can be reflected to justification description as well.
- Regarding the 3rd paragraph, as there are several companies not convinced to skip the study phase for objective 2, the suggested update from MediaTek would be a good compromise although there are larger number of companies supporting objective 2. Therefore, the moderator suggests adopting it. Further updates suggested by ZTE can also be checked if other companies are also ok or better wording to solve ZTE’s concern (since the moderator assumes there is no intention to allow autonomous switching by the text on “dynamically selecting carriers ...”).

Feedback Form 7: Necessary update for justification description

1 – QUALCOMM JAPAN LLC.

We are OK with the justification updated by the Moderator in the draft WID v001.

2 – New H3C Technologies Co.

We are fine with Justificaiton text in the draft WID 001 version

3 – DOCOMO Communications Lab.

We are fine with the updated justification.

4 – ZTE Corporation

ZTE Comment

Regarding the first bullet, we think it is ok to list intra-band CA and FR2 in the justification.

Regarding the second bullet, it seems ok to leave whether it is applicable to SCell-scheduling-PCell to working group discussion, this needs further detailed checking and discussion in working group level. Regarding whether to include “2-stage” DCI (changing “DCI” to “PDCCH”), considering the limited TU for this WI, it is preferred to stick with the legacy DCI design as much as possible, otherwise more TU may be required for this WI in RAN1. Thus, we prefer to keep “DCI” here.

Regarding the third bullet, we still prefer our previous wording. Except for the autonomous switching issue, we also mentioned that it should be clearly stated that the potential enhancements is for CA, but not for single cell (adding “for CA” after multi-carrier UL operation).

We can compromise to support the following version. The “based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration” should be deleted since it anyway is not a complete list.

*For multi-carrier UL operation **for CA**, there are some limitations of current specification, e.g. 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration, and UL Tx switching can be only performed between 2 UL bands for 2Tx UE. Dynamically selecting carriers with UL Tx switching-based-on-the-data-traffic, TDD-DL/UL-configuration, bandwidths-and-channel-conditions-of-each-band, instead-of-RRC-based-cell(s)-reconfiguration may will lead to higher UL data rate, spectrum utilization and UL capacity.*

5 – vivo Communication Technology

We are fine with the updated WID, assuming that the description may be updated if the corresponding objectives are updated.

6 – Lenovo (Beijing) Ltd

We are OK with the update.

7 – SHARP Corporation

We are OK with the updated justification description.

8 – HUAWEI TECHNOLOGIES Co. Ltd.

We are fine with the current justification from the moderator.

We don't think it is necessary to make the further changes as suggested by ZTE, since it should be the common understanding that autonomous switching is not allowed similarly as that in Rel-16/17. In addition, we are not convinced what study needs to be done, the gains for UL Tx Switching is already proved and this is why we already specified the feature in Rel-16/Rel-17, the current work listed here is to extend this for more number of bands and the corresponding gain is shown in our contribution RP-212151. Thus we think this part does not need any further change, on top of the version given by the moderator.

9 – LG Electronics Inc.

We are fine with the updated justification in the updated draft WID.

10 – China Mobile Com. Corporation

We are fine with the updated justification.

11 – Spreadtrum Communications

We are fine with the updated justification given by Moderator.

12 – Samsung Electronics Co.

One clarification question on the following description of the first paragraph:

"... thus providing higher throughout and decent coverage in the network."

What is the connection between this WI and "decent coverage"? If not relevant, we suggest to remove this. BTW, the typo 'throughout' should be corrected to 'throughput' in the same sentence.

13 – Beijing Xiaomi Electronics

we are fine with the updated justification from moderator.

14 – CAICT

We are fine with the update.

15 – VODAFONE Group Plc

We-re fine with the updated justification

16 – Nokia Corporation

OK with the updated justification as it stands, but would be happy with the revision suggested by Samsung as well as with the revision suggested by ZTE.

17 – MediaTek Inc.

For the 2nd paragraph, it is justification for Objective 1 and should provide technical support for the "benefits". From RAN1 work for R17 WI of DSS, there does agree to capture the observations in Section 2.6 of R1-2102138, where companies results showing reduced PDCCH blockage rate and improved PDSCH throughputs are collected. In this regard, we would suggest to reference the study in R17 for 2-cell scheduling case:

”One motivation is to increase flexibility and spectral/power efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells. The current scheduling mechanism only allows scheduling of single cell PUSCH/PDSCH per a scheduling DCI. With more available scattered spectrum bands or wider bandwidth spectrum, the need of simultaneous scheduling of multiple cells is expected to be increasing. To reduce the control overhead, it is beneficial to extend from single-cell scheduling to multi-cell PUSCH/PDSCH scheduling with a single scheduling DCI, **as studied in Rel-17 WI of DSS for 2-cell scheduling case**. Meanwhile, trade-off between overhead saving and scheduling restriction has to be taken into account. ”

The rest of the update by moderator is fine for us.

18 – Intel Belgium SA/NV

We are fine with suggested updates from Qualcomm regarding intra-band CA and FR2.

We agree to discuss further on objective 1 regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS or not and whether “DCI” should be updated to “PDCCH” or not.

We are fine with starting with study phase for objective 2. We are fine with ZTE’s revision assuming a study phase for objective 2 can be agreed

19 – Futurewei Technologies

We are fine with the current version

20 – Ericsson LM

Support updates from Qualcomm regarding intra-band CA and FR2. OK with changes proposed by ZTE and Samsung.

2.1.2 Necessary update for objective 1

Companies are encouraged to provide feedback if any on the moderator’s updated objective 1 shown in the updated draft WID in draft folder, based on the following moderator’s suggestions.

- Based on the situation, both proposal 1 and proposal 2 in RP-213285 should not be further discussed here, and it can be discussed in the WI.
- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, the moderator thinks it is not necessary to clarify each of such detailed aspects in the WID (i.e., it can be discussed in the WI). But the moderator would like to check if majority of companies prefer to clarify it in the WID (either it should be covered or should be precluded).
- Regarding the meaning of “both FR1 and FR2”, i.e., whether scheduling and scheduled cells are in the same frequency range or can be in the different frequency ranges, and whether both FR2-1 and FR2-2 are included by “FR2”, the moderator thinks it can also be discussed in the WI as well. But the moderator would like to check if majority of companies prefer to clarify it in the WID.
- Regarding the suggested updates from MediaTek, the moderator thinks it is reasonable to reuse the work done in Rel-17 DSS but not sure whether it is necessary to explicitly capture it in the WID. But the moderator would like to check if majority of companies prefer to adopt the suggested updates in the WID.
- Regarding the meaning of “optimized for 3 or more cells”, the moderator suggests keeping the bullet as it is since companies already clarified the meaning. But the moderator would like to check if companies

are fine with it or have any suggestion for wording update.

Feedback Form 8: Necessary update for objective 1

1 – QUALCOMM JAPAN LLC.

In general, we agree with Moderator’s view. Following are some follow-ups:

- Regarding proposal 1 and proposal 2 in RP-213285, we agree with Moderator. From our point of view, by default, features should be applicable to both licensed and unlicensed frequencies unless any specific reason indicating otherwise is identified. However, such details can be discussed in the WI.
- Regarding the interaction between the objective 1 and Rel-17 SCell to PCell CCS feature, we agree with Moderator. Such detail can be discussed in the WI.
- Regarding the meaning of “both FR1 and FR2”, we agree with Moderator. Such detail can be discussed in the WI.
- Regarding the suggested updates from MediaTek, we do not think adding “Extend and down-select from the candidate solutions evaluated in R17 DSS WI” makes sense, since the scope of the R17 DSS WI was up to 2 scheduled cells and FR1 only (although some solutions in the Rel-17 WI already considered extending to more than 2 scheduled cells). We suggest not to add this. Regarding the replacement of “DCI” by “PDCCH”, we prefer to keep “DCI”. We do not think this indeed precludes some potential solutions.

2 – New H3C Technologies Co.

We are fine with current description on objective 1

3 – DOCOMO Communications Lab.

We support the moderator’s update on objective 1.

4 – ZTE Corporation

We are fine to keep the objective 1 as it is.

Regarding the applicability to SCell-scheduling-PCell, this can be part of the working group discussion.

Regarding whether the scheduling cell and scheduled cell have to be in the same frequency range, we think this can also be part of the working group discussion. Regarding whether it is applicable to FR2-2, we don’t think any specific enhancements should be done for FR2-2. If the solution can be applied to FR2-2 without any modification, then it is fine to apply it in FR2-2. This can be part of the Rel-18 UE capability discussion from our perspective.

Regarding MediaTek’s proposal to add a bullet “Extend and down-select from the candidate solutions evaluated in R17 DSS WI”, we don’t think we need to add this general rule at this stage. Anyway, companies will strive to reuse the previous work as much as possible.

5 – Lenovo (Beijing) Ltd

Generally, we are OK with this objective. Regarding the bullet of “The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling”, maybe we can make minor update to add the case of 2 cells in Rel-17 as starting point. Otherwise, it is a bit ambiguous whether two cells are supported or not. Our suggestion is listed below:

- The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling with 2 cells in Rel-17 as starting point

6 – vivo Communication Technology

- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, we prefer to clarify it (either included or excluded) in RAN so that no need to further discuss in RAN1 WG given the limited number of TUs.
- Regarding the meaning of “both FR1 and FR2”, similarly, we prefer to clarify it in RAN at the beginning instead of further discussion in RAN1.
- Regarding the suggested updates from MediaTek, we don’t think it is needed.

7 – Apple Computer Trading Co. Ltd

In general, we prefer to make the objectives clearer, thus the TU could be utilized more efficiently in WG. To move forward, we are ok with moderator’s proposal to discuss the details in WI.

For “optimized for 3 or more cells”, it’s mis-leading, such as the design is not optimized for two cells case, is there any linkage with Rel-17 DSS? There is no agreed design for multi-CC scheduling for two cells in Rel-17.

8 – SHARP Corporation

We are OK with the moderator’s suggestions for objective 1.

9 – HUAWEI TECHNOLOGIES Co. Ltd.

We are fine with the current objective 1 from the moderator. In addition, we agree with the moderator, there is no need to clarify further detailed aspects in the WID, e.g. whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, which can be further discussed and decided in the work item phase.

10 – LG Electronics Inc.

We are fine with the objective 1 in the updated draft WID.

11 – CATT

For “optimized for 3 or more cells...”, based on the discussions in initial round, our understanding is that the intention is to clarify that the maximum number of cells to be scheduled by a single DCI is 3 or more, which is different from Rel-17 DSS. Then we are fine with the current objective 1.

12 – China Mobile Com. Corporation

We are ok with moderator’s suggestion in section 1.2.

Specifically for issue of multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, when multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, does it mean a DCI in Scell scheduling Pcell and scell simultaneously? When this is not applicable does it mean only DCI on PCell to schedule multiple carriers is supported? If so, may be it is better to support DCI in Scell scheduling Pcell and scell since it can solve PDCCH capacity problems in DSS scenario. And this can be discussed during WI.

And the R17 DSS work may be a starting point, but other solutions should not be precluded and can be studied during WI.

For “optimized for 3 or more cells”, it may be better to optimize it if the common understanding is to also include 2 cells.

13 – Samsung Electronics Co.

We are fine with current objective 1.

Among above moderator’s suggestions, specifically for FR2-2, we prefer not to include this in the WI scope due to its new PDCCH monitoring structure. If not controversial, we suggest the corresponding update.

14 – Beijing Xiaomi Electronics

we are fine with the current objective 1.

15 – Spreadtrum Communications

We are fine to discuss FR1/FR2, licensed or unlicensed, intra-band/inter-band in WI stage.

‘We ask for one clarification: only one PUSCH can be scheduling per one CC or multiple PDSCH/PUSCH can be scheduled for some CCs *with a single DCI*? We think it is better to give some restrictions on the number of PDSCH/PUSCH scheduling per CC by one DCI, such as a new bullet can be added:

- *Identify the maximum number of PUSCH/PDSCH that can be scheduled per CC with a single DCI*

16 – CAICT

We are fine with the current version.

17 – VODAFONE Group Plc

We support the moderator current proposal and agree the mentioned details can be left for the WI discussion

18 – Nokia Corporation

In principle OK with the objective 1 as suggested by moderator, but

- would prefer a clear statement on unlicensed and FR2.2 as something that will not be specifically targeted for or optimized for.
- would prefer a clear statement for what is to be supported and what not, so that the WGs can focus on the design rather than what is the design intended for. However, it seems it maybe difficult to achieve this for now, so we can live with the current wording.

19 – MediaTek Inc.

For Objective 1, the last sub-bullet is a bit strange since it seems exclude 2 cell cases. Assuming the intention is to achieve better scalable design than Rel-17, we would like to suggest the following for clarification:

- ~~The single DCI shall be optimized~~ **The solution shall be scalable** for ~~3~~ **2** or more cells for the multi-cell PUSCH/PDSCH scheduling

Considering the very limited TU for this WI, we see it will be efficient if the designs/principles studied by RAN1 in Rel-17 DSS can be leveraged. In this regard, the following note is suggested for Objective 1:

”**Note: The study in Rel-17 WI of DSS should be leveraged to avoid duplicated work**”

20 – Intel Belgium SA/NV

- Fine to not further discuss proposal 1 in RP-213285. However, it should be helpful to have a guideline on DCI size budget in the WID
- It would be helpful to clarify whether combination of multi-cell scheduling and CCS from SCell to PCell is in the scope or not. If only limited TU can be available for the WI, we prefer that PCell cannot be a scheduled cell in multi-cell scheduling by a DCI on SCell, otherwise, we may face tricky handling maximum BD/CCE division for PCell.
- We prefer to allow scheduling and scheduled cell are in different FRs. All FR1, FR2-1 and FR2-2 should be allowed in the WI
- Rel-17 DSS discussions can be reference for Rel-18 by default. However, we don't think it needs to be explicitly captured in WID, especially considering that the discussion on two-cell scheduling in Rel-17 DSS is mainly for evaluations.
- We are fine to have a bullet for this purpose, but it should be ““optimized for 2,3 or more cells””

21 – Futurewei Technologies

We are fine with the current version

22 – Ericsson LM

OK with current text for Objective 1, remaining aspects can be discussed in WG.

2.1.3 Necessary update for objective 2

Companies are encouraged to provide feedback if any on the moderator's updated objective 2 shown in the updated draft WID in draft folder, based on the following moderator's suggestions.

- Based on the situation, the moderator suggests proceeding this objective with study phase. The primary target should be up to 3 bands for now considering the concern on workload with limited TU. It may be possible to update the WID to support up to 4 bands in future plenary meeting depending on the progress of the WI, real demand from operators and necessary workload especially in RAN4.
- RAN2 can be added as secondary WG once the study phase outcome is derived and if it is decided to specify the mechanism. Anyway, only RAN1 can work on this WI in Q2 2022 and the necessary RAN2 work can also be discussed and identified in the study phase.
- The moderator would like to check if majority of companies are fine to add RRM related RAN4 work for objective 2 (the moderator thinks it is reasonable and should not be controversial, and note that RAN4 TU reservation in RP-213469 already has some RD TU for both core and perf parts).

Feedback Form 9: Necessary update for objective 2

1 – New H3C Technologies Co.

From our perspective, objective 2 should be added to WI phase because UL Tx switching schemes on two bands has developed in Rel-17 and it is easy to extend to 3 bands.

2 – SoftBank Corp.

The moderator proposal looks reasonable to us, and we support it.

3 – DOCOMO Communications Lab.

We are fine with the moderator's updates on objective 2.

4 – ZTE Corporation

We are generally fine with the updated proposal except for one issue.

As we commented in previous round, this objective is for CA, the enhancement for single cell operation should be preclude. Thus, we propose to update the main bullet as following. Otherwise, it may complicate the working group discussion as companies may argue that "multi-carrier UL operation" includes the single cell case.

2. Study and if necessary specify following enhancements for multi-carrier UL operation for CA [RAN1, RAN4]

5 – Apple Computer Trading Co. Ltd

We are fine with moderator's proposal on objective 2.

6 – SHARP Corporation

We are OK with the moderator's suggestions for objective 2.

7 – HUAWEI TECHNOLOGIES Co. Ltd.

- We have already specified UL Tx switching in Rel-16/17 which means the gains are already proved for two bands. It is also worth mentioning there is no study phase in previous releases. The intention here is to extend this feature to support the band combination with more number of bands, and thus the gains are already obvious as shown in our contribution RP-212151.

- We don't agree to limit the number of bands to 3. Firstly, the number of supported bands is mainly dependent on operator's requirements, it should be noted that many bands are ready to or will be refarmed from LTE to NR, and thus it can be expected that more number of bands will be utilized for NR, to some extent this has already been reflected in the initial round as many operators expressed the view that up to 4 bands should be considered. Secondly, RAN1/RAN2 design is agnostic with the supported number of bands and uniform design can always be possible regardless of the number of bands. Limiting to 3 bands in one release, and then in future releases to expand more bands is not a desirable way as this would only make the design not compatible with the potential increasing number of bands.

- Regarding the RAN2 impact, we don't see reasons why this cannot be added right now. The first sub-bullet under this objective 2 already indicates there is discussion on RRC reconfiguration and UE capability reporting, and this obviously requires RAN2 work, especially for this specific case RAN2 needs some time to discuss and come up with the structure for the signaling design. This is the usual way when drafting WID to add any relevant WGs, and we also hope companies can use consistent standards for different topics, we noticed that for Rel-18 DSS RAN2 is already added although there is study phase for RAN1/RAN4.

- Having said above, we suggest the objectives can be modified as below:

Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN4, RAN2]

- UL Tx switching schemes across up to **4** bands with restriction of 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1, **RAN2**)
- Switching time and other RF aspects, and RRM requirements for above UL Tx switching schemes across up to **4** bands (RAN4)

8 – LG Electronics Inc.

We are fine with the updated objective 2 in the updated draft WID.

9 – China Mobile Com. Corporation

We don't think moderator's suggestion reflect majority view. In our understanding, at least 4 bands should be supported since obviously there are more companies prefer it. Also, RAN2 should be involved as there are large number of companies suggesting to do so.

10 – CATT

We share the similar view with Huawei to support 4 bands considering the limited additional efforts, if any. In addition, we also think RAN2 should be involved. Therefore, we support the update from Huawei.

11 – Samsung Electronics Co.

We can live with current objective 2 as is while we sympathize ZTE's point on 'multi-carrier UL operation'.

12 – Beijing Xiaomi Electronics

we share similar views with CATT and Huawei. The updated objective from Huawei is fine to us.

13 – vivo Communication Technology

We are fine with the updated objective, and we also share the view that RAN2 should be involved as the need of RAN2 signaling is clear. Adding RAN2 in the bracket as suggested by Huawei is fine to us.

14 – CAICT

As we comments in initial round, we still think 4 bands should be considered and RAN2 should be involved as proposed by Huawei.

15 – VODAFONE Group Plc

We share the same view as Huawei

16 – China Unicom

Thanks for the great efforts, but I'm afraid the summary is not reflecting many companies' comments in 1st round.

For 4 bands and RAN2 TUs, these requirements are obvious and there are a list of operators to support the 4 bands into the scope. Let's treat this bullets more seriously and take all the comments into account for the intermediate round.

We share the same view with above companies and we can take Huawei's proposes as the baseline for further discussion.

17 – Nokia Corporation

The current objective 2 if v001 is something we can live with, although we would prefer to clarify that the target is for CA. We don't quite see that reason there is to mark RAN2 as a responsible company if it is just about RRC configuration and UE capabilities - both will be developed by RAN1 and liaised to RAN2 in the end of the release. If it is for some reason important in this particular WID to state RAN2, we could introduce a sub-bullet with

- UE capability and RRC configuration related signalling [RAN2]

18 – Intel Belgium SA/NV

- Fine with proceeding study phase and mainly targeting 3 bands.
- Fine to add RAN2 as secondary WG. Can moderator or other companies clarify why RAN4 is not the leading WG for this objective as UL Tx switching in Rel-16/17?
- We support the 3rd bullet.

19 – MediaTek Inc.

For Objective 2, we think the study should provide specific outcomes for justifying the necessity. Specifically, UE impact (e.g., complexity and power consumption) and system benefit should be investigated for the justification.

In our view, the benefit achieved by R17 UL TX switching partly comes from limited configuration that UE can optimize and minimize the switching time. With more complicated combinations, longer switching time and interruptions may reduce the system benefit that can be practically achieved. Considering the dependency between the system benefit and the switching time, the confirmation on the switching time assumption by RAN4 should also be needed for the study.

By the above, the following revision is suggested:

2. Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN4]

- **The design, UE impact and system benefit of UL Tx switching schemes across up to 3 bands with restriction of 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1)**
 - o **Note: The switching time assumption for the evaluation should be confirmed by RAN4**
- Switching time and other RF aspects, and RRM requirements for above UL Tx switching schemes across up to 3 bands (RAN4)

20 – Futurewei Technologies

We share the same view as CMCC, VDF, CUC, etc. that Huawei's version is preferred

21 – Ericsson LM

We prefer to add RAN2 as secondary WG and support the sub-bullet suggested by Nokia. Their inputs (e.g. on complexity of capability signaling) in study would be useful.

2.1.4 Necessary update for other part of the draft WID

Companies are encouraged to provide feedback if any on the moderator's updates other than justification and objective 1/2 shown in the updated draft WID in draft folder, based on the following moderator's suggestions.

- Due to limited TU and suggesting the objective 1 and 2 already according to RP-213469 from chairs, the moderator suggests to not add any other objective for this WI. SCells without SSB can be covered by NW energy saving SI as suggested in RP-213469.
- The moderator would like to check if companies are fine to add Rel-17 DSS WI in 2.3 and 38.133 in 5 (the moderator thinks it is reasonable and should not be controversial).
- The moderator would like to check if majority of companies are fine to update the WI name to "Multi-carrier enhancements".

Feedback Form 10: Necessary update for other part of the draft WID

1 – QUALCOMM JAPAN LLC.

- Regarding the SCells without SSB, we agree with Moderator.
- Regarding adding Rel-17 DSS WI Section 2.3, we are not sure what dependencies this WI would have with Rel-17 DSS WI. In the Rel-17 DSS WI, multi-cell scheduling was discussed but not supported. Although it is up to companies to propose a solution that has been presented in Rel-17 DSS WI, it is not clear to us why it needs to be indicated as "WI dependencies".
- Regarding the addition of 38.133 in Section 5, we are OK with it.

2 – DOCOMO Communications Lab.

We are fine with the moderator's updates. Regarding Rel-17 DSS WI, we are fine to not refer Rel-17 DSS WI in this WID as commented by Qualcomm.

3 – ZTE Corporation

Regarding the SSB-less SCell, in the initial round discussion of [94e-08-R18-NetworkEnergy], it was proposed to consider non backward compatible schemes for network energy saving while not adopted in the latest draft SID. So, it is not clear whether SSB-less SCell for inter-band would be studied in network energy savings SI. Thus, we still prefer to add the objective for SSB-less SCell in this WI.

Regarding the 2nd bullet, ok to not list Rel-17 DSS WI.

Regarding the 3rd bullet, we don't think we need to change the WI name, the current name has well reflected the corresponding justifications and objectives. Also, this name has been used in the endorsed Rel-18 RAN package, we propose to keep the WI name as it is.

4 – Lenovo (Beijing) Ltd

(1) We are OK to add SCells without SSB in Rel-18 CA enhancement. Even if SSB-less operation is discussed in other SI/WI, same discussions may happen in Rel-18 CA enhancement when some carriers are in same band. In order to not repeat same discussion in two parallel topics, we are OK to add SSB-less operation in Rel-18 CA.

(2) We are fine to add Rel-17 DSS WI in 2.3 and 38.133 in 5 since the study in Rel-17 DSS can be a starting point for Rel-18.

(3) We are OK to keep the name of CA enhancement in Rel-18.

5 – HUAWEI TECHNOLOGIES Co. Ltd.

We support to change the WI name to “Multi-carrier enhancements”. As we commented before, given the current scope of this item, we think it is more proper to name the item as “Multi-carrier enhancements”. It is noted that there was good discussion and strong operator support on “multi-carrier enhancement” in past email and GTW discussion, including the objectives that are currently captured in the WID.

6 – China Mobile Com. Corporation

We think it is better to update the WI name to ”Multi-carrier enhancements” to reflect the current scope.

7 – China Mobile Com. Corporation

continue, sorry For SSB less SCell, we share similar view with ZTE and Lenovo. The standardization of SSB less SCell can be done under the CA WI. While power saving schemes to realized dynamic adaption of time, frequency or spatial domain on such carriers once specified can be studied in network energy saving SI.

8 – Samsung Electronics Co.

- Agree with NOT to add any other objective for this WI.
- Not agree with throw the ball, SCells without SSB, to NW energy saving SI.
- Section 2.3: it is true that two-cell scheduling was studied Rel-17 DSS. However, Rel-17 DSS WID (RP-211345) has been ended up with dropping such objective.

9 – Beijing Xiaomi Electronics

As commented before, we also think ”Multi-carrier enhancements” reflects the current scope better.

10 – CAICT

We also support to change the WI name to “Multi-carrier enhancements”.

11 – VODAFONE Group Plc

We agree with the moderator’s suggestions, although the first one is yet to be captured in the network energy savings thread.

12 – Nokia Corporation

Agree with the moderator’s suggestion.

- reference to Rel-17 DSS WI carries no particular meaning. No reason for us to object, but the pointer doesn’t carry any meaning either.
- SSB-less SCell would seem to be a useful network energy saving concept and worth considering in that WI

13 – Intel Belgium SA/NV

- We share the concern on limited allocated TU, hence prefer to not include other objectives
- Fine for the second bullet
- We prefer to use ‘CA enhancement’. Assuming ‘Multi-carrier enhancements’ does not mean a single cell containing multiple carriers, it is CA of multiple cells.

14 – MediaTek Inc.

- Given the limited TU for this WI, studying SSB-less SCell for infra-band CA in network energy saving SI looks a good way forward. RAN4 can study the feasible band combinations in the SI.
- Regarding capturing R17 DSS in section 2.3, we see moderator version is reasonable. To address the concern from Samsung where 2-cell scheduling by 1 DCI is removed in the latest R17 DSS WID, we can note the observations are captured in section 2.6 of R1-2102138 as follows:
”There was discussion on multi-cell PUSCH/PDSCH scheduling with a single DCI for 2 cells in this Rel-17 DSS WI. **Observations are captured in Section 2.6 of R1-2102138.**”
- We are open for ”Multi-carrier enhancements”. But should we also change the Acronym? (currently it is: NR_CA_enh2)

15 – Ericsson LM

No need to add Rel17 DSS WI in section 2.3. The Rel17 WID was revised to remove the single DCI enhancement. Adding a reference here causes unnecessary confusion.

Necessity of changing the name at this stage is not clear to us. The current name is represented enough.

2.1.5 Necessary update for TU reservations

Companies are encouraged to provide feedback if any on the TU reservations for this WI shown in RP-213469, based on the following moderator’s suggestions.

- As suggested for the objective 2, RAN2 TU can be added once the study phase outcome is derived and if it is decided to specify the mechanism. This situation can be informed to RAN2 chair.
- The moderator would like to check again if companies are fine with current RAN1/4 TU reservations in RP-213469 based on the above suggestions from the moderator on objective 1 and 2.

Feedback Form 11: Necessary update for TU reservations

1 – Lenovo (Beijing) Ltd

We are OK to add RAN2 TU according to the outcome of study phase.

For current two objectives, we think current RAN1 TU assignment is sufficient. If SSB-less operation is added, maybe we need to increase the TU to 1.5.

2 – HUAWEI TECHNOLOGIES Co. Ltd.

As we commented before, RAN2 needs to be added as the impacted WG for objective 2. RAN2 work should start from Q3, with 0.5 TU per RAN2 meeting till Q2 2023, allowing some time to coordinate with RAN1/RAN4 discussion. As to how to handle the RAN2 TU for this WI, it shall be clearly allocated and clarified in RAN2 TU arrangement, whether to explicitly to add a line for this WI or allocated from "Misc. impacts from other RAN WGs and TSGs" can be further discussed, although we have preference to add a line as this is the conventional way when a WI has clear RAN2 impacts.

3 – CAICT

We support Huawei's proposal.

4 – Nokia Corporation

Huawei proposal for involving RAN2 would seem like a decision that should be taken above an individual WI, as the same question applies to essentially all WIs. If RAN2 is to start working on RRC configuration, UE capability (and potentially MAC-CE) signaling and that should be given an allocation in the TU sheet, this should be done consistently across all WIs, not to be debated separately for each WI.

5 – Intel Belgium SA/NV

- We are fine to add RAN2 TU for objective 2
- We still think 3 TUs in total may not be sufficient for the two objectives, but we would like to hear comments from other companies including potential means to reduce the workload.

2.2 Moderator Summary and recommendation

Necessary update for justification description

Thank you very much for valuable feedbacks from many companies. Based on the feedbacks in the intermediate round, we could observe followings.

- Almost all companies seem to be fine with the current justification description.
- There is a suggestion for the 3rd paragraph to add "for CA" and delete "based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration", which is supported by four companies but objected by one company.
- There is a question from one company (also supported by other two companies) on the 1st paragraph that whether "decent coverage" is relevant to this WI. Also, the company pointed that there is a typo in the 1st paragraph, i.e., "throughout" should be revised to "throughput".
- There is a suggestion from one company on the 2nd paragraph to add "as studied in Rel-17 WI of DSS for 2-cell scheduling case".

Based on the above situation, following is the moderator's suggestion for final checking.

- All the updates suggested by the moderator based on initial round feedbacks can be kept. As majority supports the current version, the moderator suggests no further update except for the typo regarding “throughput” for now.
- Adding “for CA” in 3rd paragraph may not be essential as WI name and whole justification description seem to already clarify this is for CA.
- Deleting “based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration” to avoid misunderstanding for “autonomous switching” seems not necessary as it seems already common understanding that the autonomous switching is not allowed.
- Regarding “decent coverage”, the moderator also thinks that it may not be so relevant to this item, but it is a general sentence and hence it may be ok to keep it.
- Adding “as studied in Rel-17 WI of DSS for 2-cell scheduling case” may not be essential. According to the feedbacks in 2.1.2 and 2.1.4, referring Rel-17 DSS WI in the WID would not be necessary.

Necessary update for objective 1

Thank you very much for valuable feedbacks from many companies. Based on the feedbacks in the intermediate round, we could observe followings.

- Clear majority of companies seem to be fine with the current objective 1 description.
- Regarding whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, one company prefer to clarify it in WID and one company prefer to preclude it, but other companies agreed to discuss it in the WI.
- Regarding the meaning of “both FR1 and FR2”, one company prefer to clarify it in WID and one company prefer to preclude FR2-2, but other companies agreed to discuss it in the WI and there are at least two companies explicitly mentioned that FR2-2 should be included in this WI. There are two companies argued that no optimization for FR2-2 is necessary. There is one company prefer to allow scheduling and scheduled cells in different FRs.
- Regarding the “optimized for 3 or more cells” part in 4th subbullet, five companies suggested some modifications, but other companies seem to be ok with current version.
- There is a suggestion from one company to add a note “The study in Rel-17 WI of DSS should be leveraged to avoid duplicated work”, but at least one company objecting to add it and other companies would also agree that it is not necessary to explicitly refer the Rel-17 DSS discussion in the WID according to feedbacks also in 2.1.4.

Based on the above situation, following is the moderator’s suggestion for final checking.

- The moderator suggests no update for objective 1 according to clear majority view.
- As commented in initial round summary, all the commented points such as whether multi-CC scheduling is applicable to Rel-17 SCell to PCell CCS feature, whether FR2-2 is applicable, whether scheduling and scheduled cells can be in different FRs and so on can be discussed in the WI and it would be more appropriate to discuss these detailed aspects in WG than in RAN.

- Regarding the “optimized for 3 or more cells” part in 4th subbullet, the moderator thinks it is already clarified by companies that 2 cells case is of course covered and no need to worry about it.
- Regarding the reuse of Rel-17 DSS discussion, the moderator thinks it is already clarified by companies that anyway companies will consider/refer it in the WI as long as it is reasonable and no need to worry about it.

Necessary update for objective 2

Thank you very much for valuable feedbacks from many companies. Based on the feedbacks in the intermediate round, we could observe followings.

- All companies commented seem to be ok to proceed this item. Note that some companies not supportive to this objective in initial round commented “can live with current version” in intermediate round.
- 10 companies suggest adding RAN2 as secondary WG for this objective, and one company is still questioning to mark RAN2 if it is just for RRC configuration and UE capabilities, but this company suggests adding separate sub-bullet for UE capability and RRC configuration related signaling as RAN2 work if there is specific reason for this objective to add RAN2 as secondary WG.
- 8 companies suggest supporting up to 4 bands instead of 3 bands based on larger number of companies supporting it in initial round discussion. It is also explained that RAN1/2 design should be agnostic with the supported number of bands as much as possible for future proof. While one company argued that larger number of bands may cause longer switching time and interruptions so that the system benefit may also be reduced. The company suggests the study on such aspect in RAN4.
- There is a suggestion to remove “if necessary” part which is also supported by several companies, but as above, one company argued that UE impact and system benefit should be investigated in the study for the justification.
- There is a suggestion to add “for CA” to preclude any enhancement for single cell operation.

Based on the above situation, following is the moderator’s suggestion for final checking.

- According to the initial round feedbacks, the moderator understands RAN2 discussion on RRC configuration and UE capability would be necessary for this objective, instead of just implementing RAN1 RRC parameter list and UE features list. Therefore, as concerned company is also ok to have separate sub-bullet for RAN2 work on RRC configuration and UE capability signaling, it can be added.
- Regarding the target number of bands, the moderator thinks it is valid argument that RAN1/2 design should be agnostic with the supported number of bands as much as possible for future proof and larger number of companies prefer to support up to 4 bands, while the concern on RAN4 workload and necessity of the study on UE impact and system benefit with increased number of bands should also be considered. The possible compromise is to keep “if necessary” part in main bullet, to update “up to 3 bands” to “up to 3 or 4 bands”, and to add two notes such as “strive for RAN1/2 design agnostic with the number of bands” under RAN1/2 sub-bullets and “UL Tx switching across up to 3 bands is to be studied first and then that for up to 4 bands can also be studied” under RAN4 sub-bullet.
- Regarding the addition of “for CA”, the moderator thinks it may not be essential, but adding it may solve some companies’ concern on single cell operation.

Necessary update for other part of the draft WID

Thank you very much for valuable feedbacks from many companies. Based on the feedbacks in the intermediate round, we could observe followings.

- Although there are three companies still prefer to add SCell without SSB as additional objective, other companies agreed with the moderator’s suggestion to not add the additional objective to this WI considering limited TUs.
- Regarding the addition of Rel-17 DSS WI in 2.3, there are four companies supporting it while there are six companies commented that it is not necessary.
- Regarding the addition of 38.133 in 5, all companies commented support it.
- Regarding the WI name update to “Multi-carrier enhancements”, there are four companies supporting it while there are other four companies not supporting it.

Based on the above situation, following is the moderator’s suggestion for final checking.

- The moderator would like to continue suggesting no additional objective for this WI considering companies’ concern on limited TU and chairs’ suggestion in RP-213469.
- Referring Rel-17 DSS WI in 2.3 can be removed.
- 38.133 in 5 can be kept.
- The WI name can be kept as it is according to RP-213469.

Necessary update for TU reservations

Thank you very much for valuable feedbacks. Based on the feedbacks in the intermediate round, we could observe followings.

- There are three companies prefer to add RAN2 TU for objective 2. Either to explicitly add a line for this WI in spreadsheet or to allocate TU from “Misc. impacts from other RAN WGs and TSGs” can be a potential way. On the other hand, there is one company argued that if RAN2 TU is reserved for RRC/UE capability(/MAC-CE) signaling for this WI, it should be done consistently across all WIs.
- There is one company still wondering whether 3 TUs in total for RAN1 is sufficient for the two objectives or not. There is one company to increase RAN1 TU from 1 to 1.5 per quarter if SCells with SSB is added as additional objective.

Based on the above situation, following is the moderator’s suggestion for final checking.

- According to the feedbacks and suggestion for objective 2, the moderator would like to contact to RAN2 chair to share the potential RAN2 discussion on the objective 2, and the moderator would like to ask RAN2 chair to decide how to handle RAN2 TU for this WI i.e., whether to explicitly add a line for this WI in spreadsheet or to allocate TU from “Misc. impacts from other RAN WGs and TSGs”. The estimate of required RAN2 TU for this WI to be shared with RAN2 chair can be 0.5 from Q3 2022 to Q2 2023 according to initial round feedbacks.
- RAN1/4 TU reservations can be kept.

3 Final Round

The moderator would like to ask companies to do the final checking for the updated draft WID v002 in the draft folder.

The updated justification and objectives according to the summary and recommendation in 2.2 are shown below.

Table 3: Updated justification and objectives

Justification

NR supports a wide range of spectrum in different frequency ranges. It is expected that there will be increasing availability of spectrum in the market for 5G Advanced possibly due to re-farming from the bands originally used for previous cellular generation networks. Especially for low frequency FR1 bands, the available spectrum blocks tend to be more fragmented and scattered with narrower bandwidth. For FR2 bands and some FR1 bands, the available spectrum can be wider such that intra-band multi-carrier operation is necessary. To meet different spectrum needs, it is important to ensure that these scattered spectrum bands or wider bandwidth spectrum can be utilized in a more spectral/power efficient and flexible manner, thus providing higher throughput and decent coverage in the network.

One motivation is to increase flexibility and spectral/power efficiency on scheduling data over multiple cells including intra-band cells and inter-band cells. The current scheduling mechanism only allows scheduling of single cell PUSCH/PDSCH per a scheduling DCI. With more available scattered spectrum bands or wider bandwidth spectrum, the need of simultaneous scheduling of multiple cells is expected to be increasing. To reduce the control overhead, it is beneficial to extend from single-cell scheduling to multi-cell PUSCH/PDSCH scheduling with a single scheduling DCI. Meanwhile, trade-off between overhead saving and scheduling restriction has to be taken into account.

For multi-carrier UL operation, there are some limitations of current specification, e.g. 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration, and UL Tx switching can be only performed between 2 UL bands for 2Tx UE. Dynamically selecting carriers with UL Tx switching based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration, may potentially lead to higher UL data rate, spectrum utilization and UL capacity.

Objectives

1. Specify a solution for multi-cell PUSCH/PDSCH scheduling (one PDSCH/PUSCH per cell) with a single DCI [RAN1]

- Identify the maximum number of cells that can be scheduled simultaneously
- Consider both intra-band and inter-band CA operation
- Consider both FR1 and FR2
- The single DCI shall be optimized for 3 or more cells for the multi-cell PUSCH/PDSCH scheduling

2. Study and if necessary specify following enhancements for multi-carrier UL operation [RAN1, RAN2, RAN4]

- UL Tx switching schemes across up to 3 or 4 bands with restriction of 2 Tx simultaneous transmission for FR1 UEs, including mechanisms to enable more configured UL bands than its simultaneous transmission capability and to support dynamic Tx carrier switching across the configured bands (RAN1)
 - UE capability and RRC configuration related signalling (RAN2)
 - Note: strive for RAN1/2 design agnostic with the number of bands, i.e., common design between 3 and 4 bands
- Switching time and other RF aspects, and RRM requirements for above UL Tx switching schemes across up to 3 or 4 bands (RAN4)
 - Note: UL Tx switching across up to 3 bands is to be studied first and then that for up to 4 bands can also be studied

3.1 Correction of company feedback

The companies can provide feedback only if there is a strong concern and/or essential modification suggestion on any part of the updated draft WID.

Feedback Form 12: Feedback on the updated draft WID

1 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for the great effort from the moderator!

1. We can accept the latest justification and objectives with a few editorial changes for the new added note under objective 2 as below:

- Note: UL Tx switching across up to 3 bands is to be **studied addressed** first and then that for up to 4 bands can also be **studied addressed**

Since “Study and if necessary specify” is used in the main bullet of objective 2, it is not proper to only mention “study” in the note. For simplicity, we can just replace “studied” by “addressed”. Alternatively, we can use a simpler note as below to replace the current one:

- **Note: Prioritize UL Tx switching across up to 3 bands**

2. Regarding the work item name, we still think “Multi-carrier enhancements” is more proper, given the current scope of this work item. For objective 2, UE does not need to support uplink CA capability in order to do switching among more than 2 bands. In addition, “multi-carrier enhancement” is majority of view for objective 2 in past email and GTW discussion, which is also the reason that “multi-carrier UL operation” is used in the objective 2.

2 – NTT DOCOMO INC.

Moderator’s comment

Thanks Huawei for the suggestions and flexibility!

The 1st suggestion is aligned with the moderator’s proposal for compromise, and hence it (1st alternative) is reflected in the updated draft WID v003.

Regarding the 2nd suggestion, the moderator could understand the intention from “UE does not need to support uplink CA capability in order to do switching among more than 2 bands” which may not be well understood among companies since we have a text “with restriction of 2 Tx simultaneous transmission”. If Huawei’s intention is common understanding and agreeable to all, it would be ok to update the WI name and above text should also be updated to “with restriction of up to 2 Tx simultaneous transmission”. If it is not common understanding and acceptable among companies, whether uplink CA capability is necessary or not may be the discussion in the WI.

The moderator would like to ask companies to check whether above is common understanding and acceptable or not.

3 – China Mobile Com. Corporation

As many companies commented before, we think we should update the WI name to “Multi-carrier enhancement” to reflect the current scope.

4 – New H3C Technologies Co.

In principal, we are fine with the updated WID. We suggest changing WI name to "Multi-carrier enhancement" and are fine with Huawei's modification on Objective 2 because it makes objective 2 more clear.

5 – China Telecom Corporation Ltd.

We appreciate moderator's great efforts on accommodating different companies' views. In general the current objectives look good to us, and we have the following additional comments:

1) On SSB-less Scell

From our perspective, this is a very useful feature with limited spec impact by extending the scenario of SSB-less Scell from intra-band to inter-band case. This objective was supported by many companies, and summarized as "non-controversial" in Oct email discussion.

We understand that this objective was moved to the network energy saving SI as per RAN Chair's guidance, considering that its benefits are not only on overhead reduction, but also on energy saving.

We can accept to further work on it in energy saving SI.

2) On the NOTE for Tx switching enhancement

We support the revision from Huawei, i.e,

Note: UL Tx switching across up to 3 bands is to be **studied addressed** first and then that for up to 4 bands can also be **studied addressed**

3) On the WI name

We also feel "Multi-carrier enhancement" reflects the current scope, since one objective was moved here from the "UL enhancement" project.

6 – CATT

For WI name, we also think "Multi-carrier enhancements" is more appropriate considering objective 2.

7 – QUALCOMM JAPAN LLC.

We have one suggestion to clarify the scope of objective 2.

It is our understanding that a given switched "band" can be of intra-band CA, and the scope is limited to address intra-band contiguous CA in that case. We therefore propose the following note.

Note: If CA is supported on a given band, only consider contiguous CA for that band.

8 – VODAFONE Group Plc

We support the updated draft WID

9 – NTT DOCOMO INC.

Moderator's comment

Thanks Qualcomm for the suggestion!

I'm afraid that reflecting Qualcomm's suggestion at this timing may be too late for some companies as I already received some contacts from companies about their support on v003 (and hence they also checked Huawei's suggestions).

Although the Qualcomm's suggested clarification would be beneficial, it may also be ok to clarify it in the WI and the moderator would like to suggest doing so.

10 – Beijing Xiaomi Electronics

For WI name, we share the similar views with companies that "Multi-carrier enhancement" is more appropriate. With the current objectives, multi-carrier enhancement can properly cover both objective 1 and objective 2. On the other hand, CA enhancement cannot cover UL Tx switching in some sense.

11 – LG Electronics Inc.

We are fine with the latest updated WID, and also OK with "multi-carrier enhancement" as WI name.

12 – SHARP Corporation

We are fine with the updated WID.

Regarding WI name, our understanding is "with restriction of up to 2 Tx simultaneous transmission" as commented by moderator and we are fine to change to "Multi-carrier enhancement".

13 – ZTE Corporation

Comment#1: Regarding the SSB-less SCell, we share similar view as China Telecom.

Comment#2: Regarding the justification, we still don't understand why some company refuse to delete "based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration" even though they share the same understanding that autonomous UL Tx switching should not be part of the scope. With this part in the justification, it is confusing and misleading. We would retain our previous proposal as shown below.

Dynamically selecting carriers with UL Tx switching-based on the data traffic, TDD-DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration, may potentially lead to higher UL data rate, spectrum utilization and UL capacity.

Comment#3: Regarding Huawei's proposal to change "to be studied" to "to be addressed", is its intention to say that RAN1 has to address the 3-band case regardless of the outcome of its study phase?

Maybe more clarification is needed.

14 – Nokia Corporation

1. OK with the WID as it now stands
2. On the change of the WI name, if there is an intention to transmit uplink on bands that don't have a corresponding DL configured to the UE, then we should say so. If this is not intended, then the switching UL in the DL CA context would not seem to conflict with CA enhancements name.
3. Although we agree with ZTE's point on deleting the background sentence, we don't see a need to discuss further revising the justification, as that would lead to further debate on the Huawei edits as well and be in between us and approved WID. What really matters is the objectives.
4. Happy to see SSB-less SCell as part of NW energy saving

15 – Nokia Corporation

To be clear on point 2. above for WID name, we do not support changing it.

16 – Guangdong OPPO Mobile Telecom.

We are fine with the latest updated WID, and We also think it is reasonable to change WI name as ”multi-carrier enhancement” .

17 – HUAWEI TECHNOLOGIES Co. Ltd.

A few additional points below to provide our views on some of the comments from other companies:

1. Regarding the note proposed by Qualcomm, we are fine to add it.

2. Regarding comment #2 from ZTE, we don’t see the necessity to delete the list in the justification because it won’t cause any misunderstanding, since it is common understanding that autonomous UL Tx switching is not part of the scope. Meanwhile, keeping the examples there can provide some idea on the potential conditions that switching will be done, which can help people to understand better the motivation to do the switching.

3. Regarding comment #3 from ZTE, we think the moderator provided very good explanation on the intention, since “Study and if necessary specify” is used in the main bullet of objective 2, it is not proper to only mention “study” in the note. Please note that it does not change the direction we are converging on, and it seems appropriate since prioritizing 3 bands and addressing 4 bands after 3 bands can be applied to not only “study” but also “if necessary specify” in terms of RAN4 work.

18 – Ericsson LM

Regarding the name change, we share same view as Nokia.

In our understanding, with changing name there will be consequences on the expected work. Therefore, if the name is changed, we should add the following sub-objective to 2nd objective:

- Multi-carrier UL operation is supported for both single TAG and multiple TAGs configurations (RAN2, RAN4)

The reason is that there can be large differences in frequencies in different bands and therefore single TAG is not feasible for all cases.

19 – LG Uplus

We are fine with the suggestion from Huawei and Qualcomm regarding the note and suggestion for clarity including WID name.

20 – Intel Belgium SA/NV

We are mostly fine with the updated draft WID.

For the second objective, it is better to add a condition ‘if up to 4 bands is to be supported’ in the first note to align with ‘up to 3 or 4 bands’

- Note: strive for RAN1/2 design agnostic with the number of bands, i.e., common design between 3 and 4 bands if up to 4 bands is to be supported

21 – CAICT

We can support the draft WID and also fine to change the WI name to ”Multi-carrier enhancement”.

22 – MediaTek Inc.

Thanks for moderator’s great work. For Objective 2, we do see the balance suggested by moderator, including ”if necessary”, ”RAN1/2 design agnostic” and ”(RAN4) Prioritize UL Tx switching across up to 3 bands” vs. ”up to 3 or 4 bands”. In this regard, we can accept current version of Objective 2 and move forward to the technical study in the respective WGs.

For multi-carrier scheduling enhancement, we think it is reasonable to reference previous study in R17 DSS since there captured observations in RAN1. With the understanding that companies now have the consensus that this enhancement is beneficial, we can also move forward to the specific designs in RAN1.

Overall, we appreciate moderator’s efforts and can support this version of WID.

23 – Lenovo (Beijing) Ltd

We are fine with the latest WID.

24 – Futurewei Technologies

We are fine with the latest WID. About the name of the WI, we also think ”Multi-carrier enhancements” is more appropriate. Please add Futurewei as a supporting company. Thanks for moderating.

25 – Telia Company AB

We support the latest WID.

26 – NTT DOCOMO INC.

NTT DOCOMO is also fine with the latest WID and WI name change with clarifying the intention and necessary sub-objective according to the comments from Nokia and Ericsson.

3.2 Moderator Summary

Thank you very much for valuable feedbacks from many companies. Based on the feedbacks in the intermediate round, we could observe followings.

- Almost all companies are fine with the latest justification description in v003 of the draft WID. One company prefers to delete “*based on the data traffic, TDD DL/UL configuration, bandwidths and channel conditions of each band, instead of RRC-based cell(s) reconfiguration*” part, but another company objects to delete the part with clarifying that concerned autonomous switching is not part of the scope and examples help to understand the motivation of switching.
- Almost all companies are fine with the latest objective 1 and 2 descriptions in v003 of the draft WID. There is a suggestion to clarify “*If CA is supported on a given band, only consider contiguous CA for that band*” for objective 2, and three companies are ok with add the note. There is a suggestion to add “if up to 4 bands is to be supported” for the note on RAN1/2 part of objective 2. There are three companies commented on the SCells without SSB, and all of them accept to not add it as additional objective for this WI.
- 13 companies support to change the WI name to “Multi-carrier enhancements”, while three companies commented that if the intention is to support the case of UL transmission on a carrier without corresponding DL carrier configured to the UE, it should be clarified and sub-objective “multi-carrier UL operation support for both single TAG and multiple TAGs configurations” should be added.

Based on the above situation, following is the moderator's suggestion.

- For the justification description, "e.g." can be added before the examples.
- The objective 1 and 2 descriptions are kept except for the updates corresponding to WI name change.
 - o The suggestion to clarify on intra-band contiguous CA can be discussed in the WI, and the suggestion to clarify "if up to 4 bands is to be supported" would not be essential and anyway RAN1/2 design agnostic with number of bands would be good for future proof.
- The WI name can be changed to "Multi-carrier enhancements" if it is common understanding and acceptable to majority that following changes for objective 2 can be done.
 - o The part "with restriction of 2 Tx simultaneous transmission" is updated to "with restriction of up to 2 Tx simultaneous transmission"
 - o The sub-bullet "Multi-carrier UL operation without CA where UL transmission is performed on a carrier without corresponding DL carrier configured to the UE, for both single TAG and multiple TAGs configurations (RAN2, RAN4)" is added
 - Some companies pointed that this sub-bullet is confusing, hence following is the suggested update for the objective 2.
 - Add "for both single TAG and multiple TAGs configurations" for 1st sub-bullet of objective 2
 - Add RAN4 as secondary WG for 1st sub-bullet of objective 2
 - Add a note "only single TAG applies for UL transmission performed on a carrier without corresponding DL carrier" under the 1st sub-bullet of objective 2

3.3 Further discussion after Final Round

There were further email discussion over reflector.

According to the discussion, following further updates were made.

- The note "only single TAG applies for UL transmission performed on a carrier without corresponding DL carrier" is updated to "no additional TAG is introduced for UL transmission on a carrier without corresponding DL carrier" to avoid a confusion.
- The additional note "this objective does not target to extend the SUL framework to support more than 1 SUL for 1 NUL" is added to solve a concern on potential large workload and impact of extending SUL framework to support more than 1 SUL for 1 NUL.

4 Conclusion

Based on the email discussion [94e-13-R18-CAEnh], the updated WID in RP-213564 is derived, and it is further updated in RP-213577 according to the further discussion after Final round.