RAN1-109-e-NWM-R18-MC_Enh-02 - Version 0.0.4
RAN1

3GPP TSG RAN WG1 #109-e R1-220xxxx

e-Meeting, May 9th – 20th, 2022

Agenda item: 9.10.2

Source: Moderator (NTT DOCOMO, INC.)

Title: Summary of discussion on multi-carrier UL Tx switching scheme #2

Document for: Discussion and Decision

1 Introduction

This contribution summarizes the following email discussion in AI 9.10.2 regarding the multi-carrier UL Tx switching scheme.

[109-e-R18-MC_Enh-02] Email discussion on multi-cell UL Tx switching by May 20 – Hiroki (DOCOMO)

- Check points: May 12, May 18, May 20

The WID describes corresponding objectives as below [1], and the highlighted part will be added according to the agreements made at RAN#95-e [2].

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

Additionally, following work plan is provided for the discussion on multi-carrier UL Tx switching scheme in RAN1#109-e meeting [3].

Schedule and TU	Work plan
RAN1#109e (1 TU)	Discuss the benefit/gain and the high-level views on the necessary impacts for the UL Tx switchin

2 References

[1] RP-220834 Revised WID on Multi-carrier enhancements NTT DOCOMO, INC.

[2] RP-221008 Moderator's summary of discussion [95e-39-R17-TEIs] 3GPP RAN WG4 Chair

[3] R1-2204397 Work plan for Multi-carrier enhancements NTT DOCOMO, INC.

[4] R1-2203136 Discussion on multi-carrier UL Tx switching Huawei, HiSilicon

[5] R1-2203208/ R1-2205131 Discussion on Multi-carrier UL Tx switching scheme ZTE

[6] R1-2203347 Discussion on multi-carrier UL Tx switching scheme Spreadtrum Communications

[7] R1-2203449/ R1-2205137 Discussion on multi-carrier UL Tx switching scheme CATT

[8] R1-2203584 Discussion on UL TX switching vivo

[9] R1-2203665 Discussion on UL Tx switching across up to 3 or 4 bands China Telecom

[10] R1-2203743 Considerations on Multi-carrier UL Tx switching scheme Sony

[11] R1-2203801 Discussion on multi-carrier UL Tx switching scheme xiaomi

[12] R1-2203926 Multi-carrier UL Tx switching scheme Samsung

[13] R1-2204027 Discussion on multi-carrier UL Tx switching scheme OPPO

[14] R1-2204088 Multi-carrier UL Tx switching scheme InterDigital, Inc.

[15] R1-2204263 On the support of multi-carrier UL Tx switching scheme Apple

[16] R1-2204325 Discussion on multi-carrier UL Tx switching scheme CMCC

[17] R1-2204399 Discussion on multi-carrier UL Tx switching scheme NTT DOCOMO, INC.

[18] R1-2204632 Discussion on Multi-carrier UL Tx switching scheme LG Electronics

[19] R1-2204724 On multi-carrier UL Tx switching scheme MediaTek Inc.

[20] R1-2204817 Discussions on multi-carrier UL Tx switching scheme Intel Corporation

[21] R1-2204889 Multi-carrier UL Tx switching Ericsson

[22] R1-2205052 Discussion on Rel-18 UL Tx switching Qualcomm Incorporated

[23] R1-2205089 Initial views on multi-carrier UL Tx switching scheme Fujitsu Limited

[24] R1-2205106 On Multi-Carrier UL Tx Switching Nokia, Nokia Shanghai Bell

[25] R1-2204909 Simulation evaluations of single user experience data rate for multi-carrier UL Tx switching Huawei, HiSilicon

3 Discussions on the target scenarios and general assumptions for Rel-18 multi-carrier UL Tx switching

3.1 Whether to specify UL Tx switching schemes across up to 3 or 4 bands in Rel-18

As described in the WID, this objective has a study phase, and Rel-18 multi-carrier UL Tx switching i.e., UL Tx switching schemes across up to 3 or 4 bands will be specified only if the necessity could be identified during the study phase.

In contributions in AI 9.10.2 and AI 9.10.3, following observations and proposals were made regarding whether to specify UL Tx switching schemes across up to 3 or 4 bands in Rel-18.

[4]	***Observation 1: 2Tx switching among 3 bands can bring average UPT gain up to ~16% compared with 2Tx swit***
[5]	***Observation 7: Regarding UL Tx switching for 4 bands, compared with mechanism#1 of Rel-16/17 UL Tx switc***
[6]	***Support the enhancement of UL Tx switching schemes across up to 3 or 4 bands with restriction of up to 2 Tx si***
[11]	***Observation 1: UL Tx switching across up to 3 or 4 bands with restriction of up to 2 Tx simultaneous transmiss***
[12]	***The ability to fully exploit the UL Tx switching feature across 3 or 4 bands is limited Additional relative gains fr***
[13]	***Proposal 1: The study stage should identify the realistic use case and justification gain from UL 2Tx switching***
[15]	***Observation 1: UL Tx switching in NR Rel-16 and Rel-17 provide sufficient flexibility in terms of switching mo***
[16]	***Proposal 1. UL Tx switching schemes across 3 and 4 bands should be both supported in Rel-18 UL Tx switchin***
[19]	***Although Tx switching among more than 2 bands may offer more UL opportunities, there are several drawback***
[20]	***Proposal 1 RAN1 to further study the benefit of Tx switching across 3 or 4 bands with the consideration of the***
[23]	***Observation 1: Dynamic Tx carrier switching is beneficial for the scenario where the UL slot timing for each C***
[25]	***Observation 1: 2Tx switching among 4 bands can increase the user perceived uplink data rate by ~20% compar***

Based on above, the situation can be summarized as below.

- Whether to specify UL Tx switching schemes across up to 3 or 4 bands in Rel-18
  - **Alt.1: Specify UL Tx switching schemes across up to 4 bands in Rel-18 (i.e., both 3 bands case and 4 bands case)**
    - Argued by: Huawei/HiSilicon, Spreadtrum, Xiaomi, CMCC, (there may be some other companies as there are contributions discussing on how to specify UL Tx switching schemes across up to 4 bands)
    - Evaluation results are shown in [4, 5, 25], and significant average UPT gain is observed.
    - Possible usage scenarios with 4 bands (e.g., 700MHz + 1.9GHz/2.0GHz/2.3GHz + 2.6GHz + 4.9GHz) are mentioned in multiple contributions, such as [4, 16].
  - **Alt.2: Further study is necessary**
    - Argued by: Samsung, OPPO, Apple, MediaTek, Intel, Fujitsu
    - Evaluation results with considering longer switching period compared with 2 bands case are shown in [19], and it is observed that the gain would be limited if significantly longer switching period for UL Tx switching across more bands.

- In addition to the impact of switching period, the implementation complexity and workload are concerned by some companies [13, 15].

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.1.1 Proposed working assumption

- **Specify UL Tx switching schemes across up to 4 bands in Rel-18**
  - **This WA can be revisited if RAN4 identifies significantly longer switching period is required for UL Tx switching across 4 bands compared with that across 2 bands**
  - **Strive for minimizing the increase of implementation complexity and workload for supporting UL Tx switching across up to 4 bands e.g., by reusing Rel-16/17 UL Tx switching mechanism as much as possible**

Feedback Form 1: 3.1.1

1 – Qualcomm India Pvt Ltd Compared Tx switching between 2 bands, dynamic switching among 3 or 4 bands would heavily increase the UE complexity on memory consumption, processing capability and etc. If majority decides to define this feature, we would need to discuss how to simplify the implementation.
2 – OPPO We would rather suggest to consult RAN4 first regarding to "**significantly longer switching period**" as well as other concerns such as complexity, before agreeing the support (even for a working assumption). RAN1 can decide later based on RAN4 feedback.
3 – Apple GmbH We do not support this WA. From our perspective, UE complexity is significant issue if more than 2 bands are configured for dynamic UL Tx switching. Before making any agreement or WA on increasing the number of bands, we need input from RAN4 on the aspects of switching period and corresponding durations. Considering longer switching periods and no UL transmission during those periods, the performance gains expected from increased number of bands may not be substantial.
4 – Esurfing IoT China Telecom We support the proposal as a WA, which can be revisited anyhow.

5 – Fujitsu Limited

Before approving this working assumption, we would suggest to draw a conclusion on the observation from the evaluation results because we are not fully convinced that this technology can always bring considerable gain considering the presence of UL interruption by switching time.

More specifically, two companies have submitted their evaluation results for UL Tx switching across 3 and 4 band, and moderate gain of UL UPT was observed under the assumption where the bands include TDD with unaligned UL slot timing and mandate simultaneous Tx/Rx. However, RAN1 did not perform any evaluation for other cases, and the achievable gain was not confirmed.

With this observation, we are OK to move forward if majority of companies want to do so.

6 – vivo Communication Technology

We are fine with making it as a WA in general, but we are wondering if the WA should cover the case of 3 bands as well since the WID is to study whether to specify **3 or 4** bands for UL TX switching. '4 bands' in the bullets can be changed to '3 or 4 bands'.

7 – Beijing Xiaomi Electronics

We agree with FL that whether a longer switching period is needed for more than 2 bands needs RAN4 expertise. From our understanding, we don't see the need to introduce a larger switching period as the UL Tx switching still happens between only two UL bands. But it's fine to check with RAN4. Regarding to the complexity comes from memory, it is valid. However, it should be considered from both penalty and benefits.

We are fine with the working assumption.

8 – ZTE Corporation

As shown in our simulation results, although the simulation results highly depend on the scheduling mechanism and simulation assumption, overall there is gain of Rel-18 UL Tx switching across 4 bands compared with Rel-16/17 UL Tx switching within 2 bands.

We are supportive of this proposal in general. However, we have some detailed comments for the wording.

1. The "significantly longer switching period" is not clear. Companies may have different metrics on "significantly longer switching period". We can simply change it to "This WA can be revisited if RAN4 input is available."

2. Another thing needs to be mentioned is to strive for a common solution for Tx switching across 3 bands and 4 bands. We propose to add this as a separate bullet..

9 – LG Electronics Inc.

We are fine with the proposed WA. Since there is not much time given to this WI to start the RAN1 discussion after RAN4 feedback, it is desirable to start the discussion based on the proposed WA.

10 – Intel Deutschland GmbH

The wording in the working assumption is very vague. It is not clear to us how "significantly longer" is longer for Tx switching time. We suggest to wait for RAN4 progress before we can make such conclusion.

11 – Nokia Corporation

Premature to take this WA

1. No additional switching delays should be one gate to pass: The Rel-16 Tx Switching already allows UEs to report such long switching gaps that render all the benefits useless.

2. We should look more carefully on the complexity related to 3 vs. 4 band support specification. The different capability and configuration options depend on what kind of UE architectures we agree to support. Jumping to say we go to 4 bands without looking at the tradeoff should ot be done.

12 – Samsung Research America

It is too early for us to agree to such a WA. Switching among 3 or 4 bands can significantly increase the UE design complexity. For a UE implementing and reporting the long R16 Tx Switching gap, it is very questionable if the gains when using 3 or 4 bands exist. It is also not clear to use how much longer ”significantly longer” really means. A possible WF could be to base the RAN1 decision on RAN4 feedback.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

Above all, **when companies raised UE complexity issue for UL Tx switching, UL-CA dualUL (Option2), instead of switchedUL (Option1)/SUL, seemed the targeted scheme.We suggest companies to clarify the targeted scheme in the future if any UE complexity concern is raised. It is appreciated!**

We support the working assumption with small modification.

We are OK with Fujitsu’s suggestion for an observation with some modifications. All the submitted simulation results show gains. And the gains are more than moderate, the word “moderate” could be replaced with a range of gains showed in the contribution papers. Unaligned UL slot timing can be misunderstood as different TA, it can be removed or refined.

Since all the submitted simulation results showed gains, RAN1 can start its work now. If RAN4 work out some switching gap longer than what we have evaluated, it only impacts on the volume of the gain, which can be analyzed accordingly later. But RAN1 switching mechanism is independent of the size of the gap anyway. Therefore, it is not reasonable to postpone RAN1 works until RAN4 input on potentially larger switching gap.

14 – InterDigital Belgium. LLC

We are ok to take WA considering that its confirmation is dependent on RAN4 input.

15 – MediaTek Inc.

We acknowledge there is a limited time for the WID which motivate making quick decisions. However, without agreeing on some of the details for Tx switching among 3 and 4 bands, it will be hard to agree on supporting the feature.

At least some restrictions need to be agreed first to ensure feasible implementation at the UE.

16 – Ericsson LM

We understand the motivation for WA, but we feel it is a bit early at this stage.

17 – DOCOMO Communications Lab.

Given we have a limited time, if we wait for RAN4 feedback, there is a high possibility that sufficient discussion time cannot be secured.

To avoid a such situation, we should start to discuss this featured based on this WA.

3.1.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - CT, FJT, vivo, Xiaomi, ZTE, LG, HW, IDC, DCM
    - After making observations based on evaluation results
      - FJT, HW
- Not support (too early)
  - QCM, OPPO, Apple, Intel, Nokia, Samsung, MTK, E///
    - Wait for input from RAN4 regarding switching period and interruption durations
      - OPPO, Apple, Intel, Nokia, Samsung
    - After making some decision on mechanism to ensure feasible complexity
      - QCM, Nokia, MTK

Although views are almost equally sprit, the moderator believes we should make working assumption including design criteria to support the feature considering quite limited TUs for this WI. Therefore, the moderator suggests to make observation first, and then to make working assumption including design criteria to address the potential concerns raised by companies so that we can also have the criteria to revisit the WA.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed Observation

- **Four contributions (3136, 4724, 4909, 5131) show their evaluation results on UL Tx switching across 3 or 4 bands at RAN1#109-e meeting.**
  - **All evaluation results show the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 2 bands, assuming TDD bands with different TDD UL/DL configurations are included in 4 bands.**

- **Evaluation results in 3136 show the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 3 bands.**
- **Evaluation results in 4724 show that the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 2 bands depends on achievable switching period, and the longer switching period for UL Tx switching across 4 bands compared with UL Tx switching across 2 bands leads to reduction of the performance gain.**

Proposed working assumption

- **Specify UL Tx switching schemes across 3 bands and across 4 bands in Rel-18**
  - **This WA can be revisited if RAN4 input is available e.g., RAN4 identifies longer switching period is required for UL Tx switching across 3 or 4 bands compared with that across 2 bands**
  - **Strive for minimizing the increase of implementation complexity and workload for supporting UL Tx switching across 3 bands and 4 bands e.g., by reusing Rel-16/17 UL Tx switching mechanism as much as possible and striving for a common solution between UL Tx switching across 3 bands and across 4 bands**

Feedback Form 2: 3.1.2

1 – ZTE Corporation

Thanks moderator for the summary.

After reading the 1st-round comments from companies, we feel that we may need to clarify the intended scenarios for this working assumption because companies seem to have different understandings on the scenarios. Without mentioning the detailed scenarios in this working assumption, companies may argue that all the scenarios are supported.

- From our perspective, almost all companies support CA as the scenarios.
- However, different companies have different views on whether to support SUL and whether to support extention of SUL (e.g., multiple SULs, intra-band SULs, intra-band NUL and SUL). The detailed scenarios of SUL should be clarified first.

For procress, we propose to update the mian bullet of this proposal as following.

Specify UL Tx switching schemes across 3 bands and across 4 bands <u>at least for CA</u> in Rel-18

2 – Apple GmbH

Thanks moderator for the updated proposals.

Regarding the proposed observations, some further clarifications should be added:

- only 3 companies provided the results

- 2 out of 3 companies did not consider the impact of different switching periods for 3 or 4 bands on the performance gains

- 1 company observed that the performance gain for 3 or 4 bands also highly depends on scheduling mechanisms

- Overall, the range of performance gains shown by 3 companies varies quite a lot depending on the simulation assumptions

Regarding the proposed WA, we are still not convinced to accept it. We don't agree with the supporting companies' argument that not making this WA will impact the progress of discussion and specifying support in due time. Regardless of this WA, we are already discussing the details of potential enhancements if 3 or 4 bands are supported and will continue to do so. Therefore, there is no reason to make this WA in this meeting and it is better to wait for RAN4 feedback on the raised issues. In the meantime, further discussion on detailed aspects can continue.

3 – LG Electronics Inc.

Thanks moderator for the summary and updated proposals. We support the proposed working assumption which reflects well the summarized observations. We are also fine with ZTE's change.

4 – CATT

Thanks moderator for the summary and updated proposal. We support the proposed working assumption. As most of companies metioned that it mat cost a lot of time to wait for RAN4's repley. Considering limited TU, we can study the UL Tx swithing scheme with this WA firstly.

5 – China Mobile Com. Corporation

We are OK with the FL proposal. From our understanding, with the available scattered spectrum increasing, up to 3 and 4 bands in a combination will be both enabled in corresponding deployment scenarios. For example, for the scenarios enabling UL Tx switching across up to 3 bands, the potential frequency bands being deployed can include 700MHz, 2.6GHz and 4.9 GHz band. And for the scenarios enabling UL Tx switching across up to 4 bands, the potential frequency bands being deployed can include 700MHz, 1.9 GHz/2.0 GHz/2.3 GHz, 2.6GHz and 4.9 GHz bands. We can still discuss some detailed switching scheme based on the WA before RAN4 input.

6 – vivo Communication Technology

We are fine with FL's proposal.

7 – MediaTek Inc.

For a given number of bands (3 or 4), not all the switching cases (6 cases for 3 bands, and 10 cases for 4 bands) can be supported by the UE. Hence, it is essential to restrict the number of cases for a given number of bands. This can be reported as UE capability per band combination.

Thus, we suggest having the following update to the WA:

Specify UL Tx switching schemes across 3 bands and across 4 bands in Rel-18

- **The supported cases by the UE for Tx switching between 3 or 4 bands are reported as UE capability. FFS: details of the UE capability reporting.**
- **This WA can be revisited if RAN4 input is available e.g., RAN4 identifies longer switching period is required for UL Tx switching across 3 or 4 bands compared with that across 2 bands**
- **Strive for minimizing the increase of implementation complexity and workload for supporting UL Tx switching across 3 bands and 4 bands e.g., by reusing Rel-16/17 UL Tx switching mechanism as much as possible and striving for a common solution between UL Tx switching across 3 bands and across 4 bands**

8 – Esurfing IoT

China Telecom

Thanks moderator for the summary and updated proposal. We support the WA. We agree the detailed scenarios of SUL should be clarified.

9 – Beijing Xiaomi Electronics

We are fine with FL's proposal.

10 – Intel Deutschland GmbH

We tend to agree with Apple suggestions. Even without this working assumption, RAN1 can still continue to discuss the supported scenarios for Rel-18 Tx switching, potential specification impact, like the following proposals. The wording "RAN4 identifies longer switching period is required for UL Tx switching" is somehow misleading. This may imply that if a longer switching period is identified by RAN4, the WA can be reverted. We do not think e.g., is needed.

Our view is that we should send LS to RAN4 regarding the multi-carrier Tx switching in this meeting and can receive the feedback as early as possible.

11 – HUAWEI TECHNOLOGIES Co. Ltd.

We don't agree on ZTE's proposal. As commented before, since Rel-15, SUL can be configured in any serving cell of a CA configuration. It makes no sense to remove a Rel-15 feature from a Rel-18. More importantly, there is no technical concern or identified issue for it. Without any technical concern, we would like to suggest not to waste precious time in debating on it.

We support the FL proposal since all simulation results show gains.

Regarding MediaTek's revision, it is only applicable to UL-CA Option 2 because for UL-CA Option 1, there is no concurrent transmission between bands and the number of cases equals to the number of bands. If a UE does not even support non-concurrent transmission on one band, then the UE is supposed to be incapable of any transmission case involving this band, which means the UE will not report support of the band for UL Tx switching. Therefore, the restriction is only applicable to concurrent transmission cases (e.g. 1T, 1T, 0T or 1T, 0T, 1T) even in UL-CA Option 2. We suggest

- T**he number of** supported **concurrent transmission** cases by the UE for Tx switching between 3 or 4 bands are **subject to**~~reported as~~ UE capability. FFS: details of the UE capability reporting **and whether supported concurrent transmission cases are also explicitly reported.**

12 – Samsung Research America We share Mediatek's views. For a given number of bands (3 or 4), not all the switching cases can be supported by the UE. The number of cases for a given number of bands should be a UE capability per band combination.
13 – InterDigital Belgium. LLC We are ok with FL proposal and also with Mediatek's proposed revision.
14 – DOCOMO Communications Lab. We support this proposal. Mediatek's revision is also OK for us.
15 – Fujitsu Limited We are fine with the proposal. This is just a comment, but regarding the condition "**assuming TDD bands with different TDD UL/DL configurations are included in 4 bands.** ", we are wondering how many operators think this is a realistic assumption given the regulatory/coexistence restriction. May be this is not necessary to be captured in the observation, but operator's input would be quite helpful.

3.1.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - CATT, CMCC, vivo, CT, Xiaomi, FJT
  - Suggest to clarify "at least for CA"
    - ZTE, LG
  - Suggest to add "supported cases by the UE for Tx switching between 3 or 4 bands are reported as UE capability"
    - MTK, HW (only for concurrent transmission), Samsung, IDC, DCM
- Not fine with the FL proposal
  - Need more clarifications on the observation
    - Apple
  - Even with out WA, RAN1 can discuss potential enhancements
    - Apple, Intel
  - Suggest to send LS to RAN4 to ask their feedback on switching period

    - Intel

Based on the above situation, the moderator would like to provide following comments.

- Regarding observation, we can add more clarifications according to the feedbacks.
- Regarding working assumption, although a few companies commented that RAN1 can discuss potential enhancements even without WA, it is good to make WA including design criteria and condition to revisit the WA so that such aspects can be further discussed efficiently as companies in RAN1/2/4 will discuss such aspects in their contributions based on the WA. The suggested bullet regarding UE capability seems to be one important criteria for several companies and hence we can check if it is agreeable to other companies as well.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed observation

- **Four contributions (3136, 4724, 4909, 5131) from three companies show their evaluation results on UL Tx switching across 3 or 4 bands at RAN1#109-e meeting.**
    - **All evaluation results show the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 2 bands, assuming TDD bands with different TDD UL/DL configurations are included in 4 bands.**
        - **Evaluation results in 3136 show the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 3 bands.**
        - **Evaluation results in 4724 show that the performance gain of UL Tx switching across 4 bands compared with UL Tx switching across 2 bands depends on achievable switching period, and the longer switching period for UL Tx switching across 4 bands compared with UL Tx switching across 2 bands leads to reduction of the performance gain. Other evaluation results did not consider the impact of longer switching period for UL Tx switching across 4 bands compared with UL Tx switching across 2 bands.**
        - **Evaluation results in 5131 observe that the gain highly depends on the scheduling mechanism.**
        - **The range of performance gains shown in four contributions varies depending on the simulation assumptions.**

Proposed working assumption

- **Specify UL Tx switching schemes across 3 bands and across 4 bands in Rel-18**
    - **The supported cases by the UE for Tx switching between 3 or 4 bands are reported as UE capability.**
        - **FFS: details of the UE capability reporting.**

- **This WA can be revisited if RAN4 input is available e.g., RAN4 identifies longer switching period is required for UL Tx switching across 3 or 4 bands compared with that across 2 bands**
- **Strive for minimizing the increase of implementation complexity and workload for supporting UL Tx switching across 3 bands and 4 bands e.g., by reusing Rel-16/17 UL Tx switching mechanism as much as possible and striving for a common solution between UL Tx switching across 3 bands and across 4 bands**

Feedback Form 3: 3.1.3

1 – Qualcomm India Pvt Ltd

Thanks for the promoted discussion.

We still hesitate to say we are ready to approve this WA to support specifying UL Tx switching across 3 and 4 bands, especially when we would anyhow need to wait for RAN4's evaluation on the performance impact by switching periods and other potential factors.

As the feasibility study should be based on the tradeoff consideration of potential complexity and performance gains, we are now with deep concerns on the potential complexity when we see some companies show preference on full flexibility switching among the bands.

Our preference is leaving this discussion until RAN4's feedback and we can discuss how to reduce the switching complexity at the same time. With solid input from both sides, we can be more confident on the price we need to pay for the potential gains.

We can't agree on Huawei's analysis of UE complexity. Compared Tx switching between 2 bands, dynamic switching among 3 or 4 bands would heavily increase the UE complexity on memory consumption, processing capability and etc. This equally applies to CA without SUL (both Option 1 and 2) and CA with SUL.

2 – ZTE Corporation

Regarding the proposed working assumption, as we commented previously, we should make the supported scenarios clear. Otherwise, companies may argue that all the possible scenarios are supported. Considering the maturity level and interest level of CA, we propose to support R18 UL Tx switching for CA first. We are open to support SUL as lower priority at least for 3 bands but clarification is needed before committing to support it.

Specify UL Tx switching schemes across 3 bands and across 4 bands <u>at least for CA</u> in Rel-18

3 – Apple GmbH

Thanks for taking our comments in to consideration for the proposed observation. We are fine to support the proposed observation.

Regarding the WA, we are still not convinced to support the proposed WA. We have similar concerns as Qualcomm that from UE complexity point of view, it is not desirable to support 3 or 4 bands. Even from performance point of view, the results are not clearly indicative that always a significant performance gain can be achieved, especially for longer switching period. Further, we think that not just the switching period duration, but also the frequency of switching might increase if full-flexibility to support switching across any of the 4 bands is supported, as being currently discussed in section 4.

In view of this, we should send an LS to RAN4 to get input on the switching periods for 3 and 4 bands. Only then, we should make an informed decision on whether to support 3/4 bands.

In addition, we don't tend to agree with the argument that this WA can help to have more concrete discussion on design details. This WA is not providing any additional directions relative to other proposals.

So, we cannot accept this WA.

4 – InterDigital Belgium. LLC

We are fine with proposed observation and working assumption.

If we wait for RAN4 input on this, there will not be enough time to complete this objective of the WI.

5 – Intel Deutschland GmbH

As commented during the previous round of discussion, we suggest to wait for input from RAN4 on the Tx switching time. Meanwhile RAN1 can continue to work to have clear understanding on the targeted scenario and UE complexity of Tx switching. In our view, it is too early to decide even as a working assumption.

The most important issue is to send LS to RAN4 regarding the multi-carrier Tx switching in this meeting and can receive the feedback as early as possible.

6 – New H3C Technologies Co.

we are fine with this proposal in general.

7 – Beijing Xiaomi Electronics

We are fine with the WA. We understand the concerns from the UE complexity because of more UL bands for UL Tx switching. However, it is a RAN-led topic and the evaluation results provided in this meeting show there are gains from supporting it. It is fair enough to have a working assumption from RAN1 perspective. It is a good guidance for the pending discussion and study. If there are technical issues we identified in the future, we can revisit this WA as mentioned in the second sub-bullet bullet. On the other hand, we think the UE capability reporting already provide a reasonable compromise on the UE complexity.

8 – China Mobile Com. Corporation

We are fine with the working assumption.

9 – vivo Communication Technology

We are fine with the working assumption to make progress, the WA can be revisited if any issue is identified by RAN4.

10 – LG Electronics Inc.

We support the proposed working assumption. Also, we agree to send an LS to RAN4 about the switching period required for Tx switching across 3 or 4 bands. However, it is not desirable to wait RAN4 feedback without RAN1 progress. Note that, as described in the 2nd sub-bullet of the proposal, this WA can be revisited when RAN4 input is available.

11 – Fujitsu Limited

Thanks FL for compiling all the comments from companies, which is definitely not easy.

For the observation, we are fine with the moderator's proposal.

For the working assumption, we are OK the the moderator's proposal, but we also understand the concern from UE side, i.e. too much complicated functionality will never be implemented (this is unfortunate but a fact from our past experience). If the sentence "**Specify UL Tx switching schemes across 3 bands and across 4 bands in Rel-18**" is too strong and companies cannot accept, then we can approve spirit by rephrasing to "**If UL Tx switching schemes across 3 bands and across 4 bands in Rel-18 is specified, the following design principle is considered**" or something like that. This is actually a very small step, but better than nothing. For us, either approach is fine.

If we should an LS is necessary, it should be approved at this meeting for the efficient use of our time.

12 – CATT

We are fine with the proposed working assumption. We believe that the second bullet can address most of companies' concerns, and discussing Tx switching scheme under this working assumption is a good start.

13 – Esurfing IoT

China Telecom

We are fine with the proposed observation and WA generally. The evaluation in this meeting shows gains and the second bullet says this WA can be revisited.

Editorial:

The supported cases by the UE for Tx switching ~~between~~ **across** 3 or 4 bands are reported as UE capability.

14 – MediaTek Inc.

Thank you for taking our suggestions into consideration. We can accept the WA.

15 – Samsung Research America

Thank you for accounting for our Round 2 comments. We can accept the FL proposed WA.

16 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you for the proposals and discussions.

For the first sub-bullet of the WA, could proponent or FL please clarify with an example how it could be a case where non-concurrent transmission can be reported as a UE capability? For example, in a 3-band scenario, the overall transmission cases are

- Non-concurrent transmission cases: {1T/2T, 0, 0}, {0, 1T/2T, 0}, {0, 0, 1T/2T},
- Concurrent transmission cases: {1T, 1T, 0}, {1T, 0, 1T}, {0, 1T, 1T}

For UL-CA Option1 with/without SUL, only three non-concurrent transmission cases are supported. If the UE reports no support of any non-concurrent transmission cases above, then the UE falls back to a UE capable of 2-band ONLY, which means the UE should never report a support of 3-band UL Tx switching in the first place. Therefore, we don't feel that such additional capability is necessary for a UE capable of UL-CA Option1 with/without SUL.

For UL-CA Option2 with/without SUL, because {1T, 0, 0} is a fallback operation mode of {1T, 1T, 0} and {1T, 0, 1T}, if a UE is incapable of {1T, 0, 0}, then the UE must be not capable of any transmission on the first UL carrier, i.e. incapable of both {1T, 1T, 0} and {1T, 0, 1T}. Therefore, the UE should report only 2-band UL Tx switching if it does not support {1T, 0, 0}. For indication of support of {1T, 0, 0} but no support of {2T, 0, 0}, then it is indicated by the existing UL-MIMO capability, no new UE capability is needed. Therefore, we don't feel that such additional capability can be applied to non-concurrent transmission cases in UL-CA Option 2 either.

Given the FFS subbullet for further details, we suggest not to limit the reporting signaling at this stage. "subject to" is much better than "reported as".

Therefore, we suggest revisions to the first subbullet.

"

The supported **concurrent transmission** cases by the UE for Tx switching between 3 or 4 bands are **subject to**~~reported as~~ UE capability.

- FFS: details of the UE capability reporting.
- **Note: For example, concurrent transmission cases are {1T, 1T, 0}, {1T, 0, 1T}, {0, 1T, 1T} for a UE capable of 3-band UL Tx switching.**

"

@ZTE As commented before, we have don't see any technical reason from you for your revised proposal. It is about Rel-15 functionality. Therefore, it is not acceptable for us.

17 – DOCOMO Communications Lab.

Support both proposed observation and working assumption. It should also be fine to send LS to RAN4 to ask their feedback on the potential increase of switching period and complexity due to larger number of bands.

3.2 Whether to support inter-band UL CA Option 1 and Option 2 in Rel-18

In Rel-16/17 UL Tx switching across 2 bands, following two options were supported, while it is not clarified in the WID whether to support the same options for Rel-18 UL Tx switching across up to 3 or 4 bands (if supported).

- Inter-band UL CA Option 1 (*switchedUL*): there is no concurrent transmissions on 2 bands
- Inter-band UL CA Option 2 (*dualUL*): there can be concurrent transmissions on 2 bands

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support inter-band UL CA Option 1 and Option 2 in Rel-18.

[4]	***Proposal 2: for both 3-bands and 4-bands scenarios, both switched mode (UL CA option 1) and dual mode (UL***
[5]	***Proposal 1: UE supporting Rel-18 UL Tx switching schemes across up to 3 or 4 bands requires support of legac***
[6]	***For Rel-18 UL Tx switching among 3 bands or 4 bands, the Tx switching scheme can be based on Rel-16/17 UL***
[7]	***Proposal 1: For dynamic UL Tx switching in Rel-18, both Tx switching modes of option 1 (SwitchedUL) and op***
[8]	***Proposal 5: Option 1(switchedUL) and option 2 (DualUL) are both supported in Rel-18 Tx switching.***
[9]	*The two options are also supported for Rel-18 inter-band UL CA case.*
[11]	***Proposal 1: For Rel-18 multi-carrier UL Tx switching, both 'switchedUL' and 'dualUL' should be supported.***
[17]	***Proposal 1: For Rel-18 UL Tx switching, following scenario is considered as 'superset' scenario, and necessary***
[22]	***Proposal 3: Adopt Table 4 for CA Option 1 mapping between Tx state and Tx layers. Proposal 5: Adopt Table 6***
[24]	***Proposal 6: uplinkTxSwitchingOption = SwitchedUL cases where even if one band transmits with 1-port only, i***

Based on above, the situation can be summarized as below.

- Whether to support inter-band UL CA Option 1 and Option 2 in Rel-18
  - **Alt.1: Support both inter-band UL CA Option 1 and Option 2 in Rel-18**
    - Argued by Huawei/HiSilicon, Spreadtrum, CATT, vivo, China Telecom, Xiaomi, DOCOMO, Qualcomm
    - It would be straightforward to support both options for inter-band UL CA as in Rel-16/17.
  - **Alt.2: Support and prioritize inter-band UL CA Option 2**
    - Argued by ZTE, Nokia/NSB

- It is argued that Option 2 is more beneficial to obtain the gain from UL Tx switching across more bands.

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.2.1 Proposed agreement

- **Support both inter-band UL CA Option 1 and Option 2 in Rel-18**

Feedback Form 4: 3.2.1

1 – Qualcomm India Pvt Ltd If majority decides to specify Rel-18 UL Tx switching, we are ok with this proposal.
2 – OPPO We are fine with the intention. But for now, the proposal needs to have a prefix saying ”If Rel-18 UL Tx switching is supported,”.
3 – Apple GmbH Agree with Oppo that the proposed agreement is conditional on whether Rel-18 UL Tx switching is supported or not with 3 or 4 bands. With the addition of ”if supported”, we are fine with proposal.
4 – Esurfing IoT China Telecom We think it is better to clarify option 1 means switched UL and option 2 means dual UL in the proposal.
5 – Fujitsu Limited The same view as Qualcomm. If majority decides to specify Rel-18 UL Tx switching, we are ok with this proposal.
6 – vivo Communication Technology If R18 TX switching is supported, we are ok to support dual UL and switched UL.
7 – Beijing Xiaomi Electronics We are fine with OPPO’s suggestion.
8 – ZTE Corporation We support both CA Option1 and Option2. Our understanding is that, if only Option1 is specified, it would be too restrictive since simultaneous transmisison is not possible for Option1. That why we propose to prioritize CA Option2.

9 – LG Electronics Inc. Since simultaneous transmission capabilities in different bands can vary depending on the UE and band combination, both Option 1 and Option 2 for UL Tx switching are supported in Rel-16/17. For the same reason, both two options should be supported in Rel-18 UL Tx switching. In addition, it should be clarified how to configure/indicate the options over 4 bands, e.g. per band combination or UE.
10 – Intel Deutschland GmbH We support the update from OPPO.
11 – Nokia Corporation We would prefer simplifying the work and focusing on the better-performing option of dual-UL, but seems this is not generally desired. We can accept the majority view. Support China Telecom's point to spell out switched UL vs. dual UL rather than option 1 and option 2.
12 – Samsung Research America We have no strong view here. For R18 inter-band UL CA, both Option 1 and 2 can be supported.
13 – HUAWEI TECHNOLOGIES Co. Ltd. We support the proposal in general. We just make sure the Rel-15 configurability of SUL on any serving cell of CA is retained here. **Proposed agreements-r1** - Support both inter-band UL CA Option 1 and Option 2 in Rel-18 - *Note: UL carrier of any serving cell in the UL CA can be a SUL carrier*
14 – InterDigital Belgium. LLC Fine with Oppo's revision.
15 – MediaTek Inc. Agree with OPPO's revision.
16 – Spreadtrum Communications Agree with OPPO's revision.
17 – DOCOMO Communications Lab. We think it could be accepted to have a prefix saying "If Rel-18 UL Tx switching is supported," from both camps. Thus, proposal would be revise as followed, If Rel-18 UL Tx switching is supported, support both inter-band UL CA Option 1 and Option 2 in Rel-18

3.2.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OK if “If Rel-18 UL Tx switching is supported” is added
    - QCM, OPPO, Apple, FJT, vivo, Xiaomi, Intel, Samsung, IDC, MTK, SPRD, DCM
  - With clarifying that Option 1 means switched UL and Option 2 means dual UL
    - CT, Nokia
  - OK but prefer to prioritize Option 2 (dual UL)
    - ZTE
  - OK but should clarify how to configure/indicate option over 3 or 4 bands
    - LG
  - OK but should clarify that UL carrier of any serving cell in the UL CA can be a SUL carrier
    - HW

The moderator thinks clarifications suggested by OPPO and CT should be fine for all companies, while other suggestions from ZTE, LG and HW need discussion that can be done separately.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **If Rel-18 UL Tx switching is supported, both inter-band UL CA Option 1 (i.e., switched UL) and Option 2 (i.e., dual UL) are suppoted**

Feedback Form 5: 3.2.2

1 – ZTE Corporation We are fine with the FL proposal. During the discussion, as we commented previously, Option2 should be prioritized.
2 – Apple GmbH We are fine with FL’s proposal
3 – LG Electronics Inc. We agree with the moderator on the need for separate discussions on the details of Option 1 or Option 2 over up to 4 bands, and support the proposal on the premise.

4 – CATT We are fine with the FL's proposal.
5 – China Mobile Com. Corporation We are fine with the proposal.
6 – vivo Communication Technology We are fine with FL's proposal
7 – MediaTek Inc. Fine with the proposal.
8 – Esurfing IoT China Telecom We are fine with the FL's proposal.
9 – Beijing Xiaomi Electronics Support FL's proposal.
10 – Intel Deutschland GmbH We are fine with the proposal.
11 – HUAWEI TECHNOLOGIES Co. Ltd. If without the bullet we suggested, we don't agree with it. Because in SID, all UL Tx switching schemes including SUL are included. The proposal can imply that SUL has been preclude. More importantly, the bullet we suggested is in line with Rel-15 spec.
12 – Ericsson LM We are fine with the proposal
13 – Samsung Research America We support the FL proposal.
14 – InterDigital Belgium. LLC Support the FL proposal.
15 – DOCOMO Communications Lab. we don't think this proposal preclude SUL. To clarify that, we are OK to add "Note: It doesn't imply SUL is precluded" in this proposal.

3.2.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - ZTE, Apple, LG, CATT, CMCC, vivo, MTK, CT, Xiaomi, Ericsson, Samsung, IDC, DCM
  - Add note "it doesn't imply SUL is precluded"
    - DCM
- Not fine with the FL proposal
  - should clarify that UL carrier of any serving cell in the UL CA can be a SUL carrier
    - HW

Based on the above situation, the moderator's suggested proposal was discussed in the GTW session. However, it was not agreed in the session because some companies cannot accept the proposal unless it is clarified together that for SUL, the existing SUL configurability in CA framework is reused. Although inter-band CA + SUL is separately discussed in 3.3, anyway we are trying to clarify target scenarios for Rel-18 UL Tx switching if supported. In that sense, SUL aspects can be discussed together with supported switching options.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement (to be discussed together with proposal in 3.3)

- **If Rel-18 UL Tx switching is supported, both inter-band UL CA Option 1 (i.e., switched UL) and Option 2 (i.e., dual UL) are suppoted**
  - **Note: it does not imply SUL is precluded. For SUL, the existing SUL configurability in CA framework is reused.**

Feedback Form 6: 3.2.3

1 – Qualcomm India Pvt Ltd As we commented online, this section is dedicated for inter-band UL CA without SUL. We think the second part of the sub-bullet "For SUL, the existing SUL configurability in CA framework is reused" should be discussed in next section – CA with SUL. We are ok with the rest part which is same as FL's proposal in 2nd round.
2 – ZTE Corporation We support the main bullet but not support the subbullet. We don't think we need to bundle CA and SUL discussion together at this stage. Because the interest level

and maturity of them are totally different.

For CA: Majority companies support CA. Companies have the same understanding on what it means and have the same understandings on Option1 and Option2.

For SUL: Companies have different understandings on ”existing SUL configurability in CA framework”. It seems only one or two companies think all possible combinations of configurations can be supported in the current spec without any restrictions. We don’t agree with this. Details please see our answer to next question.

Before clarifying these questions, we don’t think it is possible to agree on the note. There is clear majority view on the main bullet, to focus on the subsequent discussion, we should agree on the main bullet first.

3 – Apple GmbH

As we commented during the GTW, we are not fine to bundle the SUL scenario in this agreement. As we separately discussed for EN-DC, we can have separate discussion for SUL as well. Therefore, only the main bullet is acceptable.

4 – InterDigital Belgium. LLC

We are ok with this proposal.

5 – Intel Deutschland GmbH

We are fine with the main bullet. Sub-bullet regarding SUL discussion seems unnecessary as this is not part of the proposal.

6 – Spreadtrum Communications

We support the proposal.

7 – New H3C Technologies Co.

We are fine with this proposal.

For SUL, we think handling methodology is the same as that in Rel-16&Rel-17.

8 – Beijing Xiaomi Electronics

We are fine with the updated proposal. Having the note doesn’t put any restriction on the discussion about SUL. SUL can certainly discussed separately. Hence we can accept the note as a compromise.

9 – China Mobile Com. Corporation

We are fine with the main bullet. From our understanding, the proposal is clarified to support both Option 1 (switched UL) and Option 2 (dual UL) for inter-band CA scenario, and SUL can be discussed separately regardless of the note.

10 – vivo Communication Technology

We are ok with the main bullet of the proposal. Regarding the note, we suggest deleting it as SUL can be discussed separately in section 3.3.3

11 – LG Electronics Inc. We are fine with the main bullet and not sure the Note is necessary in this section. Especially, the latter part "the existing SUL configurability in CA framework is reused" of Note should be discussed in next section.
12 – Fujitsu Limited Similar to other companies, we see no strong necessity of the note, but we are OK if it is important to move forward.
13 – CATT We are fine with the proposal. The note in the proposal is necessary to clarify the supported case.
14 – Esurfing IoT China Telecom We think both inter-band UL CA with and without SUL are within Rel-18 Tx switching scope. Both CA Option 1 (i.e., switched UL) and Option 2 (i.e., dual UL) are suppoted.
15 – MediaTek Inc. Support the proposal.
16 – Samsung Research America We are fine with the main bullet, but do not think the sub-bullet note is necessary for this part of the agreement on Options 1 and 2. SUL is a separate topic to be discussed and agreed upon in 3.3
17 – HUAWEI TECHNOLOGIES Co. Ltd. As commented in GTW, the proposal is not necessary if the note is removed. We don't see any technical reason why the existing mechanism cannot be reused.
18 – Ericsson LM We support the proposal and similarly to others, we dont think note is needed.
19 – DOCOMO Communications Lab. Support in principle. For note, during several discussion, we can have common understanding that this proposal would target inter-band CA case only. Basically, we think we should discuss inter-band CA case without SUL in this proposal.

3.3 Whether to support inter-band UL CA + SUL scenario(s) in Rel-18

In Rel-16/17 UL Tx switching across 2 bands, the scenario with UL Tx switching between SUL band and corresponding NUL band was supported. In case of UL Tx switching across 3 or 4 bands, following scenarios of inter-band UL CA + SUL may be possible, while it is not clarified in the WID whether to support such scenarios for Rel-18 UL Tx switching across up to 3 or 4 bands (if supported).

- {SUL band + corresponding NUL band} + other NUL band
- {SUL band + corresponding NUL band} + other NUL band + other NUL band
- {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support inter-band UL CA + SUL scenario(s) in Rel-18.

[4]	***Proposal 2: for both 3-bands and 4-bands scenarios, both switched mode (UL CA option 1) and dual mode (UL***
[5]	***Observation 2: Compared with CA, the benefits or motivations to support 'CA+2SUL' is not clear especially con***
[7]	***Proposal 6: The mapping rule between Tx chains and antenna port for inter-band UL CA option1 (SwitchedUL***
[8]	***Proposal 1: For Rel-18 UL Tx switching, inter-band CA and SUL based Tx switching across up to 3 or 4 bands***
[9]	***Proposal 1: RAN1 needs to clarify the UL CA cases involving SUL for Rel-18 UL Tx switching across up to 3 or***
[11]	***Proposal 2: For Rel-18 multi-carrier UL Tx switching, switching schemes should be discussed case by case for***
[13]	***Proposal 3: Inter-band CA takes priority in support of UL 2Tx switching among more than two bands.***
[17]	***Proposal 3: For Rel-18 UL Tx switching, following points should be considered for target scenarios in terms of***
[22]	***Proposal 6: For SUL + CA combination, when the band combination includes four bands, Rel-18 precludes 2 S***
[24]	***Proposal 3: Configurations with more than one SUL-enabled cell are not considered Proposal 4: Consider if ba***

Based on above, the situation can be summarized as below.

- Whether to support inter-band UL CA + SUL in Rel-18
  - **Alt.1: Support inter-band UL CA + SUL in Rel-18**
    - Argued by Huawei/HiSilicon, CATT
    - It is argued that mechanisms for inter-band UL CA Option 1 can be reused for inter-band UL CA + SUL, and UL carrier of any serving cell can be a SUL carrier.
  - **Alt.2: Support inter-band UL CA + SUL excluding the scenario with more than one SUL enabled cell in Rel-18**
    - Argued by ZTE, DOCOMO, Qualcomm, Nokia/NSB
    - It is argued that {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band} scenario has not been discussed, benefit and motivation to support such scenario are unclear, and there is a concern on the workload.
  - **Alt.3: Deprioritizeor not support inter-band UL CA + SUL in Rel-18**
    - Argued by vivo, OPPO, Xiaomi, Nokia/NSB
    - It is argued that inter-band UL CA scenarios should be prioritized considering the concern on the workload.
  - **Alt.4: Further study is necessary with considering more detailed scenarios**

- Argued by China Telecom
- It is argued that it should also be studied whether both UL CA with one cell and multiple cells configured with SUL such as below are the supported scenarios.
  - SUL band with 2 contiguous carriers + NUL band corresponding to SUL carrier 1+ NUL band corresponding to SUL carrier 2
  - SUL band + other SUL band + NUL band with 2 contiguous carriers (one is corresponding to first SUL band and another is corresponding to second SUL band)

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.3.1 Proposed working assumption

- **Support at least following inter-band UL CA + SUL scenarios in Rel-18**
  - **{SUL band + corresponding NUL band} + other NUL band (if UL Tx switching across 3 bands is supported)**
  - **{SUL band + corresponding NUL band} + other NUL band + other NUL band (if UL Tx switching across 4 bands is supported)**
  - **Note: inter-band UL CA without SUL and inter-band UL CA Option 1 + SUL (which can reuse mechanisms for inter-band UL CA Option 1 without SUL) are prioritized**
  - **FFS: whether to support other scenarios of inter-band UL CA + SUL such as {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}**

Feedback Form 7: 3.3.1

1 – Qualcomm India Pvt Ltd If majority decides to specify Rel-18 UL Tx switching, we are ok with this proposal.
2 – OPPO If Rel-18 UL Tx switching is supported, we still think inter-band CA should be prioritized. Alt-2 (**Support inter-band UL CA + SUL excluding the scenario with more than one SUL enabled cell**) can be supported if time allows after RAN1 completes UL-Tx switching without SUL.
3 – Apple GmbH Again, same comment as for other proposal, that the main bullet can also include the condition ”if UL Tx switching with 3 or 4 bands is supported in Rel-18” Regarding the details of the proposal, due to very limited time-budget for this WI, we should avoid introducing any additional cases for SUL than currently supported with UL Tx switching. Otherwise, if we consider increasing the number of SULs, then we need to consider cases specific to SUL such as whether to support simultaneous transmission on two SULs , switching from one SUL to another SUL, etc.

Based on that, we would prefer to remove the entire bullet under FFS and rather replace with a note that no additional scenario including more than 1 SUL should be further considered in Rel-18.

With our proposed updates, we can accept the proposal

4 – Esurfing IoT

China Telecom

It is not clear whether all the bands (SUL and NUL bands) can have contiguous carriers within a band. We think it needs to be clarified.

5 – Fujitsu Limited

If majority decides to specify Rel-18 UL Tx switching, we are ok with this proposal. However, we don't think SUL has high priority.

6 – vivo Communication Technology

1. first, we would like to ask for clarification: is it allowed to have multiple SUL carriers in the SUL band, each of which corresponds to a separate NUL on the corresponding NUL band with the first 2 sub-bullet of the proposal?

2. regarding the note, we agree that the design of inter-band CA without SUL can be reused for the inter-band CA with SUL, considering the limited TU, we would prefer to focus on inter-band CA without differentiating the UL type

7 – ZTE Corporation

Similar view as OPPO.

If UE has to support up to 3 or 4 bands, UE has to support inter-band CA as prerequisite. From this perspective, it would be better to prioritize UL Tx switching for CA.

We also share similar view as Apple that RAN1 should not extend the existing SUL framework.

8 – LG Electronics Inc.

Since the "inter-band CA without SUL" scenario may include all other scenarios, it should be a baseline for the discussion. In addition, we think that given the limited time of this WI, scenarios involving 2 SUL bands on which necessity or motivation is not yet clear should be excluded. In this point of view, we support the FL proposal except for the last FFS bullet which can be removed.

9 – Intel Deutschland GmbH

We are generally fine with the proposed working assumption. It is unclear to use "prioritized" means in the Note. Is this correct understanding that other scenarios will also be considered in Rel-18?

10 – Nokia Corporation

We have similar view as a number of other companies that we should focus on the UL CA cases. Share the same view as Apple and ZTE that SUL framework should not be extended in this WI.

11 – Samsung Research America

We do not think that it was intention of the WI to introduce additional SUL cases. The WI objective should be on UL CA.

12 – HUAWEI TECHNOLOGIES Co. Ltd. ***Since Rel-15, the L1&2&3 specifications have supported SUL and its full compatibility to CA framework, i.e. SUL can be configured to any serving cell of a CA combination including two SULs are configured to a PCell and a SCell, respectively, regardless intra-band or inter-band CA.*** *With this legacy, for Rel-16/17 UL Tx switching, two ULs of two serving cells of UL-CA can be SUL as well. Since the mechanism of Rel-15/16/17 are targeted to be reused as much as possible in Rel-18, we don't feel the case of two SULs on two serving cells can be precluded. The motivation for the proposal is unclear. We suggest to retain the spirit that RAN1 solution is band agnostic.*
13 – InterDigital Belgium. LLC We prefer to focus on scenarios not involving SUL as a baseline.
14 – MediaTek Inc. Fine with the proposal if UL Tx switching with 3 or 4 bands is supported in R18.
15 – Spreadtrum Communications We have similar view as a some companies that it should focus on the UL CA cases.
16 – Ericsson LM We have similar view as other companies that we should focus on UL CA case.
17 – DOCOMO Communications Lab. We support this proposal in principle. Regarding FFS, as mentioned by apple, it is expected that there are many concerns on the workload. Thus, we are OK to remove the FFS.

3.3.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OK with adding "If Rel-18 UL Tx switching is supported"
    - QCM, Apple, MTK
  - OK but scenarios with more than one SUL enabled cell should be excluded
    - OPPO, Apple, ZTE, LG, Nokia, DCM
  - OK with lower priority
    - OPPO, FJT, ZTE, Nokia
  - OK with clarifying the meaning of "prioritized"

    - Intel

- Need clarification
  - Whether all bands (both SUL and NUL bands) can have multiple contiguous carriers
    - CT, vivo
  - Should focus on UL CA (without differentiating the UL type)
    - vivo, Samsung, IDC, SPRD, SPRD
  - Should consider that UL carrier of any serving cell in the UL CA can be a SUL carrier i.e., not preclude two SUL case
    - HW

The moderator thinks that the intention of the proposed WA is aligned with comments from many companies, i.e., prioritize UL CA scenarios where no differentiation between SUL and non-SUL is necessary. In addition, considering the quite limited TUs for this WI, removing FFS scenarios should be reasonable.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed working assumption

- **If Rel-18 UL Tx switching is supported, following inter-band UL CA + SUL scenarios are supported in addition to inter-band UL CA without SUL scenarios in Rel-18**
  - **{SUL band + corresponding NUL band} + other NUL band (if UL Tx switching across 3 bands is supported)**
  - **{SUL band + corresponding NUL band} + other NUL band + other NUL band (if UL Tx switching across 4 bands is supported)**
  - **Note: defining necessary mechanisms to support inter-band UL CA without SUL and inter-band UL CA Option 1 + SUL (which can reuse mechanisms for inter-band UL CA Option 1 without SUL) are prioritized, and if time allows, necessary mechanisms to support inter-band UL CA Option 2 + SUL can be discussed**

Feedback Form 8: 3.3.2

1 – Apple GmbH We are now fine with the FL's proposed WA.
2 – LG Electronics Inc. We support the proposed working assumption.

3 – vivo Communication Technology

We are fine with FL's proposal

4 – CATT

We share same view with Huawei that SUL can be configured with any serving cell in the CA framework□and there is no limitation of configureing only one SUL in the current spec. The scenario of {SUL band+Corresponding NUL band} of serving cell-1+{SUL band+Corresponding NUL band} of serving cell-2 shouldn't be excluded in the Rel-18 UL Tx switching.

5 – ZTE Corporation

After reading commpanies comments, it is clear that companies have different understandings on what the legacy SUL framework can be supported. To avoide any further confusion, we propose to clarify it before discussing this proposal.

Our understanding is as following.

1. Only up to one SUL carrier can be configured for each UE;
2. SUL and NUL are on different bands (i.e., no intra-band SUL and NUL);

6 – ZTE Corporation

3. Another thing needs to be calrified is whether UL transmission on **SUL band** and UL transmission on **the other NUL band** can be transmitted simultaneously? If yes, does it mean SUL+CA has to support CA Optoin2?

7 – Intel Deutschland GmbH

We are fine with the proposal in general. Given the limited TU, we do not think we have sufficient time to discuss "**inter-band UL CA Option 2 + SUL** ". We suggest to remove the note.

8 – HUAWEI TECHNOLOGIES Co. Ltd.

Sorry, no support. We understand the situation of limited TU. But there is no technical concern to preclude two SUL case. In all submitted contribution paper, we don't see any identified issue. So the SUL case does not cost extra TU. In our understanding, prioritization can be done only after some additional issues have been identified. More importantly, the full compatibility between SUL and CA has been specified since Rel-15, it makes no sense to write in Rel-18 spec to preclude a Rel-15 function.

Please allow us to provide an example how simple the full compatibility between SUL and CA is for UL Tx switching.

- For band combination {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}, the UE is configured with two serving cells with one SUL in each cell. Two DCIs are received from two serving cells, respectively. Since both cells are SUL cells, only two uplinks in total are scheduled to transmit by the two DCI. Therefore, the switching cases are only two dimensions, i.e. {1T,0T}, {0T, 1T}, {1T, 1T}, rather than four dimensions. To handle such two-dimension switching case, **the UL switching mechanism is the same as Rel-17 UL Tx switching**. If the UE supports UL-CA Option 2, the UL switching mechanism reuse the Rel-17 Option 2 UL tx switching to handle the extra switching case {1T, 1T}.

- Similarly, it is also two-dimension switching case for the 3-band configuration because only two serving cells are configured.

We hope the examples above could clarify no TU issue and the existing mechanism can be reused easily. **In short, once a SUL is configured, the number of configured serving cell is decreased by one, so is the number of monitored DCI. As a result, the switching mechanism becomes even easier thanks to the dimension deduction.**

For the proposal, we suggest revisions as below,

If Rel-18 UL Tx switching is supported, following inter-band UL CA + SUL scenarios are supported in addition to inter-band UL CA without SUL scenarios in Rel-18

· {SUL band + corresponding NUL band} + other NUL band (if UL Tx switching across 3 bands is supported)

· {SUL band + corresponding NUL band} + other NUL band + other NUL band (if UL Tx switching across 4 bands is supported)

· **{SUL band + corresponding NUL band} + {SUL band + corresponding NUL band} (if UL Tx switching across 4 bands is supported)**

~~·~~Note: defining necessary mechanisms to support inter-band UL CA without SUL and inter-band UL CA~~**Option 1**~~ + SUL (which can reuse mechanisms for inter-band UL CA ~~**Option 1**~~ without SUL) are prioritized~~**, and if time allows, necessary mechanisms to support inter-band UL CA Option 2 + SUL can be discussed**~~

9 – Ericsson LM

We are fine with the proposal.

10 – Samsung Research America

We support the proposed WA by the FL.

11 – InterDigital Belgium. LLC

Support the FL proposal.

12 – DOCOMO Communications Lab.

We support this proposal and agree with the clarification proposed from ZTE about ”whether UL transmission on SUL band and UL transmission on the other NUL band can be transmitted simultaneously? ”

3.3.3 3rd round discussion

After the second round email discussion, companies’ feedbacks can be summarized as below.

- Fine with the FL proposal
  - Apple, LG, vivo, Ericsson, Samsung, IDC, DCM
  - Suggest to remove “inter-band UL CA Option 2 + SUL”

    - Intel

  - Suggest to clarify current SUL framework

    - ZTE, DCM

- Not fine with the FL proposal

  - Should include scenario of {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}

    - HW, CATT

Based on the above situation, it may be good to confirm common understanding among companies on the existing SUL configurability in CA framework first as suggested by ZTE. It would be common understanding that the SUL and corresponding NUL are on different bands and simultaneous transmissions on SUL band and corresponding NUL band is not possible. The moderator thinks companies may have different understandings on following two points.

- Whether ”any serving cell in UL CA can be configured with a SUL carrier” or ”only up to one SUL carrier can be configured for each UE even in UL CA”
- Whether ”UL transmission on SUL band and UL transmission on non-corresponding NUL band can be done simultaneously” or not

The moderator would like to ask companies to provide feedback if any on the above summary and questions. The proposed working assumption can be selected from following alternatives based on the feedbacks.

Proposed working assumption Alt.1

- **If Rel-18 UL Tx switching is supported, following inter-band UL CA + SUL scenarios are supported in addition to inter-band UL CA without SUL scenarios in Rel-18**

  - **{SUL band + corresponding NUL band} + other NUL band (if UL Tx switching across 3 bands is supported)**
  - **{SUL band + corresponding NUL band} + other NUL band + other NUL band (if UL Tx switching across 4 bands is supported)**
  - **Note: defining necessary mechanisms to support inter-band UL CA without SUL and inter-band UL CA Option 1 + SUL (which can reuse mechanisms for inter-band UL CA Option 1 without SUL) are prioritized, and if time allows, necessary mechanisms to support inter-band UL CA Option 2 + SUL can be discussed**

Proposed working assumption Alt.2

- **If Rel-18 UL Tx switching is supported, following inter-band UL CA + SUL scenarios are supported in addition to inter-band UL CA without SUL scenarios in Rel-18**

- **{SUL band + corresponding NUL band} + other NUL band (if UL Tx switching across 3 bands is supported)**
- **{SUL band + corresponding NUL band} + other NUL band + other NUL band (if UL Tx switching across 4 bands is supported)**
- **{SUL band + corresponding NUL band} + {SUL band + corresponding NUL band} (if UL Tx switching across 4 bands is supported)**
- **Note: defining necessary mechanisms to support inter-band UL CA without SUL and inter-band UL CA + SUL (which can reuse mechanisms for inter-band UL CA without SUL) are prioritized**

Feedback Form 9: 3.3.3

1 – Qualcomm India Pvt Ltd

We support Alt. 1 in principle.

We disagree Alt 2 as even without UL Tx switching 3GPP never formally discussed & specified two SUL bands in a single band combination. Some key technical issues are unclear like whether two SUL could simultaneously transmit, whether SUL and its non-serving cell could simultaneously transmit. Given the limited TU, we think it would be very difficult to get consensus on these new UE behaviors.

2 – ZTE Corporation

We are open to support SUL at least for the 3 bands case as lower priority but clarification is needed before committing to support this.

First, it seems only one or two companies think all possible combinations of configurations can be supported in the current spec without any restrictions. We think this is a misleading statement. If we follow the same logic, the proponent can argue that all combinations like intra-band NUL+SUL, inter-band NUL#1+NUL#2 plus intra-band SUL#1+SUL#2 can be supported in the current RAN1/RAN2 specs even these combinations are not supported in RAN4 spec. Without any restriction, even overlapping carriers and full duplex can be supported in such configuration which is certainly not true. If proponents want to enable support of these combinations in the specs, restrictions have to be added first. Also, ambiguity will arise in the spec since the current spec was designed to support intra-band CA and inter-band CA without any consideration of supporting more than one SUL. Therefore clarifications have to be made on what combinations can be supported before agreeing to support SUL. Otherwise, the proponent will continue to think all combinations can be supported with Tx switching.

Regarding the two questions raised by moderator, our understanding is as following.

1. Only up to one SUL carrier can be configured for each UE even in UL CA.
2. UL transmission on SUL band and UL transmission on non-corresponding NUL band can NOT be done simultaneously. Otherwise, it means Option2 + SUL is supported which requires extra work.

If more than 1 SUL can be configured, then at least the following questions need to be clarified.

1. What's the motivation to introduce more than 1 SUL considering that SUL is mainly for coverage enhancement? What is different from supporting 4 bands CA- Option 1?
2. Whether SUL#1 in one cell and SUL#2 on another cell can transmit simultaneously?
3. What's the maximum number of SULs can be configured to each UE?

If intra-band SUL/SUL or intra-band SUL/NUL is supported, then at least the following questions need to be clarified.

1. What's the maximum number of intra-band SULs within one band?
2. Whether the frequency resource of intra-band SULs can overlap with each other? Is this contiguous or non-contiguous?
3. What is the rule of simultaneous transmission/reception?
4. If inter-band CA of NUL#1+NUL#2 plus intra-band of SUL#1+SUL#2 is supported, is this treated as intra-band CA or inter-band CA in the current spec description?

Since the proponent thinks the spec support all combinations of the possible configurations, please clarify how all above configurations can be supported in the specs. After all these are clear, we know what can be actually supported in the SUL framework with Tx switching.

3 – Apple GmbH

We support WA Alt 1. In our view, the third sub-bullet in WA Alt 2 is not the primary objective of this study and given the limited budget, we don't think we should go towards extending the number of SULs for UL Tx switching. Also, we raised our concerns earlier that this will result in studying new switching configurations for multiple SULs.

4 – InterDigital Belgium. LLC

We support Alt. 1.

5 – Intel Deutschland GmbH

We support Alt. 1, but as commented in the second round of discussions, given the limited TU, we do not think we have sufficient time to discuss "inter-band UL CA Option 2 + SUL". We suggest to remove the note, but if majority companies are fine with that, we can live with this.

We do not support Alt. 2, especially the third bullet. As pointed out by other companies, the motivation on whether/how to support more than 1 SUL for Tx switching is not clear to us.

6 – Spreadtrum Communications

We are supportive of Alt1.

For Alt 2, it is premature to include the third bullet. A lot of issues should be defined before the conlusion as mentioned by ZTE.

7 – New H3C Technologies Co.

We slightly prefer Alt.1 and we are open to discuss about the scenario on SUL+SUL case

8 – Beijing Xiaomi Electronics

The major divergence here is whether more than SUL can be configured for a UE. For current SUL framework, one carrier can contains one NUL+one SUL which are defined in RAN4. We need to firstly check whether it is possible there are more than two carriers contains both SUL and NUL.

9 – Fujitsu Limited

We support Alt.1

10 – LG Electronics Inc.

We prefer Alt.1. For the 3rd sub-bullet of Alt 2, we think it may be too short of a given TU to focus on this scenario.

11 – vivo Communication Technology

In our view, in the SUL framework, there is only 1 SL band for a UE. According to 5.5C Configurations for SUL in 38.101-1, each SUL band combination set includes only 1 SUL band. Thus, we support alt.1

In addition, it seems that all companies agree that at least a single SUL band is compatible with the legacy SUL framework. The controversial point is that some companies have different views on whether multiple SUL bands are supported, so we think it is also safer to support alt1.

12 – CATT

If most of companies think it is too premature to support Alt 2, we suggest that the case {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band} (if UL Tx switching across 4 bands is supported) can be as FFS for further study in the next meeting.

13 – Samsung Research America

We support Alt. 1. We would not like to see the R18 WI extend the number of SULs for UL Tx switching. We think this is not the intended objective in which the WID was written. It should also be considered that any such proposal should be discussed separately, e.g., potential benefits of >1 SUL, resulting Tx/Rx behavior for core specs, RAN4, e.g., much additional work for which there is not enough time.

14 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank FL for leading the discussions.

Above all, it is all about reusing the existing Rel-15 CA+SUL framework instead of introducing new mechanism. It makes no sense to preclude a Rel-15 functionality from Rel-18. Any technical concern is very welcome but we hope this discussion would not fall into any political voting.

The existing Rel-15 CA+SUL framework is simple, and we had provided an example before how it works. The CA framework contains only three points,

· any UE behavior WITHIN one serving cell, refers to the specified SUL mechanism.

· any UE behavior and its capability AMONG two or more serving cells, refers to the specified CA mechanism.

· If any new UE behavior is different from the above two, the spec has either explicitly specified a new UE behavior or explicitly precludes a configuration/setting.

Please note that the above three points are applicable not only to SUL feature but also other features like multiple-TRP. If SUL/multi-TRP were not able to be configured into multiple serving cells at the same time,

it would have been explicitly specified in the Rel-15 spec simply. However, since no new UE behavior that is different from the first two bullets is needed, there are never configuration restriction in the spec.

Therefore, the views that SUL configuration is not supported until explicit support is written in spec is absolutely incorrect.

Regarding the views that SUL configuration is not supported as long as there is no RAN4 band combination, it is misinterpretation of the discussion here. The discussion is about the L1/L2/L3 functionality instead of RAN4 requirements. SUL configuration is subject only to RAN1 functionality and RAN2 functionality. For example, 3GPP has claimed a CA support of 16 cells in Rel-15, but there is no any RAN4 band combinations with more than 6 cells in latest specification. Similarly, it makes no sense to claim SUL configuration/functionality is not supported because of RAN4 band combination.

With the analysis above, we have the following answers to FL's questions and some suggestions,

· Yes, any serving cell in UL CA can be configured with a SUL carrier. Otherwise, please company provides any new UE behaviour required by a configuration with additional SUL.

· Yes, UL transmission on SUL band and UL transmission on non-corresponding NUL band can be done simultaneously. Because the simultaneous transmissions are between serving cells, SUL configuration does not require additional new UE behaviour for it. Otherwise, please company provides any new UE behaviour or capability required by such operation.

Regarding the question about support of intra-band/inter-band, it is subject to UE capabilities of band combinations, which has no different from CA capability reporting.

Regarding the comment about restriction of band combination {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}, it is also subject to UE capability. If a UE does not support such band combination, just don't report a support. But it makes no sense to preclude other UEs to support it by hard-coded restriction in spec.

Regarding the question about the support of SUL with other feature together, we see no difference to answer this question by replacing SUL in this question by any other feature. The answer is subject to UE capability reporting.

15 – Ericsson LM

We are fine with Alt-1.

16 – DOCOMO Communications Lab.

We prefer Alt.1. It seems companies have different understandings on the SUL configurability in existing CA framework, and considering the limited TUs for this WI, it is safer to have focused target scenarios at least and other scenarios can be discussed if time allows.

3.4 Whether to support inter-band UL CA + EN-DC scenario(s) in Rel-18

In Rel-16 UL Tx switching, inter-band EN-DC scenario was one of the target scenarios while in Rel-17 UL Tx switching, inter-band EN-DC scenario was not the target scenarios for enhancing UL Tx switching between 2 bands. For Rel-18 UL Tx switching across up to 3 or 4 bands, it is not clarified in the WID whether to support inter-band UL CA + EN-DC scenario(s) while only NR specifications are described as affected specifications for this WI.

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support inter-band UL CA + EN-DC scenario(s) in Rel-18.

[7]	***Proposal 4: EN-DC with 3 or 4 carriers case is considered as a band combination, where only one carrier uses***
[8]	*According to the WID, only NR TS/TRs are expected to be affected, which seems to imply that the EN-DC enhancer*
[11]	*For EN-DC, enhanced UL Tx switching should not impact LTE system. On the other hand, the motivation of suppo*
[24]	*The Rel-17 extension was not done for the EN-DC case. In principle supporting EN-DC cases where UL is switchi*

Based on above, the situation can be summarized as below.

- Whether to support inter-band UL CA + EN-DC scenario(s) in Rel-18
  - **Alt.1: EN-DC cases are out of scope for Rel-18 UL Tx switching**
    - Argued by vivo, Nokia/NSB, (there may be some other companies as there are contributions not discussing EN-DC cases at all)
    - It would be straightforward according to the current WID.
  - **Alt.2: Consider EN-DC cases where only one band can be in MCG for Rel-18 UL Tx switching**
    - Argued by CATT, Xiaomi
    - It is argued that enhancements for UL Tx switching in Rel-18 should not impact LTE system.

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.4.1 Proposed conclusion

- **EN-DC cases are out of scope for Rel-18 UL Tx switching**

Feedback Form 10: 3.4.1

1 – Qualcomm India Pvt Ltd We support this proposal.
2 – OPPO Support the proposal.
3 – Apple GmbH Support the proposal
4 – Esurfing IoT China Telecom

We support the FL's proposal.

5 – Fujitsu Limited

We support this proposal

6 – vivo Communication Technology

We support the proposal

7 – Beijing Xiaomi Electronics

We don't think EN-DC case is out of scope. WID doesn't preclude any scenarios . EN-DC is not a target scenario in Rel-17 should not be the reason that EN-DC is not supported in Rel-18 UL Tx switching either. From our understanding, the complexity, mechanisms and benefits in EN-DC scenarios for NR are similar as the other scenarios.

8 – ZTE Corporation

OK with this proposal.

9 – LG Electronics Inc.

Support the proposal

10 – Intel Deutschland GmbH

We are fine with the proposed conclusion

11 – Nokia Corporation

Support the proposal

12 – Samsung Research America

We support the FL proposal, e.g., EN-DC cases are out-of-scope.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

Support. UL Tx switching for EN-DC cases has unique RAN1 spec impact as in current TS 38.214.

14 – InterDigital Belgium. LLC

Support the proposal.

15 – MediaTek Inc.

Agree with the proposed conclusion.

16 – Spreadtrum Communications

Support the proposal

17 – Ericsson LM

We support the proposal.

18 – DOCOMO Communications Lab. Support. According to the WID, it seems to imply that the EN-DC enhancement is out of scope.

3.4.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - QCM, OPPO, Apple, CT, FJT, vivo, ZTE, LG, Intel, Nokia, Samsung, HW, IDC, MTK, SPRD, E///, DCM
- Not support
  - Xiaomi

There is clear majority that EN-DC cases are out of scope for Rel-18 UL Tx switching, although one company considers mechanisms and benefits in EN-DC scenarios for NR are similar as other scenarios and hence it is not out of scope.

The moderator believes RAN1 should make following conclusion considering quite limited TUs for this WI.

Proposed conclusion

- **EN-DC cases are out of scope for Rel-18 UL Tx switching**

Feedback Form 11: 3.4.2

1 – Apple GmbH We support FL's proposed conclusion
2 – LG Electronics Inc. We support the proposed conclusion.
3 – vivo Communication Technology support the proposed conclusion.
4 – CATT If majority of companies think EN-DC cases are out of scope for Rel-18 UL Tx switching, we are fine with the proposed conclusion.

5 – Esurfing IoT ChinaTelecom We support the proposed conclusion.
6 – MediaTek Inc. Support
7 – Beijing Xiaomi Electronics Although we have different understanding on the scope, we understand the situation here. We can go with the proposal.
8 – Intel Deutschland GmbH We are fine with the proposal.
9 – HUAWEI TECHNOLOGIES Co. Ltd. OK
10 – Ericsson LM We support the proposal
11 – Samsung Research America We support the FL proposal.
12 – InterDigital Belgium. LLC Support the FL proposal.
13 – DOCOMO Communications Lab. We support the proposal

3.4.3 Outcome of 2nd round discussion and GTW session

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - Apple, LG, vivo, CT, MTK, Intel, HW, Ericsson, Samsung, IDC, DCM
  - Can accept majority view
    - CATT, Xiaomi

It was discussed in the GTW session and following conclusion was made.

Conclusion

- **EN-DC cases are out of scope for Rel-18 UL Tx switching**

3.5 Whether to support "UL transmission on a carrier without corresponding DL carrier" in Rel-18

In the WID, there is a note that "Note: no additional TAG is introduced for UL transmission on a carrier without corresponding DL carrier". The UL transmission on a carrier withtout corresponding DL carrier may be interpreted as a new concept of UL only cell which is different from SUL concept. However, it seems unclear, and some companies are confusing.

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support "UL transmission on a carrier without corresponding DL carrier" in Rel-18.

[5]	*There are at least the following interpretations of the term "a carrier without corresponding DL carrier". Alt.1: T*
[9]	*As for the note "no additional TAG is introduced for UL transmission on a carrier without corresponding DL carri*
[17]	*For potential non-CA scenario The WID captures following two notes, but it is unclear whether/how to support "U*
[23]	*The WID mentions that "Note: no additional TAG is introduced for UL transmission on a carrier without correspo*

Based on above, the situation can be summarized as below.

- Whether to support "UL transmission on a carrier without corresponding DL carrier" in Rel-18
  - **Alt.1: UL only cell is not supported in Rel-18**
    - Argued by DOCOMO, Fujitsu (there may be some other companies as contributions other than above were not discussing UL only cell at all)
    - It is argued that there is a concern on the workload due to limited TUs.
  - **Alt.2: UL only cell is supported in Rel-18**
    - Argued by ZTE, (China Telecom)
    - It is argued that spec impacts can be minimal since the CA framework can be largely reused and cross-carrier scheduling mechanism can be reused for scheduling of UL-only cell.

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.5.1 Proposed conclusion

- **UL only cell is not supported for Rel-18 UL Tx switching**

Feedback Form 12: 3.5.1

1 – OPPO

We are fine with the proposal.

2 – Apple GmbH

We are fine with the proposal

3 – Fujitsu Limited

We don't think UL only cell is the major use case of this technology. Thus, to minimize the workload, we believe alt 1 is a good way forward and support the moderator's proposal.

4 – vivo Communication Technology

We are fine with the proposal

5 – Beijing Xiaomi Electronics

We are fine with the proposal.

6 – ZTE Corporation

We support to include UL-only cell in the scope.

The UL-only cell can be supported via the existing cross-carrier scheduling framework. All the existing RAN1 scheduling mechanism can be reused and RAN2 signalling framework can be reused. The only issue may be how to activate the UL-only Cell. Actually, this is similar as SSB-less Cell under discussion in network energe saving. This can be checked with RAN4 if companies feel that the SCell activation procedure needs to be studied for UL-only cell.

7 – LG Electronics Inc.

We are fine with the proposal.

8 – Intel Deutschland GmbH

We are fine with the proposed conclusion

9 – Nokia Corporation

We support the proposal

10 – Samsung Research America

We support the FL proposal, e.g., UL-only cell is out-of-scope for R18 work.

11 – InterDigital Belgium. LLC

Support the FL proposal.

12 – MediaTek Inc.

Agree with the proposed conclusion.

13 – Spreadtrum Communications Support the proposal
14 – Ericsson LM We support the proposal.
15 – DOCOMO Communications Lab. Support. Given the limited TUs, we think it's difficult to get the conscience to support UL only cell in RAN1.

3.5.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OPPO, Apple, FJT, vivo, Xiaomi, LG, Intel, Nokia, Samsung, IDC, MTK, SPRD, E///, DCM
- Not support
  - ZTE

There is clear majority that UL only cell is out of scope for Rel-18 UL Tx switching, although one company considers existing mechanism and signaling framework can be reused for UL only cell while there may be an issue on how to activate the UL only cell and it can be checked with RAN4.

The moderator believes RAN1 should make following conclusion considering quite limited TUs for this WI.

Proposed conclusion

- **UL only cell is not supported for Rel-18 UL Tx switching**

Feedback Form 13: 3.5.2

1 – ZTE Corporation We don't support this proposal. Also, we don't think a conclusion at this stage is necessary. Since the only concern on UL-only Cell mentioned by companies is how to activate this UL-only Cell, this falls into RAN4 scope. If companies don't want to send LS to RAN4, we can subbmit tdocs to RAN4 to seek information from RAN4 expertise there. However, we understand the situation here. Moderator doesn't need to bring this issue up again in future meetings in RAN1 unless the situation changes. But again, we don't think a conclusion at this stage is needed.

2 – Apple GmbH We are fine with FL's proposal
3 – LG Electronics Inc. We support the proposed conclusion
4 – China Mobile Com. Corporation We are fine with the FL proposal.
5 – vivo Communication Technology We are fine with FL's proposal
6 – CATT We are fine with FL's proposal.
7 – MediaTek Inc. Support
8 – Beijing Xiaomi Electronics Support.
9 – Intel Deutschland GmbH We are fine with the proposal.
10 – HUAWEI TECHNOLOGIES Co. Ltd. Support. Scell activation is not the only issue for supporting UL-only serving cell. It is also obvious that Scell activation has RAN2 and RAN1 impacts as well.
11 – Ericsson LM We support the proposal
12 – Samsung Research America We support the FL proposal.
13 – InterDigital Belgium. LLC Support the FL proposal.
14 – DOCOMO Communications Lab. We support the proposal

3.5.3 Outcome of 2nd round discussion and GTW session

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - Apple, LG, CMCC, vivo, CATT, MTK, Xiaomi, Intel, HW, Ericsson, Samsung, IDC, DCM
- Not fine with the FL proposal
  - Don't make the conclusion at this stage so that RAN4 can discuss on it
    - ZTE

It was discussed in the GTW session and following conclusion was made.

Conclusion

- **UL only cell cases are out of scope for Rel-18 UL Tx switching**

3.6 Whether to support inter-band UL CA with intra-band contiguous carriers within band(s) in Rel-18

In Rel-17 UL Tx switching between band A and band B, the band B can have two contiguous aggregated carriers, and the same state of Tx chain is applied to the intra-band two contiguous carriers. For Rel-18 UL Tx switching, it is not clarified in the WID that whether to support inter-band UL CA with intra-band contiguous carriers within a band, how many bands can have intra-band contiguous carriers, and how many contiguous carriers within a band can be supported.

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support inter-band UL CA with intra-band contiguous carriers within band(s) in Rel-18.

[6]	***For Rel-18 UL Tx switching among 3 bands or 4 bands, the Tx switching scheme can be based on Rel-16/17 UL***
[9]	*In Rel-17 Tx switching, if one band has 2 contiguous carriers, the same state of Tx chain is applied to intra-band U*
[13]	*In Rel-17, up to two continuous carrier per NR band has been supported for UL Tx switching. So, it is a starting po*

Based on above, the situation can be summarized as below.

- Whether to support inter-band UL CA with intra-band contiguous carriers within band(s) in Rel-18
  - **Alt.1: For Rel-18 UL Tx switching across up to 3 or 4 bands, there can be up to two**

contiguous carriers within a band and the same state of Tx chain is applied to the intra-band contiguous carriers within the band

- Argued by Spreadtrum, China Telecom, OPPO
- It is argued that the same mechanism can be used for intra-band CA carriers as in Rel-17.

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.6.1 Proposed agreement

- **For Rel-18 UL Tx switching across up to 3 or 4 bands, there can be up to two contiguous carriers within a band, and the same state of Tx chain is applied to the intra-band contiguous carriers within the band**
  - **The UL Tx switching mechanisms can be same between the case with one carrier in a band and the case with two contiguous carriers in a band**

Feedback Form 14: 3.6.1

1 – Qualcomm India Pvt Ltd We support this proposal in principle. However, we think the sub-bullet might be not clear. We see all the proposals are with same understanding that Rel-17 intra-band contiguous CA principle would be reused, which is single RF chain would cover both carriers in one band and UE jointly checks the configuration of the two carriers and use the maximum ports number among the scheduling for the two carriers on the band to decide whether to switch or not. We would suggest using the following wording for the sub-bullet. - A single RF chain would cover both carriers in one band and UE jointly checks the configuration of the two carriers and use the maximum ports number among the scheduling for the two carriers on the band to decide whether to switch or not.
2 – OPPO We are fine with the proposal.
3 – Apple GmbH We are fine with the proposal and updates by Qualcomm and also suggest adding similar condition as we suggested for other proposals i.e. ”if supported”. Also, we would like to clarify that this proposal doesn’t imply that more than one band can have two contiguous carriers within a band.

4 – Esurfing IoT

China Telecom

We are fine with the proposal.

5 – Fujitsu Limited

We are fine with the proposal, and the proposal by Qualcomm looks good.

6 – vivo Communication Technology

we are also fine with further clarification from Qualcomm, but it should be clarified if there can be more than 2 bands configured with multiple carriers, or if there is only one band configured with 2 carriers.

7 – Beijing Xiaomi Electronics

We are fine with the proposal.

8 – ZTE Corporation

We support the main bullet.

Actually, we think the subbullet can be removed as it doesn't add any additonal information on top of the main bullet. Thus, we can avoid debating on the wording suggested by companies.

9 – ZTE Corporation

Sorry for spaming, our understanding is that the "band" in this proposal refers to non-SUL band.

10 – LG Electronics Inc.

We support the proposal

11 – Intel Deutschland GmbH

We are fine with the proposal in principle. We also share similar view as other companies that further clarification is needed on whether this is for only one band with two contiguous carriers or more than one bands.

12 – Nokia Corporation

In principle OK with the proposal

Agree with ZTE tthat the sub-bullet is not needed

Agree with Intel et.al that it would be good to clarify if it is one band only with 2 carriers, or if any number of bands can have 2 carriers. Perhaps we could agree that one band with 2 carriers, FFS if more than one band can have 2 carriers.

13 – Samsung Research America

We support the intention of the FL proposal. However, we prefer the proposed wording from Qualcomm which makes the intent much clearer.

14 – HUAWEI TECHNOLOGIES Co. Ltd. We support the proposal in general. But we don't see the reason to limit it up to two contiguous which is usually a RAN4 property of a CA band combination rather than RAN1 property. In Rel-17 UL Tx switching, the RAN1 switching mechanism is only about band-to-band switching without any restriction on the number of contiguous carriers in one band. It can be reused in Rel-18, therefore, we suggest **Proposed agreement-r1** Reuse the R17 mechanism to support contiguous intra-band CA for up to 4 UL bands, i.e. • The same state of UE Tx chains is applied to all intra-band UL carriers in one band • UL Tx switching is only triggered between different band
15 – InterDigital Belgium. LLC Fine with proposal with updates from Qualcomm
16 – MediaTek Inc. Fine with the proposal.
17 – DOCOMO Communications Lab. We support the proposal and proposed clarification by Qualcomm. Regarding the number of bands with 2 contiguous carriers in a band, at this moment, we can say at least one band and FFS for more than one band as suggested by Nokia.

3.6.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OPPO, CT, Xiaomi, LG, MTK
  - OK with updating sub bullet
    - QCM, Apple, FJT, vivo, Samsung, IDC, DCM
  - OK with adding "If Rel-18 UL Tx switching is supported"
    - Apple
  - OK with clarifying whether there can be more than 1 band with multiple carriers
    - Vivo, Intel, Nokia, DCM
  - OK with removing sub-bullet
    - ZTE, Nokia

- OK but no need to limit to up to two contiguous carriers
    - HW

The moderator thinks that the suggested clarification on sub-bullet from QCM seems fine for many companies, and it would be good to keep the updated sub-bullet to clarify the implication of the main bullet. Regarding the number of contiguous carriers within a band and number of bands with multiple carriers among 3 or 4 bands, at least one band with up to two contiguous carriers should be fine for all, while more than one band and more than two configuous carriers can be FFS at this moment.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **If Rel-18 UL Tx switching is supported, for Rel-18 UL Tx switching across up to 3 or 4 bands, there can be up to two contiguous carriers within a band, and the same state of Tx chain is applied to the intra-band contiguous carriers within the band**
    - **A single RF chain would cover both carriers in one band and UE jointly checks the configuration of the two carriers and use the maximum ports number among the scheduling for the two carriers on the band to decide whether to switch or not**
    - **At least one band can have up to two contiguous carriers within a band among 3 or 4 bands**
        - **FFS whether there can be more than two contiguous carriers within a band**
        - **FFS whether there can be more than one band with multiple carriers within a band**

Feedback Form 15: 3.6.2

1 – ZTE Corporation

It seems that companies are proposing to support intra-band SUL (e.g., two SULs from the same band). Per the exisiting WID, SUL framework should not be extended. To make it clear, we propose to update the main bullet as below.

If Rel-18 UL Tx switching is supported, for Rel-18 UL Tx switching across up to 3 or 4 bands, there can be up to two contiguous carriers within a non-SUL band, and the same state of Tx chain is applied to the intra-band contiguous carriers within the band

Regarding the first subbullet, it has no RAN1 spec impact from our perspective since RAN1 never talks about ”RF chain”. We would be ok to make it as a note (for information only).

2 – Apple GmbH

In our view, extending the number of contiguous carriers within a band or increasing the number of bands with more than one carrier is not the primary objective of this study. And considering the limited TU

budget, we don't think that such enhancements should be considered. Therefore, we suggest to remove the two FFS under second sub-bullet and remove "at least" from the second sub-bullet.

3 – LG Electronics Inc.

We support the proposal. Also fine with ZTE's suggestion.

4 – vivo Communication Technology

We are fine with FL's proposal.

5 – CATT

We are fine with FL's proposal.

6 – Esurfing IoT

China Telecom

It needs to be clarified whether a SUL band can have up to two contiguous carriers.

7 – MediaTek Inc.

Agree with Apple's view, extending the number of contiguous carriers within a band is not part of the scope. Hence, the FFS need to be removed.

8 – Beijing Xiaomi Electronics

We are fine with FL's proposal.

9 – Intel Deutschland GmbH

We share similar views as other companies that the FFS can be removed. The scope and UE complexity increase need to be considered for Rel-18 Tx switching.

10 – HUAWEI TECHNOLOGIES Co. Ltd.

@ZTE, the WID is clear that only multiple SULs configured within ONE serving cell is out of scope. So your revision is unnecessary.

It is OK to give companies more time to check whether 3 contiguous CCs has no extra RAN1 impact. But could FL clarify whether the following sentence will be captured in RAN1 spec? "**there can be up to two contiguous carriers within a band"**

We don't want to capture it into RAN1 spec in any case because it is only specified in RAN4 band combination and we don't see extra UL Tx switching mechanism to support 3 contiguous CCs compared to 2 contiguous CC.

We prefer it is band agnostic in RAN1 spec.

11 – Ericsson LM

OK in principle. FFS needs clarification.

12 – Samsung Research America We share the view of Apple and Intel and others that the FFS should be removed (extending the number of contiguous carriers within a band or increasing the number of bands with more than one carrier is not the primary objective of this study). We support the main bullet and the first sub-bullet parts of the FL proposal.
13 – InterDigital Belgium. LLC Support the FL proposal.
14 – DOCOMO Communications Lab. We support this proposal in principle. In addition that, we are OK to add ”note: RAN1 spec may be described with agnostic to number of contiguous carriers within a band” in this proposal.

3.6.3 3rd round discussion

After the second round email discussion, companies’ feedbacks can be summarized as below.

- Fine with the FL proposal
  - Vivo, CATT, Xiaomi, IDC, DCM
  - Suggest to clarify a band is “non-SUL” band
    - ZTE, LG
    - Objected by HW
  - Suggest to remove FFS parts i.e., exclude more than one band and more than 2 contiguous carriers
    - Apple, MTK, Intel, Samsung
  - Suggest to clarify that RAN1 spec is described agnostic to number of carriers within a band
    - HW, DCM
  - Suggest to have further clarification on FFS parts
    - E///

Based on the feedbacks, the moderator suggests to remove FFS parts while clarifying that RAN1 spec would be described agnostic to number of carriers within a band.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **If Rel-18 UL Tx switching is supported, for Rel-18 UL Tx switching across up to 3 or 4 bands, there can be up to two contiguous carriers within a band, and the same state of Tx chain is applied to the intra-band contiguous carriers within the band**
    - **A single RF chain would cover both carriers in one band and UE jointly checks the configuration of the two carriers and use the maximum ports number among the scheduling for the two carriers on the band to decide whether to switch or not**
    - **One band out of 3 or 4 bands can have up to two contiguous carriers within a band**
    - **Note: RAN1 spec would be described agnostic to number of carriers within a band**

Feedback Form 16: 3.6.3

1 – Qualcomm India Pvt Ltd

We want to clarify whether the 2nd bullet and 3rd bullet conflict with each other. We support the 2nd sub-bullet to limit the contiguous carrier number to be two and the spec should reveal this correctly. If the 3rd bullet is on how to organize the wording in the spec, this should be left to the editor & rapporteur at end of the release. For any case, this note seems not necessary and would create ambiguity.

We are fine with the rest part.

2 – ZTE Corporation

We don't support this proposal for the following reasons.

1. Following the same rule as in Rel-16/17, only non-SUL band can be configured with contiguous carriers. This should be clarified in the main bullet.

2. We don't think RAN1 should restricts only one band out of 3 or 4 bands can have up to two continuous carriers within a band, especially for the 4 bands case. In the end, the number of contiguous carriers in each band is up to UE capability. We propose to allow all the non-SUL bands to support up to 2 carriers subject to UE capability.

3. The first bullet should be a note. Otherwise, we don't understand why RAN1 is discussing RF issues here.

3 – Apple GmbH

In principle, we are fine with the proposal to limit the number of contiguous carriers to 2 in only one of the bands among 3 or 4 bands.

4 – InterDigital Belgium. LLC

Fine with the proposal.

5 – Intel Deutschland GmbH

We are fine with the proposal. Note is not needed.

6 – Spreadtrum Communications

We are supportive of the proposal.

7 – New H3C Technologies Co.

We support this proposal

8 – Beijing Xiaomi Electronics

We are not sure why we need to restrict only one band can be configured with two contiguous carrier. For UL Tx switching, the number of carriers within a band should be agnostic. Whether more than one carriers are located in each band are determined by RAN4, we should not preclude the case wherein more than one band contains two carriers.

9 – Fujitsu Limited

We support this proposal.

10 – vivo Communication Technology

We prefer the proposal in round2, R16/17 case where up to 1 band can be configured with 2 carriers should be the baseline, while whether more than one band can have up to two contiguous carriers in R18 can be FFS at this stage.

11 – LG Electronics Inc.

For the 1st sub-bullet, we are fine with that as a Note.

For the 2nd sub-bullet, we could add the following Note under that.

- Note: The spec does not restrict which band can have up to two contiguous carriers within the band.

12 – CATT

Regarding the note, does it mean that the number of carrier within a band will not be described in the spec? If my understand is correct, why is this proposal needed?

13 – Esurfing IoT

China Telecom

We agree RAN1 spec would be described agnostic to number of carriers within a band, and does not need to capture the second bullet

14 – MediaTek Inc.

Fine with the proposal.

15 – Samsung Research America

We can support the FL proposed agreement.

16 – HUAWEI TECHNOLOGIES Co. Ltd.

RAN1 spec should be band agnostic as usual. We can live with the main bullet only if the note is kept, with a reason commented before.

Regarding the first bullet, it is about the L1 triggering mechanism on when a triggering occurs for intra-band. We prefer to simplify it as "the Rel-17 mechanism on whether/when a UL Tx switching occurs or not is reused." Because there is no difference of UE behaviour to support intra-band between 2-band UL Tx switching and 3-band/4-band UL Tx switching. It also save us time by avoiding discussion of wording refinement.

Regarding the second bullet, it is subject to UE capability. In our understanding, it should not be captured in RAN1 spec as hard-coded restriction because no different UE behavior from RAN1 perspective.

Regarding ZTE's comment on SUL/non-SUL, it is obviously not true. There is no such restriction in any specification. As commented before, no RAN4 band combination does not mean no RAN1/2 functionality. Since it is purely about the necessity of RAN4 requirements for certain RAN4 band combination, kindly suggest ZTE to propose it in RAN4.

17 – DOCOMO Communications Lab.

We support this proposal.

3.7 Whether to support UL Tx switching with multiple TAGs in Rel-18 and how to proceed the discussion between RAN1 and RAN4

In Rel-16/17 UL Tx switching, only the case of single TAG for two UL carriers for SUL and for UL CA (i.e., co-located and synchronized network deployment for the two UL carriers) has been assumed. On the other hand, in the WID for Rel-18 UL Tx switching, it is described that mechanisms to support dynamic Tx carrier switching across the configured bands for both single TAG and multiple TAGs configurations are to be studied. In addition, at the RAN#95-e, it was agreed to add a note that "Note: Extension of TX switching for 2 bands to multiple TAG configurations is included in the scope. The work is limited to RAN4". Although the note said that "the work is limited to RAN4", it seems some companies consider it is better to discuss on the impact of multiple TAGs in RAN1 to facilitate the discussion in RAN4 since RAN4 discussion on this WI will start in Q3 2022 while RAN1 discussion starts in Q2 2022.

In contributions in AI 9.10.2, following observations and proposals were made regarding whether to support UL Tx switching with multiple TAGs in Rel-18 and how to proceed the discussion between RAN1 and RAN4.

[4]	*Compared with dynamic switching between two carriers belonging to the same TAG, it calls for more complicated*
[5]	*Currently, UL Tx switching is only performed between the UL carriers within the same TAG. If the UL carriers bel*
[15]	*To increase the likelihood to configuring multiple combinations of 3 or 4 bands for dynamic UL Tx switching, intro*
[16]	***Observation 1. For dynamic UL Tx switching across the configured bands for multiple TAGs, the clarification o***
[17]	*On the other hand, in the Rel-18 WID, it is described that both single TAG and multiple TAGs configurations are co*
[18]	*Lastly, it may need to be checked whether there is any RAN1 impact on supporting UL Tx switching over multiple T*

[19]	*The current Tx switching is specified for co-located and synchronized network deployment for the two uplink carrie*
[21]	***The UL TX switching feature for UL CA is currently supported for co-located scenarios with the single-TAG ass***
[22]	*However, we think there might be different understanding on which WGs should take lead of multiple TAG for more*

Based on above, the situation can be summarized as below.

- Whether to support UL Tx switching with multiple TAGs in Rel-18
  - **Alt.1: Support UL Tx switching with multiple TAGs in Rel-18**
    - Argued by Ericsson, (Qualcomm (limit to no more than two TAGs))
  - **Alt.2: Not support UL Tx switching with multiple TAGs in Rel-18**
    - Argued by MediaTek
- How to proceed the discussion between RAN1 and RAN4
  - **Alt.1: UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case are discussed in RAN4 first and RAN1 should wait for RAN4 discussion**
    - Argued by Huawei/HiSilicon, ZTE, (Qualcomm)
    - It is argued that the potential issues such as switching period and time mask should be discussed in RAN4 and the agreed note said that the work is limited to RAN4.
  - **Alt.2: UL Tx switching with multiple TAGs for more than 2 bands case are discussed in RAN1 (to provide the RAN1's understanding on potential RAN1 impact to RAN4)**
    - Argued by CMCC, DOCOMO, LG, Qualcomm, (Apple, MediaTek, Ericsson)
    - It is argued that it may need to discuss potential RAN1 impact in RAN1 to facilitate the discussion in RAN4 with considering limited TUs, and [21] argued that minor specification impact such as modified time mask and capability is expected.

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

3.7.1 Proposed way forward

- **Clarify which WG should lead the discussion on whether to support UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case**
  - **RAN1's understanding is that [RAN4 should lead the discussion with considering inputs from RAN1 regarding potential RAN1 impact if any]**
- **Discuss on the potential RAN1 impact for UL Tx switching with multiple TAGs and share the identified RAN1 impact if any with RAN4**

- **[Assuming that UL Tx switching with multiple TAGs would largely increase the complexity of UE and gNB, the number of TAGs should be limited to up to 2 if UL Tx switching with multiple TAGs is supported, and capability aspects may need to be discussed]**
- **[Assuming that longer switching period and interruption due to TA difference between UL carriers for switching, there may be performance degradation which may need to be evaluated in RAN1]**

Feedback Form 17: 3.7.1

1 – Qualcomm India Pvt Ltd We support to limit the TAG number to 2, and we are ok with rest of the proposal.
2 – OPPO We have the same understanding that RAN4 should lead the discussion relating to multi-TAG regardless of 2 bands or more than 2 bands. We are fine with the rest parts of the proposal.
3 – Apple GmbH We are fine with the proposed way forward that basically RAN4 leads the discussion related to multi-TAG for any number of bands
4 – Esurfing IoT China Telecom We prefer RAN1 to discuss the Tx switching mechanism for single TAG scenarios with priority, as the note says the work is limited to RAN4 for 2 bands with multiple TAGs.
5 – Fujitsu Limited Fine with moderator's proposal.
6 – vivo Communication Technology We think mTAG case should be led by RAN4, and RAN1 should focus single TAG case until feedback/request is received from RAN4, the 2nd bullet may not be needed at this stage.
7 – Beijing Xiaomi Electronics We are fine with the proposal.
8 – ZTE Corporation Our proposal is to let RAN4 to lead the multiple TAGs discussion. RAN1 should strive for a solution that is common for both single TAG and multiple TAGs.
9 – LG Electronics Inc. We do not prefer to discuss on UL Tx switching with multiple TAG in RAN1 before starting discussion/-analysis in RAN4. We believe that RAN4 should lead the discussion.

10 – Intel Deutschland GmbH

Our understanding is that whether to support UL Tx switching with multiple TAGs should be discussed in RAN4 first. Given the workload for Tx switching and limited TU, it is not clear to whether we can support such features in Rel-18 multi-carrier Tx switching.

11 – Nokia Corporation

Agree that this is supposed to be a RAN4 discussion as there is no impact to RAN1. It should be given that this is limited to 2 TAG support, and >2 TAGs is out of scope.

12 – Samsung Research America

We think that the question if to support UL Tx switching with multiple TAGs should be discussed in RAN4 first.

13 – HUAWEI TECHNOLOGIES Co. Ltd.

According to the SID, as copied below, the study work for multiple TAG is limited to RAN4 at least for 2-band case. Therefore, we don't feel that the second bullet is in line with the SID.

o *Note: Extension of TX switching for 2 bands to multiple TAG configurations is included in the scope. The work is limited to RAN4.*

Similarly, "potential RAN1 impact" should be removed from the first bullet.

14 – InterDigital Belgium. LLC

OK with the proposal.

15 – Ericsson LM

On the FL proposal, we are fine with proposal in general. But as we explain below, we think RAN1 answer on any potential impact for 2-band case should be clarified in this meeting. Understandably, we can investigate more for 3 and 4 bands cases later.

- We support to limit the maximum number of TAGs to 2.
- Regarding the RAN4 or RAN1 lead work, we would like **to get clear feedback from RAN1 this meeting on the 2-bands case** for the following reasons:
  - Dual TAGs for 2-bands **has been already extensively discussed in RAN4 during Rel-18**. Companies can refer to plenary discussion [95e-39-R17-TEIs]. On the question whether support of 2-TAGs for 2-bands has RAN1 impact, some companies in RAN4 (including Ericsson) have the view that is not the case. They wanted to send LS to RAN1 to ask the question, but some companies didn't agree to send LS and question from RAN1.
  - Therefore, since this topic is going to be visited in next plenary, it is important **to know at this RAN1 meeting if there is any company in RAN1 that assumes support of 2-TAGs for 2-bands has RAN1 impact. We believe not.**
    - The answer to this question should not be related to 3 or 4 bands for the reason explained.

- For 3 or 4 bands, we share the view that RAN4 can lead. But from our view, the progress for 2-bands should not be dependent on the progress for 3 or 4 bands.

16 – Spreadtrum Communications

we share the same view that multiple TAG should be discussed in RAN4 first.

17 – DOCOMO Communications Lab.

We think it should be decided in RAN4 that whether to support mTAG.

On the other hands, we think it would help the discussion in RAN4 to discuss on the potential RAN1 impact for UL Tx switching with multiple TAGs and share the identified RAN1 impact if any with RAN4.

If it is clarified that the impact of the decision to introduce mTAG is significant from the RAN1 perspective, it will obviously have a significant impact on the RAN4 discussion.

Of course, RAN1 should discuss this feature assuming single TAG, first

3.7.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OPPO, FJT, Xiaomi, IDC
  - OK with limiting the TAG number to up to 2
    - QCM, Nokia, E///
  - OK with removing 2nd bullet, i.e., prefer to focus on signle TAG in RAN1 until RAN4 requests RAN1 work
    - CT, vivo, LG, Intel, Samsung, HW, SPRD
  - OK with striving for common solution for both single TAG and multiple TAGs
    - ZTE
  - OK with removing “potential RAN1 impact” from 1st bullet
    - HW
  - OK with clarifying whether there is any RAN1 impact or not for supporting multiple TAGs scenario
    - E///, DCM

It seems all companies are fine to clarify that RAN4 will lead the discussion on whether to support UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case i.e., as in 1st bullet. However, it seems views are almost equally sprit whether we can keep 2nd bullet or not, i.e., whether RAN1 can share some input to RAN4 before RAN4 requests so or RAN1 should wait for RAN4 request. The moderator still thinks that considering the limited TUs for this WI, it is worth correcting companies' views as early as possible.

The moderator would like to ask companies to provide feedback if any on the above summary, following updated FL proposal and question.

Proposed conclusion

- **It is RAN1's understanding that RAN4 should lead the discussion on whether to support UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case**
    - **If RAN4 decides to support UL Tx switching with multiple TAGs, RAN1 considers the number of TAGs should be limited to up to 2**

Question to companies

- **Do you identify any potential RAN1 impact to support UL Tx switching across 2 bands with 2 TAGs?**
- **Do you identify any potential RAN1 impact to support UL Tx switching across 3 or 4 bands with 2 TAGs?**

Feedback Form 18: 3.7.2

1 – Apple GmbH We are fine with FL's proposed conclusion. Regarding the question, I think it can be FFS whether any RAN1 enhancements are needed or not, if multiple TAGs are supported.
2 – LG Electronics Inc. We support the proposed conclusion
3 – China Mobile Com. Corporation We are fine with the proposal. Regarding the questions from FL, since the clarification of switching period time mask is unclear for multiple TAGs, the ambiguity of switching trigger time and UL transmission start time may result in the interruption of data transmission. Thus, if RAN4 decides to support UL Tx switching with multiple TAGs, the switching period time mask for multiple TAGs should be clarified by RAN4
4 – vivo Communication Technology we are fine with the proposed conclusion.

5 – CATT

We are fine with the proposed conclusion. We can further study whether there is RAN1 impact to support UL Tx switching across the bands with multiple TAGs.

6 – Esurfing IoT

China Telecom

We support the proposed conclusion. The potential RAN1 impact of multiple TAGs can be FFS.

7 – MediaTek Inc.

Support the proposed conclusion.

RAN1 impact can be studied once there is progress on UL Tx switching with multiple TAGs.

8 – Beijing Xiaomi Electronics

we are fine with the conclusion.

9 – Intel Deutschland GmbH

We are fine with the proposed conclusion.

10 – HUAWEI TECHNOLOGIES Co. Ltd.

With the latest questions, there seems potential RAN1 impact under consideration. In this case, with limited TU, whether multiple TAG is supported should not be fully up to RAN4, RAN1 should be allowed to have a further study on its feasibility after RAN4 inputs. Therefore, revisions are suggested,

Proposed conclusion

- **It is RAN1's understanding that RAN4 should lead the discussion on ~~whether to support~~ UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case**
- **If ~~RAN4 decides to~~ support UL Tx switching with multiple TAGs, RAN1 considers the number of TAGs should be limited to up to 2**

11 – Ericsson LM

We are in general fine with proposed conclusion. But this conclusion has impact on WID and should be discussed in plenary. We also see at part of that, we have to separate 2-bands case.

On the questions:

- For two bands we dont see any RAN1 impact.
- On 3 or 4 band, it is difficult at this stage to comment.

12 – Samsung Research America We are ok with the FL proposed conclusion.
13 – InterDigital Belgium. LLC Support the FL proposed conclusion.

3.7.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Regarding the proposed conclusion
  - Fine with the FL proposal
    - Apple, LG, CMCC, vivo, CATT, CT, MTK, Xiaomi, Intel, Samsung, IDC
  - Suggest to remove "RAN4 decides" so that RAN1 is allowed to have further study on its feasibility
    - HW
  - Should be discussed in plenary
    - E///
- Regarding questions on potential RAN1 impact
  - It is FFS
    - Apple, CATT, CT, MTK, E// (for 3 or 4 bands)
    - Depends on RAN4's clarification on switching period time mask
      - CMCC
  - No RAN1 impact for 2 bands
    - E///

Based on the above situation, the moderator's proposed conclusion was discussed in the GTW session, but it was not agreed. The moderator would like to ask companies to resume the discussion on following latest version of the proposed conclusion with moderator's suggested modification according to the discussion in GTW session.

Proposed conclusion

- **It is RAN1's understanding that RAN4 should lead the discussion on UL Tx switching with multiple TAGs for both 2 bands case and more than 2 bands case**
    - **At least for UL CA, it is RAN1 understanding that there is no RAN1 specification impact**
    - **For further discussion in RAN1 with regards to UL Tx switching with multiple TAGs, it will be discussed only if triggered by RAN4**
    - **[If it is decided to support UL Tx switching with multiple TAGs, it is RAN1's working assumption that the number of TAGs should be limited to up to 2]**

Feedback Form 19: 3.7.3

1 – Qualcomm India Pvt Ltd

Our understanding is M-TAG may or may not be with RAN1 impact which would depend on whether RAN4 can solely solve the increased switching period issue caused by different TAG. However, we are ok that RAN4 takes the lead of the discussion as this is majority view.

We hesitate to agree on the first bullet without deep analysis & technical discussion in RAN1. Meanwhile, as we don't see any different view on last bullet, we would suggest approving the it in case this would eventually come back to RAN1 per RAN4's request.

All in all, we suggest removing the 1st bullet and approve the rest two bullets without square bracket.

2 – ZTE Corporation

We are ok with the proposal. Also fine to remove the first bullet.

3 – Apple GmbH

In our view, we don't need to make such a strong statement in sub-bullet 1 that we don't see any RAN1 impact. We also agree with Qualcomm that how the different TAGs among the switching carriers are handled by RAN4 solutions may or may not require RAN1 enhancements.

So the proposal can be acceptable to us, if sub-bullet 1 can be removed. It is clearly enough that RAN1 shouldn't spend any time on this unless otherwise triggered by RAN4.

4 – InterDigital Belgium. LLC

We are fine with the proposal. It is ok to remove the first bullet.

5 – Intel Deutschland GmbH

We are fine with the proposal. It is too early to mention no RAN1 impact without detailed analysis in case of mTAG. First sub-bullet is not needed.

6 – Spreadtrum Communications

Support the proposal.

7 – New H3C Technologies Co.

We support this proposal

8 – Beijing Xiaomi Electronics

We are fine with the proposal.

9 – China Mobile Com. Corporation

We are fine with the main bullet of the proposal. We also recommend removing the first sub-bullet. It is premature to make the conclusion that there is no RAN1 impact. Considering the ambiguity issue on switching period time mask for multiple TAGs, whether there is RAN1 specification impact depends on the solutions of RAN4. Thus, we can further discuss RAN1 impact after RAN4 draws conclusion.

10 – vivo Communication Technology

Ok with the proposal. for the first bullet, it should be clarified if the 'UL CA' refers to CA with SL or CA without SUL or both.

11 – Fujitsu Limited

We are OK to remove the first bullet. Other parts look fine.

12 – LG Electronics Inc.

We are fine with the main bullet and the 2nd sub-bullet.

For other sub-bullets,

- One clarification question for the last sub-bullet: Does it mean that RAN1's discussion should be limited to up to 2 TAGs even though RAN4 would proceed discussion (earlier before RAN1 discussion) without considering limitation on the number of TAGs? We failed to see the reason of different assumption on the number of TAGs between RAN1 and RAN4.
- We think the 2nd sub-bullet is sufficient at this stage. It would be better to have the further analysis/clarification (either RAN1 or RAN4) before agreeing the 1st and 3rd sub-bullets.

13 – CATT

We are OK with the proposal.

14 – Esurfing IoT

China Telecom

Remove the first bullet is fine to us.

15 – MediaTek Inc.

No need for the first bullet point. We support the rest of the proposal.

16 – Samsung Research America We can support the FL proposed conclusion with exception of the first sub-bullet. We think it is premature to conclude without a more detailed look first. We also think the sub-bullet is not needed with respect to the remainder of the FL proposed conclusion.
17 – HUAWEI TECHNOLOGIES Co. Ltd. If the first sub-bullet is true, then it is not expected to have further RAN1 discussion as in the second sub-bullet. Therefore, either one of them is suggested to remove. Fine with vivo's suggestion for clarification on UL-CA. The intention of "at least" here is unclear.
18 – Ericsson LM Regarding main bullet and 1st sub-bullet: As discussed in GTW, the case of 2-bands should be clear that there is no RAN1 impact. If the main bullet is removed, we suggest to provide sufficient context for the 1st sub-bullet to clarify that for 2-bands and 2-tags, there is no RAN1 impact. We are fine to extend that for more bands (3 or 4), but if companies need more time, for 3 or 4 bands we can mention "at least for 2 bands", or "FFS for 3 or 4 bands". On 2nd and 3rd sub-bullets, we are fine.
19 – DOCOMO Communications Lab. We are fine with proposed conclusion with removing 1st and 3rd sub-bullets as there are some companies having concerns on the sub-bullets.

3.8 Clarifications on some general assumptions for Rel-18 UL Tx switching

In contributions in AI 9.10.2, following observations and proposals were made regarding some general assumptions for Rel-18 UL Tx switching based on the Rel-16/17 assumptions.

[6]	***For Rel-18 UL Tx switching among 3 bands or 4 bands, the Tx switching scheme can be based on Rel-16/17 UL***
[8]	*Many of the design of UL Tx switching highly depend on RAN4's work. From the RAN1's perspective, some aspects*
[13]	*In Rel-16 and Rel-17, Tx switching from up to two bands to up to two ports for one band is supported. In Rel-18, b*
[18]	***Proposal #2: In case where one Tx chain is on band A and another Tx chain is on band B, when two 1-port UL***

Although some of above proposals seems straightforward assumptions for Rel-18 as well as in Rel-16/17, it would be worth clarifying them. The moderator would like to ask companies to provide feedback if any on the following potential FL proposal.

3.8.1 Proposed agreement

- **Following assumptions are maintained for Rel-18 UL Tx switching across up to 3 or 4 bands**

- **When one of the the two Tx chains is triggered to switch from one band to another band, another Tx chain is also not expected to be used for transmission properly during the switching period.**
    - **E.g., when Tx chain #1 is switching from band A to band B, Tx chain #2 linked to band C is not expected to be used for transmission during the switching period.**
- **Only when the two Tx chains are linked to one NR band, the 2-ports UL transmission on the NR band is possible.**

Feedback Form 20: 3.8.1

1 – Qualcomm India Pvt Ltd The first sub-bullet would rely on the UE implementation, and same consideration for the example. We think it would be better we firstly discuss and reach the consensus on which switching cases should be supported (e.g. whether the example is a valid case). The second sub-bullet seems straightforward.
2 – OPPO Agree. We suppose all bullets are conditioned on "if Rel-18 UL Tx switching across up to 3 or 4 bands" is supported.
3 – Apple GmbH Support the proposed agreement with "if supported"condition in the main bullet.
4 – Beijing Xiaomi Electronics For the first subbullet, we agree with Qualcomm it is relevant to UE implementation. It may be a little early to make such a conclusion at this stage.
5 – Beijing Xiaomi Electronics We are generally fine with the proposal. For the first sub-bullet, we think alternative 1 should be the most straightforward mechanism. We do understanding the concern on the UE complexity. We are open to discuss the other alternatives. For the second sub-bullet, we share the same views with Qc/OPPO. Besides, my understanding on the first four sub-subbullets under the second sub-bullet are related to alternative 1. If so, we think alternative 1 is the better place to capture this mechanisms for UE complexity reduction.
6 – ZTE Corporation The first bullet needs to be checked with RAN4 first. The second bullet seems not necessary.

7 – LG Electronics Inc.

The case of the first sub-bullet (i.e., one of the two Tx chains is triggered to switch from one band to another band) may depends on the UE's capability for the band combination. For UL Tx switching in 2 bands, it is obvious both 2 bands are limited to be used for UL transmission during switching period because each band corresponds to either switch-from band or switch-to band. However, in the example of the proposal, band C is neither switch-from nor switch-to band, so it may need to be clarified whether UL transmission even on the band C also requires to be limited when the Tx chain is switched from band A to band B. We can further discuss it after reaching a consensus on which UL Tx switching scenarios/conditions are supported in Rel-18.

8 – vivo Communication Technology

The first bullet: on one hand, this assumption is straightforward and simple from the perspective of UE implementation, and it also helps to simplify the discussion of TX switching on 3 or 4 bands. one the other hand, we understand companies' comments that if TX handling may be also related to other aspects such as the band for transmission, TX design, UE implementation, etc. We, therefore, suggest that at least UE following this assumption can be considered as a basic UE capability. And then we can further discuss if to consider other assumptions with which advanced or higher flexibility for TX handling can be supported.

The 2nd bullet: OK

9 – Intel Deutschland GmbH

We are generally fine with the proposal. We share similar view as OPPO that "if supported" needs to be included.

10 – Nokia Corporation

Agree with Qualcomm, maybe premature to commit to the 1st bullet, and the 2nd bullet is obvious to the point of being unnecessary - two port transmissions are only possible when there are two ports on the carrier.

11 – Samsung Research America

We are fine with the FL proposal.

12 – HUAWEI TECHNOLOGIES Co. Ltd.

The first bullet is not necessary. Because RAN4 sent LS to RAN1 in Rel-16 that once UL Tx switching is triggered, all ULs are interrupted. A new agreement is not needed.

13 – InterDigital Belgium. LLC

Agree with Qualcomm and others that the first bullet is premature.

14 – DOCOMO Communications Lab.

We support proposal and are OK with OPPO's revision that "if supported" needs to be included.

3.8.2 2nd round discussion

1st round feedbacks can be summarized as below.

- Support
  - OK with adding "If Rel-18 UL Tx switching is supported"
    - OPPO, Apple, Intel, Samsung, DCM
  - OK with only 2nd bullet
    - QCM, Xiaomi, HW, IDC
  - OK with making 1st bullet as "at least considered as basic UE capability" and adding FFS for other assumptions
    - vivo
- Not support
  - ZTE, Nokia

Regarding the 1st bullet, although some companies commented it is premature to decide, it seems this assumption can be considered as baseline as suggested by vivo according to Rel-16/17 assumptions. We can make it as working assumption and other assumptions can also be considered with UE capability.

Regarding the 2nd bullet, some companies pointed it is quite straightforward and obvious, while other companies seem to be ok to have clarification just for sure.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **If Rel-18 UL Tx switching is supported, following assumptions are applied for Rel-18 UL Tx switching across up to 3 or 4 bands**
  - **Only when the two Tx chains are linked to one NR band, the 2-ports UL transmission on the NR band is possible**
  - **(Working assumption) It is assumed as a baseline UE capability that when one of the the two Tx chains is triggered to switch from one band to another band, another Tx chain is also not expected to be used for transmission properly during the switching period**
    - **Other advanced UE capability/assumption can also be considered**

Feedback Form 21: 3.8.2

1 – Apple GmbH

We don't prefer to add any text related to baseline or advanced UE capability. Either the earlier version of this bullet from previous round is acceptable or we can simply remove this entire bullet for now from the proposed agreement.

2 – LG Electronics Inc.

We support the proposal.

We fully understood that many companies prefer to follow the general assumptions made in Rel-16/17 with 2 bands. Meanwhile, it is also necessary to consider that the situation has a bit changed in Rel-18 as the number of applicable bands increases. For the sake of the progress, we can accept the WA proposed by the moderator.

3 – vivo Communication Technology

We support FL's proposal

4 – CATT

We support the proposal.

5 – MediaTek Inc.

Support.

6 – Beijing Xiaomi Electronics

The word 'properly' in the second subbullet is a little bit confusing. I think the intention is the second Tx chain is interrupt during the switching period of the first Tx chain. Hence we propose to delete 'propoerly'. We are fine with others.

7 – Intel Deutschland GmbH

We are fine with the proposal.

8 – HUAWEI TECHNOLOGIES Co. Ltd.

As commented before, the second sub-bullet is unnecessary. It has been agreed in RAN4, as copied below. It should be reused in Rel-18. If any new agreement for this perspective is needed for Rel-18, it should be discussed in RAN4.

LS R4-2103234

· UL outage due to switching

– **Reuse Rel-16 agreement for UL CA and SUL, i.e., UL outage due to switching is applicable to both carrier 1 and carrier 2**

9 – Samsung Research America

We support the FL proposed agreement.

10 – InterDigital Belgium. LLC Support the FL proposed agreement.
11 – DOCOMO Communications Lab. We support the proposal.

3.8.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - LG, vivo, CATT, MTK, Intel, Samsung, IDC, DCM
  - Suggest to remove "properly"
    - Xiaomi
- Not fine with the FL proposal
  - Should remove WA part
    - Apple, HW

There are two companies not fine with the working assumption part, but their arguments are different. Apple prefers previous version of the description i.e., agreeing on the "baseline" behavior only. Huawei argues that it is unnecessary as the "baseline" behavior was agreed in RAN4 for 2 bands case and hence it should be discussed in RAN4. The moderator thinks that it seems common preference to adopt at least the "baseline" behavior in WA part for Rel-18, while some companies would think it may be too early. However, considering limited TUs and this WI is RAN1 led item different from Rel-16/17 UL Tx switching, the moderator suggest to make the working assumption as "RAN1's understanding" so that RAN4 can also discuss and revert the WA if necessary.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **If Rel-18 UL Tx switching is supported, following assumptions are applied for Rel-18 UL Tx switching across up to 3 or 4 bands**
  - **Only when the two Tx chains are linked to one NR band, the 2-ports UL transmission on the NR band is possible**
  - **(Working assumption) It is RAN1's understanding that the following assumption can be considered as a baseline UE capability/assumption for Rel-18 UL UL Tx switching across up to 3 or 4 bands**

- **When one of the the two Tx chains is triggered to switch from one band to another band, another Tx chain is also not expected to be used for transmission during the switching period**
    - **Other advanced UE capability/assumption can also be considered with RAN4 inputs if necessary**

Feedback Form 22: 3.8.3

1 – Qualcomm India Pvt Ltd The first bullet is ok. The second bullet should rely on UE implementation (to be discussed in RAN4) and the supported switching scenarios & restrictions to be agreed. We would suggest leaving it for future discussion and work with RAN4 on the UE implementation.
2 – ZTE Corporation We are still not clear why RAN1 should discuss the interruption issue. We think the second bullet should be discussed in RAN4 instead of RAN1.
3 – Apple GmbH Similar views as earlier commented and agree with Qualcomm and ZTE that the second bullet be better discussed in RAN4. We can take the first bullet as the agreement
4 – InterDigital Belgium. LLC Support updated FL proposal.
5 – Intel Deutschland GmbH We are fine with the proposal.
6 – New H3C Technologies Co. We are fine with first bullet and then second bullet should be discussed by RAN4.
7 – Beijing Xiaomi Electronics Share similar views with Qualcomm
8 – vivo Communication Technology Support the proposal. This assumption is not only about whether the UL using another TX is interrupted by the TX with ongoing switching when configuring 3 or 4 bands, specifically, it is also related to switching cases and UE states which would be discussed in RAN1. Although the LS R4-2103234 cited by Huawei is for R17 with 2 bands, in which case the UL outage due to switching applies to both carrier 1 and carrier 2. Thus, we think it can be used as a baseline for R18 discussion.

9 – LG Electronics Inc. We support the moderator's updated proposal. It seems that the confirmation of RAN4 in R4-2103234 is about UL outage due to switching between 2 carriers. We are not sure if this can be directly applied to a switching case that one Tx chain is switched from one band to another band while the other Tx chain in the 3rd band is not involved in that switching. At this time, it would be good to have a working assumption on a baseline UE capability/assumption and to further discuss on the advanced UE capability/assumption, as FL suggested in current proposal.
10 – CATT We are fine with the updated proposal.
11 – Esurfing IoT We are fine with the proposal.
12 – MediaTek Inc. Fine with the proposal.
13 – Samsung Research America Ok for us.
14 – DOCOMO Communications Lab. Support in principle. As mentioned by some companies, in our understanding, we have no consensus regarding whether UL outage in Rel-16 can be reused for Rel-18. Thus, we need to support this proposal as baseline. otherwise, we need to wait for RAN4 output, then it would be late to discuss it.

4 Discussions on mechanisms for Rel-18 multi-carrier UL Tx switching

4.1 Potential mechanisms for dynamic Tx carrier switching across the configured bands

As described in the WID, mechanisms for dynamic Tx carrier switching across the configured bands can be studied. In Rel-16/17 UL Tx switching between 2 bands, dynamic Tx carrier switching is performed based on the UL scheduling i.e., via UL grant and/or RRC configuration for UL transmission. For Rel-18 UL Tx switching, it is not clarified in the WID whether to reuse the mechanism or to introduce new mechanism considering the switching across larger number of bands than that in Rel-16/17.

In contributions in AI 9.10.2, following observations and proposals were made regarding mechanisms for dynamic Tx carrier switching across the configured bands.

[4]	***Observation 2: For uplink CA option 1 and SUL, transmission switching time is triggered whenever current UL***
[5]	*For the Rel-18 UL Tx switching, there could be two potential frameworks to achieve the objective. Framework#1:*
[6]	***For Rel-18 UL Tx switching among 3 bands or 4 bands, the Tx switching scheme can be based on Rel-16/17 UL***
[7]	*If the cases showed in the Table 1 and Table 2 are adopt for inter-band UL CA option1, the UE will be not expecte*
[8]	***Proposal 2: The Tx switching between different cases for 3 or 4 bands can at least include Scenario 1: Switchin***
[9]	***Proposal 8: For inter-band UL CA Option 1 with and without SUL, if Tx switching across 3 or 4 bands is confi***
[10]	***Proposal 1: Introduce a capability signal where UE declare what antenna combinations support simultaneous o***
[11]	*Regarding to the mechanism of indicating UL Tx switching, UE can get the message of UL Tx switching via UL gr*
[12]	*For the UE implementation, increasing the number of times the Tx chain(s) must be switched across the configurea*
[14]	*Another possible approach to support UL Tx switching is to specify which UL carriers or resources are to be used*
[16]	*Option 1. Dynamically indicate carriers/bands combination out of 3 or 4 candidate bands for UL Tx switching by*
[17]	*Based on above, for Rel-18 UL Tx switching across up to 3 or 4 bands, RAN1 should discuss following points whil*
[18]	*Now in Rel-18, it is supposed to discuss about UL Tx switching across up to 3 or 4 bands to support more configur*
[19]	*Supporting the switching between all these cases could be challenging for most of the UEs. Also, from network ope*
[21]	*Another observation is the large number of cases for 3, and specially 4 bands. It is important to study whether all*
[22]	*From UE perspective, a CA capable UE needs to keep sufficient memory and processing capability to handle data*

Based on above, the situation can be summarized as below.

- Potential mechanisms for dynamic Tx carrier switching across the configured bands in Rel-18
  - **Alt.1: Dynamic Tx carrier switching can be across all the configured bands (3 or 4 bands) and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission**
    - Argued by Huawei/HiSilicon, Spreadtrum, CATT, vivo, China Telecom, Xiaomi, Samsung, InterDigital, CMCC, DOCOMO, MediaTek
    - It would be the straightforward extension from Rel-16/17 and is considered/assumed by many companies, while some companies pointed that this extension would cause the increase of complexity due to larger number of bands. In addition, this alternative requires some mechanism for the issue on ambiguous switching state due to larger number of switching states.
    - Considering UE/gNB complexity, some potential solutions are proposed as below.
      - **UE can report the supports of only some of concurrent UL cases (combinations of 2 bands for concurrent UL transmissions)**
        - Argued by Huawei/HiSilicon, Sony, LG, MediaTek
      - **0/1/2 port switching is supported for only 2 configured bands out of 3 or 4 configured bands**
        - Argued by Samsung, Sony
      - **only 0/1 port switching is supported across all configured bands when 3 or 4 bands are configured**

        - Argued by Samsung

    - **prioritization rules between uplink carriers are specified**

        - Argued by InterDigital, LG

- **Alt.2: NW indicates 2 bands out of the configured bands (3 or 4 bands) via DCI or MAC-CE, and dynamic Tx carrier switching between indicated bands is same as Rel-17**

    - Argued by ZTE, CMCC, LG, Ericsson, (Samsung)
    - It is argued that this alternative can fully reuse the Rel-17 mechanism/cases and can minimize the standardization effort to designing the indication of 2 bands out of the configured bands. In addition, it is also argued that this alternative framework is agnostic with the number of bands.

- **Alt.3: One anchor band is selected among configured bands (3 or 4 bands), and dynamic Tx carrier switching can be performed only from the anchor band to a non-anchor band and from a non-anchor band to the anchor band**

    - Argued by Qualcomm
    - It is argued that this alternative is one possible method to simplify UE implementation, and following solutions are also proposed considering UE implementation complexity.

        - **No restriction on the UEs choice of MIMO capability on any of the bands/CCs involved in the UL Tx switching band combination is introduced**
        - **After one RF state switch, the next RF state switch must occur after 14 symbols or later**

            - QCM proposed which SCS is assumed for the symbol duration is FFS, while Xiaomi proposed to assume largest SCS for the symbol duration

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

4.1.1 Proposed agreement

- **Following possible mechanisms for dynamic Tx carrier switching across the configured bands are considered and the down-selection will be done at RAN1#110**

    - **Alt.1: Dynamic Tx carrier switching can be across all the configured bands (3 or 4 bands) and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission**
    - **Alt.2: NW indicates 2 bands out of the configured bands (3 or 4 bands) via DCI or MAC-CE, and dynamic Tx carrier switching between indicated bands is same as Rel-17**
    - **Alt.3: One anchor band is selected among configured bands (3 or 4 bands), and dynamic Tx carrier switching can be performed only from the anchor band to a non-anchor band and from a non-anchor band to the anchor band**

- **Other mechanisms are not precluded**

– **RAN1 should strive for supporting a solution(s) to address the concern on UE/gNB complexity increase due to UL Tx switching across larger number of bands compared with Rel-16/17, and following candidate solutions are considered**

  - **UE can report the supports of only some of concurrent UL cases (combinations of 2 bands for concurrent UL transmissions)**
  - **0/1/2 port switching is supported only for 2 configured bands out of 3 or 4 configured bands**
  - **Only 0/1 port switching is supported across all configured bands when 3 or 4 bands are configured**
  - **Prioritization rules between uplink carriers are specified**
  - **No restriction on the UEs choice of MIMO capability on any of the bands/CCs involved in the UL Tx switching band combination is introduced**
  - **After one RF state switch, the next RF state switch must occur after 14 symbols or later (FFS: which SCS is assumed for the symbol duration)**
  - **Other solutions are not precluded**

Feedback Form 23: 4.1.1

1 – Qualcomm India Pvt Ltd

For the first bullet, we are ok to down-select among the alternatives. Given quite a few companies showing concerns on potential exponential increased complexity by fully dynamic switching among 3 or 4 bands, we would suggest RAN1 considering precluding Alt 1 for progress.

For the second bullet, we support the principle that the solution should address the concern on implementation complexity. We have concern on define "prioritization rule between uplink carriers" as this violates current principle that "network guarantee no conflict scheduling decision" and would require a large RAN1 workload to work out a priority rule.

2 – OPPO

We are ok with the most parts of proposal, except:

1) For the second sub-bullet, we share the same view as Qualcomm on "prioritization rule between uplink carriers". We suppose multiple concurrent uplink transmissions should be avoided by gNB. Maybe this sub-bullet can be removed.

2) "**down-selection will be done at RAN1#110**" is a bit strong promise. It is better to say "RAN1 strives to down-select at RAN1 #110".

3 – Apple GmbH

- On the first bullet, we do not support Alt 1 as this will have the significant impact on UE complexity. Regarding Alt 3, we are not sure how much it helps to reduce the UE complexity and furthermore, it might require additional specification efforts to specify anchor bands. In our view, Alt-2 is the

most preferred option. This provides the dynamic flexibility to indicate 2 bands from a set of 3 or 4 configured bands. And it doesn't require introduction of any new switching cases or long switching gaps. Mostly, Rel-17 cases can be reused.

- Regarding second bullet, we share similar concern as Qualcomm and Oppo that introducing any prioritization rule for switching between UL carriers will significantly increase the RAN1 workload.
- Also agree with Oppo that wording in terms of timeline can be relaxed. Considering that the decisions in RAN1 may rely on inputs from RAN4, so achieving down-selection by RAN1#110 might not be realistic.

4 – Esurfing IoT

China Telecom

We are OK for the first bullet listed the alternatives for down-selection, but prefer remove the second bullet at this stage. Some of the details in the second bullet relate to which Alt is chosen from the first bullet from our understanding. Alternatives from the first bullet need to be discussed firstly.

5 – Fujitsu Limited

We think the moderator's proposal is a good starting point of our discussion.

6 – vivo Communication Technology

For the first bullet, we are open to studying the alternatives for down selection

For the second bullet, it is premature to discuss these detailed solutions at the very first meeting, we suggest removing it. More specifically,

1. the first sub-bullet is subjected to UE capability, which can be discussed later
2. benefits of restriction in 2nd or 3rd sub-bullets are not clear to us
3. for the 4th sub-bullet, we have a similar view as Qualcomm, there should be no Prioritization rules between uplink carriers.

7 – ZTE Corporation

Regarding the first bullet, we think the down-selectoin should be done as soon as possible because this will impact the subsequent discussion. For example, if Alt.1 is adopted, RAN1 needs to discuss all these different tables for swtiching cases. However, if Alt.2 is adopted, this kind of time-consuing discussion can be avoided and RAN1 only needs to determine how to indicate the 2 bands.

Regarding the second bullet, we prefer to delete it because if Alt.2 is adopted, these complexisity doesn't exist any more. Or we can list these aspects under Alt.1.

Among the three alternatives, we support Alt.2 because it can fully reuse the Rel-16/17 UL Tx switching scheme and it is a common solution for 3 bands and 4 bands.

8 – LG Electronics Inc.

- For the first bullet: We support Alt 1 as a baseline of mechanisms for dynamic Tx carrier switching. We believe that one of the main advantages of Rel-18 UL Tx switching is the potential gain from the increased scheduling flexibility by extending the number of bands which Tx switching can occur. From this point of view, limiting back to 2 bands or fixing 1 band only on which UL Tx switching is restricted, may not be the way to achieve this potential gain. In order to obtain all meaningful

switching gains in up to 4 bands shown by several companies' contributions, we believe all possible cases for UL Tx switching should be discussed.

- For the second bullet: We have a similar view with China Telecom. It is a bit premature to exclude certain candidate solutions at this point even though the first bullet is not sufficiently discussed.

9 – Intel Deutschland GmbH

We are generally fine with the first bullet. We support Alt 1 for Rel-18 multi-carrier Tx switching as this is a general framework for Tx switching to exploit the benefit. We can further discussion restriction on the combinations depending on UE capability.

For the second bullet, it seems to us too early to discuss this before we can conclude some high level design first

10 – Nokia Corporation

We are generally fine with the 1st bullet and its sub-bullet, although it maybe a tall order to call for a down-selection in the next RAN1 meeting. We would see the Alt1 offering the best flexibility, but would need to better understand if it is possible to expect multi-band UL Tx Switching UEs to two PAs that are capable of transmitting on all the bands in the band combination.

On the second main bullet, this is a "RAN1 should strive for" proposal that, if agreed, carries very little weight. Suggest not discussing it further.

11 – Samsung Research America

We support the FL proposal.

12 – HUAWEI TECHNOLOGIES Co. Ltd.

Above all, when companies raised UE complexity issue for UL Tx switching, UL-CA dualUL (Option2), instead of switchedUL (Option1)/SUL, seems the targeted scheme. **We suggest companies to clarify the targeted scheme in the future if any UE complexity concern is raised.**

1. For switchedUL (Option1), the switching is always between two bands, the source band and the target band. But the switching for dualUL (Option2) may be between three bands. Therefore, Alt 2 is motivated for the 3-band switching but is unnecessary for Option1 because such two-stage indication can always be simplified to one-stage indication with less signaling latency and less uplink interruption. Additionally, the benefit of Alt 3 seems only to preclude some concurrent transmission between non-anchor bands which never occurs in Option 1. There is no clear motivation to have Alt 3 for Option 1. **Therefore, Alt 1 seems the only choice for Option 1. We suggest to adopt Alt 1 for Option 1 now and save the down-selection only for Option 2.** If it is not agreeable, separate down-selection for Option 1 and Option 2 cannot be precluded. A note to clarify it seems necessary, i.e. separate down-selection for switchedUL and dualUL is not precluded.

2. 0/1/2 port switching seems not a clear definition, a clarification is suggested or a tdoc reference can be added.

3. Many alternatives seem just scheduling restrictions. Too many restrictions may lead to reduced scheduling flexibility and performance reduction. Therefore, **we suggest to add a note as follows:**

- Note: performance reduction caused by any scheduling restriction should be taken into account in the down-selection.

4. Suggest to remove “and/or RRC configuration” from Alt.1, because it is not any further Rel-18 enhancement but has been supported by Rel-17.

13 – InterDigital Belgium. LLC

We are fine with the FL proposal. We prefer to keep all the alternatives open at this stage, including prioritization rules.

We think scheduling flexibility is important to yield significant benefits with this feature, and therefore Alt. 1 is preferred.

14 – Ericsson LM

The FL proposals provides a good structure for the work.

It seems companies have different preferences and nothing can be down selected.

15 – Spreadtrum Communications

Support the proposal.

16 – DOCOMO Communications Lab.

For the first bullet, we support this proposal as a framework to discuss switching mechanisms.

For the second bullet, we think it should be discuss to solve concerns about implementation complexity raised from some companies, regardless of whether Alt 1, 2, or 3 is decided in the first bullet.

4.1.2 2nd round discussion

1st round feedbacks can be summarized as below.

- For 1st bullet
  - OK
    - CT, FJT, vivo, LG, Intel, Nokia, Samsung, IDC, E///, SPRD, DCM
  - Not support Alt.1
    - QCM, Apple, ZTE
  - Support Alt.1
    - LG, Intel, HW(at least for switched UL), IDC
  - Not support Alt.3
    - Apple, ZTE
  - Down-selction at RAN1#110 should be best-effort

    - OPPO, Apple

  - Clarify separate down selection for switched UL and dual UL is not precluded

    - HW

- For 2nd bullet

  - OK

    - FJT, Samsung, IDC, E///, SPRD, DCM

  - Not support "prioritization rule between uplink carriers are specified"

    - QCM, OPPO, Apple, vivo

  - Should be listed under Alt.1 in 1st bullet

    - ZTE

  - Tdoc reference can be added for each candidate

    - HW

  - Add a note "performance reduction caused by any scheduling restriction should be taken into account for down selection"

    - HW

  - Not support (too early)

    - CT, vivo, ZTE, LG, Intel, Nokia

The moderator would like to clarify that both bullets are listing all proposals from contributions submitted in this meeting, i.e., nothing is precluded. The intention of this proposal is to encourage companies to investigate which mechanism is better/necessary and to provide such analysis in their contributions for next meeting to facilitate the discussion. For many companies, this meeting is the first time to see some proposals and it is good to emphasize all proposals on the table to facilitate the discussion considering limited TUs for this WI. So, the moderator would like to reflect only some comments for clarifications and would like to ask companies to consider proposals from other companies for further investigation towards next meeting.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **Companies are encouraged to investigate pros and cons of following possible mechanisms for dynamic Tx carrier switching across the configured bands, and RAN1 strives for the down-selection at RAN1#110**

- **Alt.1: Dynamic Tx carrier switching can be across all the configured bands (3 or 4 bands) and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission**
- **Alt.2: NW indicates 2 bands out of the configured bands (3 or 4 bands) via DCI or MAC-CE, and dynamic Tx carrier switching between indicated bands is same as Rel-17**
- **Alt.3: One anchor band is selected among configured bands (3 or 4 bands), and dynamic Tx carrier switching can be performed only from the anchor band to a non-anchor band and from a non-anchor band to the anchor band**
- **Note: Other mechanisms are not precluded**
- **Note: separate down-selection for switched UL and dual UL is not precluded**

- **RAN1 should strive for supporting a solution(s) to address the concern on UE/gNB complexity increase due to UL Tx switching across larger number of bands compared with Rel-16/17, and companies are encouraged to investigate pros and cons of following candidate solutions**
  - **UE can report the supports of only some of concurrent UL cases (combinations of 2 bands for concurrent UL transmissions)**
  - **Switching across 0/1/2 ports is supported only for 2 configured bands out of 3 or 4 configured bands and other bands support switching across 0/1 port only**
  - **Only switching across 0/1 port is supported across all configured bands when 3 or 4 bands are configured**
  - **Prioritization rules between uplink carriers are specified**
  - **No restriction on the UEs choice of MIMO capability on any of the bands/CCs involved in the UL Tx switching band combination is introduced**
  - **After one RF state switch, the next RF state switch must occur after 14 symbols or later (FFS: which SCS is assumed for the symbol duration)**
  - **Note: Other solutions are not precluded**
  - **Note: In addition to the UE/gNB complexity reduction, performance reduction caused by any scheduling restriction can also be taken into account for down-selection**

Feedback Form 24: 4.1.2

1 – Apple GmbH Although, our first preference would be to narrow down the list of options based on comments from previous round. However, considering this is just the first meeting, we are fine to list all potential options for further study.
2 – LG Electronics Inc. We agree with the moderator's assessment and support the proposal.

3 – China Mobile Com. Corporation

We are fine to further study the possible options above.

4 – CATT

We are fine with the proposal.

5 – Esurfing IoT

China Telecom

Thanks moderator for listing all the all proposals from contributions. We think alternatives from the first bullet should be focused and discussed firstly. Depending on the Alt chosen, mechanism(s) in the second bullet may or may not be necessary.We prefer not make the second bullet as agreement before the decision of the first bullet.

6 – Beijing Xiaomi Electronics

Sorry for putting our comments on the wrong place in the first round discussion. We are OK with the proposal and to make a down-selection in the future.

7 – MediaTek Inc.

We have concern on the assumptions for this proposal. If the UE support switching between 4 bands (as an example), this doesn't imply that the UE support all the 10 switching cases.

Thus, instead of saying:

- "Alt.1: Dynamic Tx carrier switching can be across all the configured bands (3 or 4 bands) and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission"

We should have something like the following:

- "Alt.1: Dynamic Tx carrier switching can be across all the **supported switching cases by the UE** and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission"

8 – Intel Deutschland GmbH

We tend to agree with China Telecom that it would be good to first decide on the first bullet. The second bullet can be considered at the later stage

9 – InterDigital Belgium. LLC

Support the FL proposal.

10 – DOCOMO Communications Lab.

Support the proposal.

We believe the second bullet is important to consider which alt in first bullet should be selected.

From the discussion so far, it is clear that several companies concerned about complexity as a discussion point for selecting alt in the first bullet.

Thus, both first and second bullet should be supported to facilitate discussion for selecting Potential mechanisms for Rel-18 Tx switching .

4.1.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - Apple, LG, CMCC, CATT, Xiaomi, IDC, DCM
  - Only for first bullet (mechanims) and second bullet (solutions for complexity reduction) should be discussed after the decision on first bullet
    - CT, Intel
  - Should change "configured bands (3 or 4 bands)" to "supported switching cases by the UE"
    - MTK

Based on the above situation, the moderator thinks the first bullet and the second bullet can be checked separately. The moderator still believes that it is good to emphasize all proposals on the table to facilitate the discussion considering limited TUs for this WI. Therefore, it would be good if both bullets can be agreed in this meeting.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **Companies are encouraged to investigate pros and cons of following possible mechanisms for dynamic Tx carrier switching across the configured bands, and RAN1 strives for the down-selection at RAN1#110**
  - **Alt.1: Dynamic Tx carrier switching can be across all the supported switching cases by the UE and based on the UL scheduling, i.e., via UL grant and/or RRC configuration for UL transmission**
  - **Alt.2: NW indicates 2 bands out of the configured bands (3 or 4 bands) via DCI or MAC-CE, and dynamic Tx carrier switching between indicated bands is same as Rel-17**

- **Alt.3: One anchor band is selected among configured bands (3 or 4 bands), and dynamic Tx carrier switching can be performed only from the anchor band to a non-anchor band and from a non-anchor band to the anchor band**
- **Note: Other mechanisms are not precluded**
- **Note: separate down-selection for switched UL and dual UL is not precluded**

Proposed agreement

- **RAN1 should strive for supporting a solution(s) to address the concern on UE/gNB complexity increase due to UL Tx switching across larger number of bands compared with Rel-16/17, and companies are encouraged to investigate pros and cons of following candidate solutions**
  - **UE can report the supports of only some of concurrent UL cases (combinations of 2 bands for concurrent UL transmissions)**
  - **Switching across 0/1/2 ports is supported only for 2 configured bands out of 3 or 4 configured bands and other bands support switching across 0/1 port only**
  - **Only switching across 0/1 port is supported across all configured bands when 3 or 4 bands are configured**
  - **Prioritization rules between uplink carriers are specified**
  - **No restriction on the UEs choice of MIMO capability on any of the bands/CCs involved in the UL Tx switching band combination is introduced**
  - **After one RF state switch, the next RF state switch must occur after 14 symbols or later (FFS: which SCS is assumed for the symbol duration)**
  - **Note: Other solutions are not precluded**

Feedback Form 25: 4.1.3

1 – Qualcomm India Pvt Ltd We are ok with the proposal.
2 – ZTE Corporation For the first proposal: We don't support the last note. We are not sure about companies' intention here. It is argued that TU is limited and common solution should be strived, we don't understand why companies propose to have separate scheme for Option1 and Option2. For the second proposal: We propose to list this as a proposal in chair note, we don't need to agree on anything here because most of bullets are too broad and it is not clear what it means, e.g., prioritization rules.
3 – Apple GmbH We are fine with the proposal

4 – InterDigital Belgium. LLC

Fine with the proposal.

5 – Intel Deutschland GmbH

We are fine with the first proposal. We may need further discussion on the second proposal.

6 – Spreadtrum Communications

Support the proposals.

7 – New H3C Technologies Co.

we are fine this proposal

8 – Beijing Xiaomi Electronics

We are generally fine with these two proposals. One clarification: the second proposal can be applied to alt1 only or it can be equally applied to alt1-alt3 in the first proposal?

9 – China Mobile Com. Corporation

We are fine with the proposal.

10 – vivo Communication Technology

For the first proposal: ok

For the 2nd proposal: as we commented before, some bullets are not clear for further study. We agree with ZTE's suggestion to list it in the chairman's note just for reference.

11 – Fujitsu Limited

We are fine with the propsoal

12 – LG Electronics Inc.

We are fine with both proposals with the understanding that the intentions are to list all proposals of contributions and to encourage companies to investigate which mechanism is better/necessary.

In addition, it seems the following Note of the previous proposal is missing in the updated proposal, which can be an important aspect to down-select with consideration of a balance between the potential complexity and performance gains.

- *"Note: In addition to the UE/gNB complexity reduction, performance reduction caused by any scheduling restriction can also be taken into account for down-selection"*

13 – CATT

We are OK with the both of proposals for further down-selecting in the next meeting.

14 – Esurfing IoT China Telecom We are fine with the first proposal. We do not think the second proposal relates to all the alternatives of the first proposal. It can be further discussed after the Alt is down selected.
15 – MediaTek Inc. Fine with the proposal.
16 – Samsung Research America We are ok with the FL proposed agreements.
17 – Ericsson LM We are fine with the proposal,
18 – HUAWEI TECHNOLOGIES Co. Ltd. OK with the second proposal. But it is unclear for us why the second, third and fifth bullet in the second proposal has additional RAN1 impact. They seem only UE capability. For the first proposal, Alt 2 has no benefit at all for UL-CA Option1 as commented before. For Alt 3, it is proposed only for UL-CA Option 2 in its tdoc, which seems not necessary for UL-CA Option 1 either. However, for progress, we can live with the last note in the proposal.
19 – DOCOMO Communications Lab. We support first and second proposal.

4.2 Potential switching configuration(s) to be supported for Rel-18 UL Tx switching

In Rel-16, it was assumed that one of the two Tx chain is fixed to one band and another Tx chain can switch between the band and another band, i.e., called as 1Tx-2Tx switching. In Rel-17, in addition to the 1Tx-2Tx switching, 2Tx-2Tx switching where both of two Tx chains can switch between 2 bands was supported. For Rel-18, it is not clarified in the WID that which switching configuration(s) is/are supported.

In contributions in AI 9.10.2, following observations and proposals were made regarding potential switching configuration(s) to be supported for Rel-18 UL Tx switching.

[4]	*Note 1: A UE may only support 1 Tx in any one of three bands so that there is only 1 antenna in the band. For exa*
[5]	***Observation 5**: If framework#1 is adopted, all the 32 different combinations should be considered for Rel-18 UL*
[9]	*The above mapping cases in proposal 4~7 are listed considering each band can support maximum 2Tx chain. If th*
[17]	***Proposal 2:** For Rel-18 UL Tx switching, following candidate switching configurations should be considered fo*
[21]	*One can also consider assuming the cases that only one TX chain can be switched, or for switching across 4 bands*
[24]	*Implementations and band combinations where one Tx is is able to transmit on a subset of bands of a band combin*

Based on above, the situation can be summarized as below.

- Potential switching configuration(s) to be supported for Rel-18 UL Tx switching
  - **For 3 bands case**
    - **Switching configuration.3-1: Both of two Tx chains can switch to any of 3 bands (e.g., all the 3 bands support up to 2Tx)**
    - **Switching configuration.3-2: Only one of two Tx chains can switch to any of 3 bands**
      - 3-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 3 bands support up to 2Tx)
      - 3-2-2: another Tx chain can switch between 2 bands out of 3 bands (e.g., only 2 bands out of 3 bands support up to 2Tx)
    - **Switching configuration 3-3: Both of two Tx chains can switch across subset of 3 bands**
      - 3-3-1: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain can switch between 2 bands (e.g., A and C) out of 3 bands
      - 3-3-2: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain is fixed to another band (e.g., C)
  - **For 4 bands case**
    - **Switching configuration.4-1: Both of two Tx chains can switch to any of 4 bands (e.g., all the 4 bands support up to 2Tx)**
    - **Switching configuration.4-2: Only one of two Tx chains can switch to any of 4 bands**
      - 4-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 4 bands support up to 2Tx)
      - 4-2-2: another Tx chain can switch between 2 bands out of 4 bands (e.g., only 2 bands out of 4 bands support up to 2Tx)
      - 4-2-3: another Tx chain can switch between 3 bands out of 4 bands (e.g., only 3 bands out of 4 bands support up to 2Tx)
    - **Switching configuration 4-3: Both of two Tx chains can switch across subset of 4 bands**
      - 4-3-1: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 3 bands (e.g., A, B and D) out of 4 bands
      - 4-3-2: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 2 bands (e.g., A and D) out of 4 bands
      - 4-3-3: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain is fixed to another band (e.g., D)
      - 4-3-4: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 4 bands while another Tx chain can switch between 2 bands (e.g., C and D) out of 4 bands

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

4.2.1 Proposed agreement

- **Following possible switching configurations are considered and the down-selection will be done at RAN1#110**
  - **For 3 bands case**
    - **Switching configuration.3-1: Both of two Tx chains can switch to any of 3 bands (e.g., all the 3 bands support up to 2Tx)**
    - **Switching configuration.3-2: Only one of two Tx chains can switch to any of 3 bands**
      - **3-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 3 bands support up to 2Tx)**
      - **3-2-2: another Tx chain can switch between 2 bands out of 3 bands (e.g., only 2 bands out of 3 bands support up to 2Tx)**
    - **Switching configuration 3-3: Both of two Tx chains can switch across subset of 3 bands**
      - **3-3-1: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain can switch between 2 bands (e.g., A and C) out of 3 bands**
      - **3-3-2: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain is fixed to another band (e.g., C)**
  - **For 4 bands case**
    - **Switching configuration.4-1: Both of two Tx chains can switch to any of 4 bands (e.g., all the 4 bands support up to 2Tx)**
    - **Switching configuration.4-2: Only one of two Tx chains can switch to any of 4 bands**
      - **4-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 4 bands support up to 2Tx)**
      - **4-2-2: another Tx chain can switch between 2 bands out of 4 bands (e.g., only 2 bands out of 4 bands support up to 2Tx)**
      - **4-2-3: another Tx chain can switch between 3 bands out of 4 bands (e.g., only 3 bands out of 4 bands support up to 2Tx)**
    - **Switching configuration 4-3: Both of two Tx chains can switch across subset of 4 bands**
      - **4-3-1: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 3 bands (e.g., A, B and D) out of 4 bands**
      - **4-3-2: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 2 bands (e.g., A and D) out of 4 bands**
      - **4-3-3: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain is fixed to another band (e.g., D)**

- **4-3-4: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 4 bands while another Tx chain can switch between 2 bands (e.g., C and D) out of 4 bands**

Feedback Form 26: 4.2.1

1 – Qualcomm India Pvt Ltd

We are ok to make down-selection. Given quite a few companies showing concerns on the potential exponential complexity by fully dynamic switching among 3 or 4 bands, we would propose to consider precluding the "both 2Tx chains can switch to any of 3 or 4 bands" for progress.

We could leave the rest options for future discussion.

2 – OPPO

1). "**down-selection will be done at RAN1#110**" is a bit strong promise. It is better to say "RAN1 strives to down-select at RAN1 #110".

2). We share the same concern as Qualcomm on the potentially exponential-wise complexity. Qualcomm's suggestion or any others to avoid such complexity should be in place with the proposal.

3 – Apple GmbH

We think it is a bit premature to make this agreement in this meeting. The details included in this proposal are follow-up to the proposal in section 4.1.1. We would prefer to first agree/down-select from the alternatives discussed in proposal 4.1.1. Following that, we can start the discussion related to possible switching configurations.

4 – Esurfing IoT

China Telecom

From our understanding, the specification does not restrict which Tx chain is fixed to a certain band, which Tx chain can switch across bands. It is up to UE implementation.

For example, if 1Tx-2Tx switching is configured for band pair A and B, when the Tx chain state 0T (band A)+2T(band B) changes to 1T(band A)+1T(band B), for one UL transmission the first Tx chain is switched from band B to band A. For another UL transmission resulting Tx chain state 0T (band A)+2T(band B) changing to 1T(band A)+1T(band B), it may also be that the second Tx chain is switched from band B to band A, which is not restricted by specification. Whether Tx switching is required is judged from the antenna port sate in specification.

5 – Fujitsu Limited

We are fine with the moderator's proposal. If companies think the statements are too strong, we can just capture them as "observation", which helps our further consideration.

6 – Beijing Xiaomi Electronics

We are fine with the proposal. We also think 'down-selection will be done at RAN1#110' is too strong considering we need to make a down-selection for proposal 4.1.1. From our perspective, we should firstly make progress for proposal 4.1.1.

7 – ZTE Corporation

Similar view as Apple. We think it is a bit too premature to make this agreements because it highly depends on the discussion of Alt.1/2/3 above.

If Alt.2 is adopted, RAN1 doesn't need to discuss all these cases.

8 – LG Electronics Inc.

At this time, it is not demonstrated yet, for a certain alternative, how much UE complexity is required or how much gain due to UL Tx switching is obtained compared to other alternatives. Therefore, we think the most flexible configurations (3-1 and 4-1) should be prioritized as the starting point for discussion. Moreover, it seems be premature to exclude any specific alternative without any analysis/evaluation in this first meeting. We prefer to first agree/down-select from the alternatives discussed in proposal 4.1.1.

9 – Intel Deutschland GmbH

We share similar view as other companies. It would be good to wait for the progress in 4.1.1.

10 – Nokia Corporation

It is good to spell out these options and we support recording them. However, it is likely too strong to say that we downselect in the next meeting.

We should aim to limit the number of combinations allowed to enable a meaningful ecosystem. Thinking of e.g. a 4-band deployment it would not be feasible to support all these UE types for UL Tx switching. It would be fairly critical to have just one type of switching on a given band combination. It just risks that most combinations are not going to be configured and the perhaps least attractive, but first-to-market device type dictates what the deployment is stuck with.

11 – Samsung Research America

We support to capture the listed options as shown in the FL proposal and the idea of a later down-selection of number of meaningful combinations for UE implementation given performance/complexity trade-off's. However, we do not think that down-selection will be possible by the next RAN1 meeting, e.g., this is too ambitious. We first need to decide on the alternatives identified in the FL proposal in 4.1.1

12 – HUAWEI TECHNOLOGIES Co. Ltd.

Similar comment for the down-selection as above, some of alternatives are potentially useful only for UL-CA Option2. A separate down-selection should not be precluded.

Many alternatives seem just scheduling restrictions. Too many restrictions may lead to reduced scheduling flexibility and performance reduction. Therefore, we suggest to add a note as following:

- Note: performance reduction caused by any scheduling restriction should be taken into account in the down-selection.

13 – InterDigital Belgium. LLC

Same view as above companies that we should make progress on 4.1.1 first.

14 – Ericsson LM We see to have the list and including all combinations, is very helpful to progress the work. Hence, we support to capture the listed options. On down-selection, it is needed but maybe not realistically feasible in Next meeting, but we should aim for it.
15 – Spreadtrum Communications We support the proposal.
16 – DOCOMO Communications Lab. As commented in 4.1.1, regardless of whether Alt 1, 2, or 3 is decided in the first bullet in 4.1.1, possible switching configurations should be discussed. This proposal is a start point to discuss possible switching configurations, thus first we suggest to support this proposal and future discuss in detail.

4.2.2 2nd round discussion

1st round feedbacks can be summarized as below.

- OK
  - FJT, SPRD, DCM
- OK with precluding Switching configuration.3-1 and 4-1
  - QCM, OPPO
- Down selection at RAN1#110 can be best effort
  - OPPO, Xiaomi, Nokia, Samsung, E///
- Should start the discussion after down selection on the switching mechanism
  - Apple, ZTE, LG, IDC
- It is up to UE implementation and no restriction in the specification
  - CT
- Clarify separate down selection for switched UL and dual UL is not precluded
  - HW
- Add a note “performance reduction caused by any scheduling restriction should be taken into account for down selection”
  - HW

The moderator would like to clarify again that this proposal is listing all possible switching configurations based on contributions submitted in this meeting, i.e., nothing is precluded. So, it is not "premature" to list up all possibilities, rather it should be helpful for further investigation within limited TUs for this WI. On the other hand, as some companies commented, down selection should be done after making some progress on the discussion on switching mechanism. Therefore, it can be clarified.

The moderator would like to ask companies to provide feedback if any on the above summary and following updated FL proposal.

Proposed agreement

- **Following possible switching configurations are considered, and RAN1 will discuss the down-selection after making some progress on the discussion on the switching mechanism**
  - **For 3 bands case**
    - **Switching configuration.3-1: Both of two Tx chains can switch to any of 3 bands (e.g., all the 3 bands support up to 2Tx)**
    - **Switching configuration.3-2: Only one of two Tx chains can switch to any of 3 bands**
      - **3-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 3 bands support up to 2Tx)**
      - **3-2-2: another Tx chain can switch between 2 bands out of 3 bands (e.g., only 2 bands out of 3 bands support up to 2Tx)**
    - **Switching configuration 3-3: Both of two Tx chains can switch across subset of 3 bands**
      - **3-3-1: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain can switch between 2 bands (e.g., A and C) out of 3 bands**
      - **3-3-2: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain is fixed to another band (e.g., C)**
  - **For 4 bands case**
    - **Switching configuration.4-1: Both of two Tx chains can switch to any of 4 bands (e.g., all the 4 bands support up to 2Tx)**
    - **Switching configuration.4-2: Only one of two Tx chains can switch to any of 4 bands**
      - **4-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 4 bands support up to 2Tx)**
      - **4-2-2: another Tx chain can switch between 2 bands out of 4 bands (e.g., only 2 bands out of 4 bands support up to 2Tx)**
      - **4-2-3: another Tx chain can switch between 3 bands out of 4 bands (e.g., only 3 bands out of 4 bands support up to 2Tx)**

- **Switching configuration 4-3: Both of two Tx chains can switch across subset of 4 bands**
  - **4-3-1: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 3 bands (e.g., A, B and D) out of 4 bands**
  - **4-3-2: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 2 bands (e.g., A and D) out of 4 bands**
  - **4-3-3: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain is fixed to another band (e.g., D)**
  - **4-3-4: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 4 bands while another Tx chain can switch between 2 bands (e.g., C and D) out of 4 bands**

- **Note: separate down-selection for switched UL and dual UL is not precluded**
- **Note: In addition to the UE/gNB complexity reduction, performance reduction caused by any scheduling restriction can also be taken into account for down-selection**

Feedback Form 27: 4.2.2

1 – Apple GmbH In our view, these switching configuration options are specific to only some of the alternatives discussed in 4.1, but not all. For this reason, we would prefer not to make this agreement now and rather wait for the decision on the alternatives in section 4.1
2 – LG Electronics Inc. We agree with the moderator's assessment and support the proposal.
3 – vivo Communication Technology While we understand the motivation of the moderator, we are wondering if it is possible for companies to study so many configurations (more than 10) and converge on one or some of them in the next two meetings. Moreover, we think that the scope of switching configuration may be narrowed down once the switching mechanism becomes clearer, e.g., maybe only a subset of these configurations will be discussed at that time point. We prefer not to have the agreement at this stage.
4 – CATT We are fine with the proposal. Considering the flexibility of scheduling, Switching configuration.3-1 for 3 band case and configuration.4-1 for 4 band case are our preferred switching configuration.
5 – Esurfing IoT China Telecom

Our understanding is the same as in the first round, the specification does not restrict which Tx chain is fixed or switched across bands. It is up to UE implementation. The possible switching configurations we need to discuss is if part or all of the bands out of 3 or 4 bands support up to 2Tx.
6 – Beijing Xiaomi Electronics We are fine with the proposal.
7 – MediaTek Inc. It seems to us these are UE capability options rather than "switching configuration" options. As an example, if the UE supports "Switching configuration 3-2", the gNB can't operate that UE with "Switching configuration 3-1".
8 – Intel Deutschland GmbH Thanks for the FL's great effort for listing all the possible configurations. We tend to agree with other companies that it would be good that RAN1 can narrow down Tx switching mechanism first before making this agreement on configurations.
9 – Samsung Research America We are fine with the FL proposal.
10 – InterDigital Belgium. LLC Fine with the FL proposal.
11 – DOCOMO Communications Lab. We support the proposal.

4.2.3 3rd round discussion

After the second round email discussion, companies' feedbacks can be summarized as below.

- Fine with the FL proposal
  - LG, CATT, Xiaomi, Samsung, IDC, DCM
- Not fine with the FL proposal
  - Should discuss after down-selection on switching mechanism
    - Apple, vivo, Intel
  - We need to discuss whether part or all of the bands out of 3 or 4 bands support up to 2 Tx
    - CT

The moderator thinks that this is fundamental point like target scenario discussion since in Rel-16 and Rel-17 the switching configurations to be supported were clarified in WID while it has not been clarified for Rel-18. Therefore, similar to proposals in 4.1, the moderator believes that it is good to emphasize all possible switching configurations to facilitate companies' investigation considering limited TUs for this WI.

Therefore, the moderator would like to ask companies again to provide feedback if any on the above summary and following FL proposal.

Proposed agreement

- **Following possible switching configurations are considered, and RAN1 will discuss the down-selection after making some progress on the discussion on the switching mechanism**
  - **For 3 bands case**
    - **Switching configuration.3-1: Both of two Tx chains can switch to any of 3 bands (e.g., all the 3 bands support up to 2Tx)**
    - **Switching configuration.3-2: Only one of two Tx chains can switch to any of 3 bands**
      - **3-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 3 bands support up to 2Tx)**
      - **3-2-2: another Tx chain can switch between 2 bands out of 3 bands (e.g., only 2 bands out of 3 bands support up to 2Tx)**
    - **Switching configuration 3-3: Both of two Tx chains can switch across subset of 3 bands**
      - **3-3-1: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain can switch between 2 bands (e.g., A and C) out of 3 bands**
      - **3-3-2: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 3 bands while another Tx chain is fixed to another band (e.g., C)**
  - **For 4 bands case**
    - **Switching configuration.4-1: Both of two Tx chains can switch to any of 4 bands (e.g., all the 4 bands support up to 2Tx)**
    - **Switching configuration.4-2: Only one of two Tx chains can switch to any of 4 bands**
      - **4-2-1: another Tx chain is fixed to a certain band (e.g., only 1 band out of 4 bands support up to 2Tx)**
      - **4-2-2: another Tx chain can switch between 2 bands out of 4 bands (e.g., only 2 bands out of 4 bands support up to 2Tx)**
      - **4-2-3: another Tx chain can switch between 3 bands out of 4 bands (e.g., only 3 bands out of 4 bands support up to 2Tx)**
    - **Switching configuration 4-3: Both of two Tx chains can switch across subset of 4 bands**

- **4-3-1: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 3 bands (e.g., A, B and D) out of 4 bands**
- **4-3-2: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain can switch between 2 bands (e.g., A and D) out of 4 bands**
- **4-3-3: one of two Tx chains can switch between 3 bands (e.g., A, B and C) out of 4 bands while another Tx chain is fixed to another band (e.g., D)**
- **4-3-4: one of two Tx chains can switch between 2 bands (e.g., A and B) out of 4 bands while another Tx chain can switch between 2 bands (e.g., C and D) out of 4 bands**

- **Note: separate down-selection for switched UL and dual UL is not precluded**
- **Note: In addition to the UE/gNB complexity reduction, performance reduction caused by any scheduling restriction can also be taken into account for down-selection**

Feedback Form 28: 4.2.3

1 – Qualcomm India Pvt Ltd

We prefer the spec should not restrict which Tx chain is fixed or switched across certain bands. It is up to UE implementation.

We prefer to add the following note in the proposed agreement.

- The Spec should not restrict which Tx chain is fixed or switched across certain bands. It is up to UE implementation.

2 – ZTE Corporation

We don't support the proposal with the following reasons.

1. The first note is not needed, similar comment as our previous one.
2. If Alt.2 is selected, we don't need to discuss all these cases. Everything can follow the Rel-16/17 switching mechanism.
3. This can list as a proposal in chair note instead as an agreements.

3 – Apple GmbH

We are still think that this agreement should be discussed after the down-selection from the proposed agreement in 4.1.3 As ZTE pointed out, if Alt 2 is selected in 4.1.3, then there is no need for this discussion. Considering this is only the first meeting, we think already we will be making a good progress by listing the alternatives in 4.1.3. Further details related to the down-selected alternative can be discussed and possibly agreed in RAN1#110.

4 – InterDigital Belgium. LLC

Support the proposal. OK to have note proposed by Qualcomm.

5 – Intel Deutschland GmbH

As commented in the 2nd round, we suggest to discuss this after down-selection on switching mechanism in 4.1.3.

6 – New H3C Technologies Co.

We needn't limit which TX chain is fixed to certain some bands

7 – Beijing Xiaomi Electronics

We are OK with the proposal. Although we agree with the argue that it is better to wait for progress on which alternative of Tx switching is selected, there is no harm to list all the potential configurations to facilitate the pending discussion. We can still focus on the mechanisms of UL Tx switching.

8 – China Mobile Com. Corporation

Since the proposal is only applicable to the individual switching mechanism in 4.1, we are fine to discuss the detailed switching configurations after the switching mechanism is determined in 4.1.3.

9 – vivo Communication Technology

We still think simply listing all combinations does not help the discussion, we prefer to focus on other more important issues.

10 – LG Electronics Inc.

We are fine with the proposal with the understanding that the intention of the proposal is to list all possible switching configurations for further investigation.

11 – CATT

We are fine with the proposal. The listed potential switching configuration cases can be a guideline for further discussion.

12 – Esurfing IoT

China Telecom

As commented in previous round, our understanding is the spec should not restrict which Tx chain is fixed or switched across certain bands. It is up to UE implementation.

If the intention is to list all possible switching configurations, we can use the wording in the brackets

- For 3 bands case
  - all the 3 bands support up to 2Tx
  - only 1 band out of 3 bands supports up to 2Tx
  - only 2 bands out of 3 bands support up to 2Tx
- For 4 bands case
  - all the 4 bands support up to 2Tx
  - only 1 band out of 4 bands supports up to 2Tx
  - only 2 bands out of 4 bands support up to 2Tx
  - only 3 bands out of 4 bands support up to 2Tx

13 – MediaTek Inc. We think this should be left to UE capability. No need to put restriction in the specs.
14 – Samsung Research America We support the FL proposal in the sense that we are ok to list the possible switching configurations. We support the inclusion of the note suggested by QCOM that ”Spec should not restrict... up to UE implementation.”
15 – Ericsson LM We are fine with the proposal and share the same view as LG.
16 – HUAWEI TECHNOLOGIES Co. Ltd. In our understanding, the proposal overlaps with the first bullet of S3.1.3, i.e. ”**The supported cases by the UE for Tx switching between 3 or 4 bands are reported as UE capability.** ” Once the UE capability is introduced there, the proposal here seems unnecessary.
17 – DOCOMO Communications Lab. Support this proposal and note proposed by QC.

4.3 Potential solutions to address the issue on ambiguous switching state

In Rel-17 2Tx-2Tx switching for inter-band UL CA Option 2, there is the issue on ambiguous switching state where the switching state after the UL Tx switching is not unique, since there are multiple switching states for the case of 1-port transmission on one band only. The RRC configuration (*uplinkTxSwitching-DualUL-TxState*) was introduced to address the issue in Rel-17. For Rel-18 UL Tx switching across 3 or 4 bands, many contributions pointed that the issue would become more complex in Rel-18 due to potential larger number of switching states.

In contributions in AI 9.10.2, following observations and proposals were made regarding potential solutions to address the issue on ambiguous switching state for Rel-18 UL Tx switching.

[5]	*For framework#2, the legacy UL Tx switching mechanism for CA and SUL can be fully reused. Thus, there is no ne*
[6]	*Meanwhile, it needs to handle the case that the state of Tx chains after Tx switching is not unique for UL CA optior*
[8]	***Proposal 6: Down select the four alternatives for mapping between UL transmission ports and Tx chains. Alt 1:***
[9]	*The state of Tx chains after Tx switching is not unique in this case similar as in Rel-17. For instance, if the current*
[17]	*Whether/how to solve potential more ambiguous switching cases (e.g., defining RRC configurations as in Rel-17) F*

Based on above, the situation can be summarized as below.

- Potential solutions to address the issue on ambiguous switching state
  - Alt.1: Introduce a new RRC signaling similar to *uplinkTxSwitching-DualUL-TxState*

    - Argued by Spreadtrum, China Telecom, DOCOMO

- Alt.2: Adopt Alt.2 mechanism discussed in 4.1 to fully reuse *uplinkTxSwitching-DualUL-TxState*

    - Argued by ZTE (companies supporting Alt.2 in 4.1 would have same view)

- Alt.3: Restrict the port-mapping combination so that the switching state after the UL Tx switching is unique

    - Argued by vivo

The moderator would like to ask companies to provide feedback if any on the above summary and following potential FL proposal.

4.3.1 Proposed agreement

– **If there is the issue on ambiguous switching state where the switching state after the UL Tx switching is not unique in Rel-18 UL Tx switching mechanism, following potential solutions are considered.**

- **Alt.1: Introduce a new RRC signaling similar to *uplinkTxSwitching-DualUL-TxState***
- **Alt.2: Adopt the mechanism below to fully reuse *uplinkTxSwitching-DualUL-TxState***

    - **NW indicates 2 bands out of the configured bands (3 or 4 bands) via DCI or MAC-CE, and dynamic Tx carrier switching between indicated bands is same as Rel-17**

- **Alt.3: Restrict the port-mapping combination so that the switching state after the UL Tx switching is unique**

Feedback Form 29: 4.3.1

1 – Qualcomm India Pvt Ltd We support Alt. 1 to introduce a new RRC signaling to solve the ambiguity issue.
2 – OPPO If the intention is to down-select in this meeting rather than to agree the three alternatives in package, we prefer Alt-1.
3 – Apple GmbH If we agree to support configuration of 3 or 4 bands for UL Tx switching in Rel-18, then Alt-2 is an acceptable option to us. With this option, the specification effort is minimum and its keeps the same UE complexity as in Rel-17.
4 – Esurfing IoT China Telecom

We think this proposal is also related to which alternative from proposal in section 4.1.1 is chosen, and can not be decided before alternatives from proposal in section 4.1.1 are down selected. It is premature to make the detailed option as agreement.

5 – vivo Communication Technology

Before discussing the detailed solution to solve the ambiguity issue, we need to determine the switching state/cases to be supported first.

6 – Beijing Xiaomi Electronics

We are fine with the options for further down-selection. Our preference is alt.1.

7 – ZTE Corporation

We feel that down-selection of Alt.1/2/3 should be done first and then we can come back to this issue. Again we support Alt.2 to reduce the spce impact and reuse the legacy mechanism as much as possible.

8 – LG Electronics Inc.

We believe that one of the main advantages of Rel-18 UL Tx switching is the potential gain from the increased scheduling flexibility by extending the number of bands which Tx switching can occur. From this point of view, limiting back to 2 bands or fixing 1 band only on which UL Tx switching is restricted, may not be the way to achieve this potential gain. In this perspective, we prefer Alt 1. But, as commented by China Telecom, this issue is closely related to section 4.1.1, so it may be premature to select one before discussing section 4.1.1 sufficiently.

9 – Intel Deutschland GmbH

We share similar view as other companies that it would be good to wait for the progress for 4.1.1.

10 – Nokia Corporation

We share the view expressed by many that thi maybe a bit premature to call and can be parked.

11 – Samsung Research America

For us, it is not right away urgent to decide how to resolve the ambiguity issue. And we will first need to decide on the supported R18 switching states/cases first before a meaningful solution can be agreed.

12 – HUAWEI TECHNOLOGIES Co. Ltd.

It should be clear in the proposal that the ambiguity issue only occurs for UL-CA Option2. Additionally, without a rough shape of Rel-18 Option 2 mechanism, it seems too early to conclude this issue. At least it should be added that “Other solutions are not precluded”.

13 – InterDigital Belgium. LLC

Agree with above companies that this issue could be decided later. However, it would be fine to make agreement listing options without precluding other solutions.

14 – Ericsson LM

FL listing the option is very helpful. But the decision is a bit premature at this stage.

15 – Spreadtrum Communications Agree that it can be decided later, after proposal in 4.1.1.
16 – DOCOMO Communications Lab. We support this proposal since this proposal is a start point to discuss the issue on ambiguous switching state. Also, we are OK with HW's suggestion that it should be added that "Other solutions are not precluded".

4.3.2 Summary of 1st round discussion

1st round feedbacks can be summarized as below.

- OK
  - Xiaomi
- OK with adding "other solutions are not precluded"
  - HW, IDC, DCM
- Support Alt.1
  - QCM, OPPO, Xiaomi
- Support Alt.2
  - Apple, ZTE
- Should start the discussion after down selection on the switching mechanism
  - CT, vivo, ZTE, LG, Intel, Nokia, Samsung, HW, IDC, E///, SPRD

Although the moderator's intension of this proposal is similar to proposals in 4.1 and 4.2, larger number of companies consider this point can be discussed after making some progress on the switching mechanism.

Therefore, the moderator would like to stop the discussion on this proposal at this moment.

4.4 Other proposals

Although the moderator tried to list up all the possible discussion points and proposals for the RAN1#109-e meeting in above sections based on the contributions and the work plan, there may or may not be some other discussion point and proposal that need to be discussed at this meeting.

The moderator would like to ask companies to provide such additional discussion point and proposal if any. Please note that the moderator thinks some proposals/observations regarding potential longer switching period should be discussed in RAN4 according to the WID.

Feedback Form 30: 4.4