3GPP TSG-RAN WG2 Meeting #116-e R2-21xxxxx

Electronic, November 1 - November 12, 2021

Agenda item: 8.22

Source: Apple

Title: Summary of [AT116-e][023][NR17] FR2 UL Gap (Apple)

Document for: Discussion

# 1 Introduction

This is the summary of the following offline email discussion.

**[AT116-e][023][NR17] FR2 UL Gap (Apple)**

Scope: Treat R2-2109358, R2-2110076, R2-2109798, R2-2109570, R2-2109571

Determine agreeable parts, Identify discussion points for online (if needed).

Intended outcome: Report (Reply LS in ph2)

Deadline: Friday W1 (CB online). Rapporteur suggests that the Phase 1 comment collection stops at Thursday 10:00AM UTC, Week 1 (Oct. 4), to get ready for Friday comeback.

# 2 Contact info

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| --- | --- | --- |
| Company Name | Contact Person | Email Address |
| ZTE | LiuJing | liu.jing30@zte.com.cn |
| Apple | Yuqin Chen | yuqin\_chen@apple.com |
| Huawei, HiSilicon | Yang Zhao | zhaoyang@huawei.com |
| OPPO | Zhongda Du | duzhongda@oppo.com |
| MediaTek | Felix Tsai | chun-fan.tsai@mediatek.com |
| Intel | Candy Yiu | Candy.yiu@intel.com |

# 3 Phase 1 Discussion

For companies to better understand the background, as mentioned by [2], one major use case for FR2 UL gap is UE can detect whether or not human body is close to Tx antennas by doing sensing during UL gaps, and thus avoid unnecessary P-MPR when human targets are not close to the Tx antennas.

## 3.1 Discussion on FR2 UL gap configuration

**Topic 1: RRC signaling design on FR2 UL gap configuration**

Contribution [2] presented that the FR2 UL gap should be configured by dedicated RRC signaling. [3] specifically proposed to add it into MeasGapConfig. It was also mentioned in both [2] and [3] that the configuration on FR2 UL gap can be based on existing measurement gap configuration.

Regarding the detailed FR2 UL gap configuration, [2] and [3] propose that it should comprise *gapOffset*, *ugl*, *ugrp*. In addition, [2] also proposes to indicate *refFR2ServCellAsyncCA.*

**Question 1: Do companies agree to introduce the UL gap configuration into dedicated RRC signaling, with following potential parameters:**

**a) *gapOffset***

***b) ugl***

***c) ugrp***

**d) *refFR2ServCellAsyncCA***

**e) others (Please elaborate)**

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| --- | --- | --- |
| Company | Parameters needed for FR2 UL gap configuraion | Comments |
| ZTE | At least a), b), c) | For d), we are not sure.  We think UE needs to know which cell’s SFN/subframe is used as timing reference for UL gap position calculation, so besides refFR2ServCellAsyncCA, we may also need to add the following IE (detailed value range needs further discussion).  refServCellIndicator ENUMERATED {pCell, pSCell, mcg-FR2} |
| Apple | a) b) c) d) | As presented in R2-2110076, ugl and ugrp are already mentioned in the RAN4 LS.  *gapOffset* is used for network to make a distribution on gap configurations to UE(s) so to achieve a better scheduling performance. Thus we believe it should be kept in UL gap configuration.  As for timing reference indication, basically our understanding is only FR2 serving cell can work as reference cell for UL gap configuration. In details, if synchronous FR2 CA is configured, the SFN and subframe of any FR2 serving can be used in the gap calculation. For asynchronous FR2 CA configuration, the SFN and subframe of a serving cell on FR2 frequency indicated by the *refFR2ServCellAsyncCA* is used in the gap calculation.  [Response to ZTE comment]: For ZTE’s comment on refServCellIndicator, our view is we should avoid using the FR1 serving cell for timing reference. That is why we propose to use refFR2ServCellAsyncCA. |
| Huawei, HiSilicon | a), b), c) | Not sure about d). It is a bit unclear what kind of granularity is such configuration, e.g. per UE, per FRX or anything else? We think this should be first clarified by RAN4 before deciding in RAN2. |
| OPPO | a), b), c) | Also not sure about d). From RAN4 LS the UL gap is very similar to measurement gap in the sense UE will stopping serving and turn to do something else. So it will likely that the way to calculate gap will be the same as what is done for measurement gap. So we kind agree with ZTE’s opinion. But again we also agree with Huawei RAN2 need wait for further input from RAN4 instead to decide on this at this meeting. |
| MediaTek | At least a), b), c) | For d), we can check with R4 if only FR2 cell could be used as reference cell for this UL gap calculation. |
| Intel | a,b,c,d | A,b,c are needed. If UE needs to know reference timing, then (d) is also needed. |
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It was further discussed in [2] that instead of explicit configuration on *ugl* and *ugrp*, whether to consider referring to UL gap pattern ID (as in LTE meas gap configuration) since it’s likely only a few gap patterns will be introduced.

**Question 2: Which option do companies prefer:**

**Option 1 - Explicit configuration on *ugl* and *ugrp* (same as in NR meas gap configuration)**

**Option 2 - Referring to UL gap pattern ID (same as in LTE meas gap configuration)**

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| Company | Option preferred | Comments |
| ZTE | Option 1 | So far, we think Option 1 is clear.  But if we model “UL FR2 gap” as a new gap purpose under Rel-17 concurrent gap, then we may need to refer to a “gap configuration ID” (not gap pattern ID). |
| Apple | Option 2 | The main reason of selecting Option 2 is we believe the gap patterns will be not too many. In Rel-15 NR discussion, explicit configuration was agreed mainly because the gap patterns defined by RAN4 can get to a quite large number. |
| Huawei, HiSilicon | Pending on the number of patterns | We understand RAN4 is still discussing the value ranges for the patterns, and thus this depends on the decision from RAN4. If the number is small, Option 1 is more straight forward. |
| QCOM | Option-1 | Given the number of patterns to be supported is small |
| OPPO | Option 1 | It is not clear whether such UL FR2 gap will be brand new pattern or some legacy measurement gap pattern can be reused. Before knowing this we don’t understand why we need a new signaling scheme. |
| MediaTek | Both seems fine | Suggest to discuss later based on ASN.1 proposal. It is not so clear on the difference between two proposals as the number of gap pattern is still under discussion. |
| Intel | Option 1 | We prefer to be consistent with current NR measurement gap configuration. Ideally if the gap configure can also be merge in the MGE framework as well. |
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In addition, [4] has the following proposal regarding the LS to RAN4:

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| R2-2109570 [4] | **Proposal4: In the response LS to RAN4, RAN4 is asked to clarify about the detail parameters of UL gap pattern including the time domain unit e.g. in ms or slot or symbol etc. And whether the defined parameters can be applicable for all intended cases.** |

**Question 3: Should we ask RAN4 the following question: RAN4 is asked to clarify about the detail parameters of UL gap pattern including the time domain unit e.g. in ms or slot or symbol etc. And whether the defined parameters can be applicable for all intended cases.**

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| Company | Yes/No | Comments |
| ZTE | No with comments | Based on RAN4 WF R4-2114964, RAN4 is discussing the value range of UGL and UGRP, so we think RAN4 will inform us about the conclusion.  However, we think we need ask RAN4 to clarify many aspects (see our response to Q4/7/8). And, it is unclear about the relationship between legacy gap and UL gap? Can legacy gap (e.g. per-UE gap, FR2 gap) be reused for UL gap? Or they must be configured non-overlapped in time domain? |
| Apple | No strong view | We think RAN4 has a quite good understanding that such information should be determined. |
| Huawei, HiSilicon | Yes | We are fine to ask RAN4 for clarification, also including the granularity as we mentioned in Q1. |
| QCOM | Yes |  |
| OPPO | Yes | Our understanding is that RAN4 LS is to trigger RAN2 discussion and further understand what is missed from RAN2 point of view. So a LS for clarification can serve this purpose. In addition we also need understand RAN2 solution is forward compatible or not since not every case is concluded in RAN4 yet. |
| MediaTek | No strong view | It seems that reply LS is needed anyway, we could include this even if R4 is already discussing. |
| Intel | Yes/No | Since it is currently being discussed in RAN4 according to RAN4 LS, RAN2 should wait for RAN4 before RAN2 decide. |
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**Topic 2: UE assistance on FR2 UL gap**

[2] mentions that UL gap is for UE sensing on proximity of human body, which means the selection on UGL and UGRP would largely depend on UE implementation. It is then proposed in [2] and [4]:

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| R2-2110076 [2] | **Proposal 6: RAN2 to discuss introducing a UE assistance information reporting on preferred UL gap patterns.** |
| R2-2109570 [4] | **Proposal2: Reuse RRC message UEAssistanceInformation to incorporate UE assistant information.** |

**Question 4: Do companies think it’s helpful to have a UE assistance information reporting on preferred UL gap patterns?**

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| Company | Yes/No | Comments |
| ZTE | Leave it to RAN4 | It is unclear to us whether preferred UL gap pattern is dynamically changed? Or kind of static for a given device?  If it is static, then UE capability should be used instead of UAI (like report the *supportedGapPattern*).  So far, RAN4 LS (and also their WF) only mentioned that UE can indicate the requirement of activation/deactivation to network, but they haven’t mentioned the preferred gap pattern, we suggest to ask RAN4 for more information. |
| Apple | Yes | In measurement gap configuration, the value of each relevant parameter can be decided by network according to the reference signal pattern used by neighbor cells and the only factor from UE side is UE capability on measurement gap pattern support.  However, UL gap is for UE sensing on proximity of human body, which means the selection on UGL and UGRP would largely depend on UE implementation. Therefore, we believe an assistance information from UE on the preferred UL gap pattern is beneficial. |
| Huawei, HiSilicon | Yes, but… | We understand RAN4 is discussing this issue as well, perhaps also need to check RAN4 latest progress.  The UE may support multiple patterns, and if to introduce UAI reporting preferred UL gap patterns, is only one of the pattern selected at a time? |
| QCOM | Yes |  |
| OPPO | Yes | First of all we don’t think it is relevant to UE capability. Instead assistant information is help network to know whether a UL gap is needed now and how. |
| MediaTek | Yes, but… | We should also check with RAN4 on whether this is intended behavior. |
| Intel | Yes | It UL gap is introduced, then UE assistance information is needed. We prefer to reuseRRC UEAssistnaceInformation. |
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**Topic 3: FR2 UL gap configuration in MR-DC/NR-DC deployment**

In dual connectivity deployment, regarding which node provides the FR2 UL gap configuration to UE, [2] discusses which node should configure the FR2 UL gap in MR-DC and NR-DC and proposes the following:

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| R2-2110076 [2] | * **In (NG) EN-DC, UL gap is configured by SN to UE;** * **In NE-DC, UL gap is configured by MN to UE;** * **In NR-DC, either MN or SN can configure UL gap to UE, depending on which CG is configured with FR2.** |

**Question 5: Do companies agree with the following statement on which node should configure UL gap to UE?**

**a) In (NG) EN-DC, UL gap is configured by SN to UE;**

**b) In NE-DC, UL gap is configured by MN to UE;**

**c) In NR-DC, either MN or SN can configure UL gap to UE, depending on which CG is configured with FR2.**

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| --- | --- | --- |
| Company | Which are agreeable? | Comments |
| ZTE | a), b) | a) and b) are simple, because only NR node has FR2 serving cells.  But for NR-DC, we are not sure it is a good idea to allow flexibility in both MN and SN, what if both MN and SN are configured with FR2 serving cells?  So far, we prefer to follow the basic principle that only MN configures UL gap in case of NR-DC, which means MN can deliver the UL gap pattern to SN node, and SN can request MN to configure UL gap pattern (if haven’t received from MN). We can reconsider this framework if problem is identified. |
| Apple | All a) b) c) | It is believed that the FR2 UL gap is fully independent from legacy measurement gap. In details, the FR2 UL gap only applies to FR2, without impacting FR1 band operation, thus no impact to perUE gap. Our reasoning is UE supporting UL gap should conditionally also support per FR gap.  Then, considering FR2 bands are only configured in one CG (there is no FR2-FR2 DC BC in RAN4 spec), the configured UL gap would be restricted to all FR2 cells inside one CG. Thus, for simplicity, in NR-DC scenario, it is reasonable to allow either node configure FR2 UL gap to UE, depending on which CG is configured with FR2.  For EN-DC and NE-DC, it would be straightforward for NR node to make the FR2 UL gap configuration.  Since this question is largely dependent on the FR2 UL gap relationship with existing measurement gap, we would be fine if companies would like to ask RAN4 on that regard first. |
| Huawei, HiSilicon |  | Perhaps it should be first clarified whether all these options need to be supported. |
| QCOM | ALL |  |
| OPPO |  | We also think we need clarify the scenario first. In case all of them need be supported we can reuse current framework of measurement gap configuration as much as possible unless some new scheme is strongly motivated which is missed so far. |
| MediaTek | a), b) | For c), we are not sure. We are prefer only MN do the configuration. |
| Intel | All 3 | It is reasonable for the node configure FR2 to configure UL gap. |
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[2] then presents that there is no need for MN and SN to coordinate FR2 UL gap configuration as FR2-FR2 DC is not supported.

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| R2-2110076 [2] | **Proposal 10: There is no need to coordinate UL gap configuration between MN and SN.** |

**Question 6: Do companies agree that there is no need to coordinate FR2 UL gap configuration between MN and SN?**

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| --- | --- | --- |
| Company | Yes/No? | Comments |
| ZTE | No | We think even if both MN and SN can configure UL gap, coordination between MN and SN is still needed (at least to avoid two UL gap configurations).  In addition, if UAI is used to request UL gap, then based on current spec, the UAI message can only be sent to MN, we need to discuss how to inform SN (if SN is NR node). |
| Apple | Yes | Following the logic we presented in Question 5, FR2 UL gap is confined in one single CG thus the gap configuration is only relevant to the node which configures FR2 band to UE.  [Response to ZTE comment]: Regarding ZTE’s comment that UAI can only be sent to MN, we are a little bit confused and would like to understand more. UAI to SN can be transmitted via SRB3 or via SRB1 through ULInformationTransferMRDC. |
| Huawei, HiSilicon | Yes |  |
| QCOM | ANY | As long as the configuration is valid/practical (e.g. avoiding overlap with legacy DL gap) |
| OPPO | Comment | Too early to decide |
| MediaTek | FFS | Suggest to finalize uu interface first and check whether inter-node coordination is needed to ensure the configuration is reasonable. |
| Intel | Yes/No | Depending on what agreement RAN2 takes in Q5. If UL gap is configured only by the node configured FR2, then MN SN coordination may not be needed. |
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## 3.2 Discussion on FR2 UL gap activation/deactivation

**Topic 1: UL gap activation/deactivation status indication**

On FR2 UL gap activation/deactivation, three different views are presented in contributions.

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| R2-2110076 [2] | Both RRC and MAC CE | **Proposal 1: Introduce UL gap configuration with a flag indicating activated/deactivated status into dedicated RRC signaling.**  **Proposal 2: Introduce a new MAC CE for UL gap activation and deactivation.** |
| R2-2109798 [3] | Only RRC | **Proposal 3:** RAN2 to focus on the RRC-based activation/deactivation in Rel-17. |
| R2-2109570 [4] | Only MAC CE | **Proposal1: RAN2 should go to #2 alternative i.e. MAC signalling will be used to activate or deactivate of RRC configuration** |

**Question 7: Which one should be supported by RAN2 to activate/deactivate FR2 UL gap?**

**Option 1 - Both RRC based on MAC CE based**

**Option 2 - Only RRC based**

**Option 3 - Only MAC CE based**

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| --- | --- | --- |
| Company | Option Preferred | Comments |
| ZTE | Option 1,  but fine with Option 2. | It seems RAN4 agreed both RRC-based and MAC-CE based approaches. However, RAN4 LS does not clearly indicate the relationship between them.  There are two possible understandings:   * **Understanding 1:** RRC signalling is used to provide the configuration of UL gap, and RRC signalling can also indicate the “initial” activation/deactivation state of the UL gap pattern. Then network uses MAC CE to further deactivate/active the UL gap. * **Understanding 2:** RRC signalling and MAC CE can be used independently. This can further include following two sub cases: * Case 1: network only use RRC signalling to activate or deactivate the UL gap pattern. * Case 2: RRC signalling is only used to provide UL gap configuration, and MAC CE will be used to activate or deactivate the gap pattern.   We need to discuss which one is the correct understanding, or ask RAN4 for clarification.  On the other hand, if only RRC-based approach is considered, we think the whole function can become simple and standard effort can be reduced, so we are also fine with Option 2. |
| Apple | Option 1 | The two approaches with RRC and MAC CE are already agreed in RAN4. We should respect their conclusions.  [Response to ZTE comment]: According to our understanding, Understanding 1 is aligned with RAN4 agreement. |
| Huawei, Hisilicon | Option 2 | We don’t see this is a case which needs dynamic mechanism, such pattern is rather semi-static and thus we think RRC-based solution is already sufficient. |
| QCOM | Option-2 | We don’t see the value of MAC CE … Preference is to have UE configured and activated in the same RRC message |
| OPPO | Option3 | Option 1 is also acceptable for us |
| MediaTek | Option 2 or 1 | We also think option 2 is enough but it seems that RAN4 already agreed to use MAC CE.  For option 1, we think the correct understanding is Understanding 1 from ZTE. |
| Intel | Option 2 | MAC CE activation has less delay than RRC, however, it is also larger spec impact. |
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On the granularity of FR2 UL gap, [2] mentioned that the activated UL gap would be restricted to all FR2 serving cells inside one CG. [4] mentioned that RAN4 LS doesn’t indicate any flexibility is needed in frequency range level or cell group level or cell level thus suggested to ask RAN4 with this regard.

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| --- | --- |
| R2-2110076 [2] | **Proposal 8: MAC CE design should guarantee that the activation/deactivation on UL gap apply to all FR2 serving cells.** |
| R2-2109570 [4] | **Proposal3: RAN2 send response LS to ask RAN4 what is the control granularity of the UL gap for both RRC configuration and UE capability.** |

**Question 8: Do companies agree with that the activated UL gap applies to all FR2 serving cells inside the CG with FR2 bands?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Not sure | Based on RAN4 LS and WF, it is unclear whether UL FR2 gap impact the UL scheduling in all FR2 serving cells, or only the FR2 serving cells on specific bands? Or only the FR2 serving cells in one CG?  We think more clarification from RAN4 is needed, and the outcome of the question will also impact the discussion on UL gap framework in MR-DC case (Q5). |
| Apple | Yes | We think it is quite obvious the activated FR2 UL gap should apply to all FR2 serving cells inside the CG with FR2 bands.  We are also fine to request RAN4’s guidance on this question if companies prefer. |
| Huawei, HiSilicon | Yes but | We think it is reasonable for the CG with FR2 bands, but is it possible that one CG can contain both FR1 and FR2 and in this case does it apply to FR2 cells as well? Better to double check with RAN4 in general on the supported granularity. |
| QCOM | Yes |  |
| OPPO | Not sure | Would like to check with RAN4 first |
| MediaTek | Not sure | In DC, not sure whether this FR2 UL gap is applicable within a CG or across two CG. Suggest to clarify with RAN4. |
| Intel |  | May be it is good to ask RAN4 for input if UL gap applies to all FR2 serving cells inside one CG or across CGs. |
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**Topic 2: UE indication on the need of UL gap activation/deactivation**

RAN4 LS has following information with respect to the UE indication on the need of UL gap activation/deactivation.

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| On how can UE indicate to the NW UL gap activation/de-activation is needed:   * UL gap should be explicitly activated by NW via signaling   + How can UE indicate to the NW UL gap activation is needed?     - If needed, UE explicitly indicates to NW by signaling * UL gap should be explicitly deactivated by NW via signaling   + How can UE indicate to the NW UL gap deactivation is needed?   If needed, UE explicitly indicates to NW by signaling |

[2] presented that both RRC *UEAssistanceInformation* message and a (new) MAC CE can be utilized. [3] proposes to go with UAI message.

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| R2-2110076 [2] | **Proposal 9: Once the indication of need of UL gap activation/deactivation from UE is agreed in RAN4, RAN2 can discuss which one to use between RRC *UEAssistanceInformation* message or a (new) MAC CE.** |
| R2-2109798 [3] | **Proposal 2:** Support RRC-based request for activation/deactivation of UL gaps by reusing UAI. |

**Question 9: Assuming RAN4 agrees with the need, which option do companies prefer for UE(s) to report the indication of need of UL gap activation/deactivation?**

**Option 1 - *UEAssistanceInformation* message**

**Option 2 - MAC CE**

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| --- | --- | --- |
| Company | Preferred Option | Comments |
| ZTE | See comment | We think this relates to the outcome of Q7.  For example, if MAC CE is used to activate/deactivate UL gap, then assistance information is assumed to be carried in MAC CE as well. Otherwise, we think using UAI (Option 1) is sufficient. |
| Apple | Option 1 is preferred | UAI message is simpler as the trigger condition can be left to UE implementation.  If a new MAC CE is chosen, new conditions to trigger the MAC CE should be defined, which may require some extra efforts. |
| Huawei, HiSilicon | Option 1 | If RAN4 agrees the need, we think UAI seems already sufficient as this is seen rather semi-static. |
| QCOM | Option-1 |  |
| OPPO | Option1 |  |
| MediaTek | Option-1 |  |
| Intel | Option 1 | UEAssistanceInformation can be reused. |
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## 3.3 Discussion on UE capability

In [3], it mentions that the UL gaps are tied to the MPE reporting and has the following proposal.

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| R2-2109798 [3] | **Proposal 4**: UE supporting Rel-17 UL gaps shall also support Rel-16 MPE reporting. |

**Question 10: Is it agreeable that UE supporting Rel-17 UL gaps shall also support Rel-16 MPE reporting?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Yes | We think this is the common understanding in RAN4. |
| Apple | Yes | We think it makes sense for UE supporting FR2 UL gap to also support Rel-16 MPE reporting. |
| Huawei, HiSilicon | Not sure | Better to check with RAN4. |
| QCOM | Yes |  |
| OPPO | Comment | We would like to double check with RAN4. It is obvious we need a response LS based on questions in this email anyway☺  In addition we would also like to check with RAN4 what granularity of the UE capability itself considering it is also not clear how to apply the configuration from network related to question 8. |
| MediaTek | FFS | Suggest to postpone the UE capability discussion. R4 should tell us more information in the feature table |
| Intel |  | Wait for RAN4 input |
|  |  |  |

# 4 Phase 2 Discussion

[TBA]

# 5 Conclusions

Based on the discussion above, below are the summaries.

# 6 References

1. R2-2109358 LS on UL gap in FR2 RF enhancement
2. R2-2110076 RAN2 impact from UL gap in FR2 RF enhancement Apple
3. R2-2109798 UL gaps for FR2 Nokia, Nokia Shanghai Bell
4. R2-2109570 Discussion on UL gap pattern for FR2 TX power management OPPO
5. R2-2109571 Draft LS on UL gap for FR2 TX power management OPPO