3GPP TSG-RAN WG2 Meeting #117-e R2-22xxxxx

Electronic, February 21 – March 03, 2022

Agenda item: 8.24.1

Source: Apple

Title: Summary of [AT117-e][058][NR17] FR2 UL Gap (Apple)

Document for: Discussion

# 1 Introduction

Discussions with Deadline **Schedule 1**:

A **first round** with **Deadline for comments W1 Thur Feb 24th 1200 UTC** to settle scope what is agreeable etc

A Final round with **Final deadline W2 Wed March 2nd 1200 UTC** to settle details / agree CRs etc.

Additional deadlines check points etc if needed are defined by the Rapporteur of each discussion respectively. In case some parts of an email discussion need more time, doesn’t converge, need not yet planned on-line treatment, then Rapporteur please contact chair.

This is the summary of following email discussion.

* [AT117-e][058][NR17] FR2 UL Gap (Apple)

Scope: Treat R2-2202155, R2-2202156, R2-2202508, R2-2202918, R2-2202510, R2-2202511, R2-2202507, R2-2202509. Ph1 Determine agreeable parts and converge on discussion points if any, Ph2 agree CRs (and Reply LS only if needed).

Intended outcome: Report, Agreed CRs, endorsed UE cap CRs (38306, 38331) for Merge.

Deadline: Schedule 1

[1] R2-2202155 Reply LS to RAN2 on UL gap in FR2 RF enhancement (R4-2202419; contact: Apple) RAN4 LS in Rel-17 To:RAN2

[2] R2-2202156 LS to RAN2 on UL gap in FR2 RF enhancement (R4-2202420; contact: Apple) RAN4 LS in Rel-17 To:RAN2

[3] R2-2202506 RAN2 impact from FR2 UL gap Apple discussion Rel-17 NR\_RF\_FR2\_req\_enh2

[4] R2-2202918 Introduction of FR2 UL gap Apple R&D CR Rel-17 37.340 16.8.0 0295 - B NR\_RF\_FR2\_req\_enh2

[5] R2-2202507 Introduction of FR2 UL gap Apple CR Rel-17 38.331 16.7.0 2893 - B NR\_RF\_FR2\_req\_enh2

[6] R2-2202509 Introduction of FR2 UL gap Apple CR Rel-17 38.321 16.7.0 1191 - B NR\_RF\_FR2\_req\_enh2

[7] R2-2202510 Introduction of FR2 UL gap UE capability Apple draftCR Rel-17 38.331 16.7.0 B NR\_RF\_FR2\_req\_enh2

[8] R2-2202511 Introduction of FR2 UL gap UE capability Apple draftCR Rel-17 38.306 16.7.0 B NR\_RF\_FR2\_req\_enh2

# 2 Contact info

|  |  |  |
| --- | --- | --- |
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# 3 Phase 1 Discussion

## 3.1 Discussion on two RAN4 LS(s)

Regarding the two RAN4 LS(s) [1] [2], the rapporteur thinks they can be noted without immediate actions. We can further discuss if any reply LS is required after detailed questions are addressed.

**Question 1: Do companies agree that the two LS(s) [1][2] can be noted for now?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Yes |  |
| vivo | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes but | In [1] A2-1, there seems an undetermined issue on whether UL gap configuration is allowed across FR2 bands, and this would impact the signalling design in RAN2. It is unclear whether RAN4 means the configuration of the UL gap can only be applicable within a CG? |
| Apple | Yes | Regarding Huawei’s question, I think RAN4 is working on it so we could just wait for their input. |
| Intel | Yes |  |
| Samsung | Yes |  |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes (but see comments) | Agree with both Huawei and Apple: We can wait for the next RAN4 LS to resolve the issue brought up by Huawei. But if we don't get LS by next RAN2, then RAN2 should resolve the issue without waiting for RAN4. |
| Ericsson | Yes |  |
| MediaTek | Yes |  |

**Summary:** All (11) companies agree the two RAN4 LS(s) (R2-2202155, R2-2202156) on FR2 UL gap can be noted. On how to apply the FR2 UL gap, RAN2 just wait for RAN4 further input.

**Proposal 1: RAN4 LS(s) (R2-2202155, R2-2202156) can be noted.**

## 3.2 FR2 UL gap handling in MR-DC scenario

**Issue 1: NR-DC with FR1 MCG + FR2 (+FR1) SCG**

In RAN4 LS [1], it is mentioned that the timing reference for FR2 UL gap is based on SFN/subframe of FR2 serving cell.

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| **Q3:** For FR2 UL gap timing reference configuration, whether the SFN/subframe of a FR2 serving cell or a FR1 serving cell (e.g., PCell, PSCell) can be used as timing reference for FR2 UL gap?  **A3:** Timing reference for FR2 UL gap is based on the SFN/subframe of FR2 serving cell. |

[3] pointed out that this leads to conflict between the RAN2 agreement and RAN4 agreement.

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| RAN2 agreed to follow legacy FR2 gap design to allow Pcell, PSCell or MCG FR2 serving cell as SFN timing reference, while RAN4 agreed that only FR2 serving cell can be the SFN timing reference. |

[3] then presented an issue with using Pcell as the SFN timing reference for FR2 UL gap timing determination in FR1 MCG + FR2 SCG, due to the large MRTD (maximum receiving timing difference) and proposes the following observations and proposals:

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| --- |
| **Observation 1: In async DC deployment, the large MRTD between FR1 Pcell and SCG FR2 serving cell leads to huge ambiguity on FR2 slot number determination in FR2 UL gap.**  **Proposal 3: Revert RAN2 agreement for NR-DC scenario and follow RAN4 conclusion to specify that only FR2 serving cell can be configured as SFN timing reference.** |

**Question 2: Do companies agree to follow with RAN4 agreement that “timing reference for FR2 UL gap is based on the SFN/subframe of FR2 serving cell”?**

|  |  |  |
| --- | --- | --- |
| Company | Yes / No | Comments |
| ZTE | Yes, but only if complex MN-SN coordination is not required | We agree that there will be additional interruption if FR1 serving cell is used as timing reference for FR2 UL gap (same as in legacy FR2-gap).  But in legacy gap, the reason for supporting using FR1 serving cell (e.g. Pcell) for calculating FR2 gap is that complex MN-SN coordination can be avoid in some cases. For example, when FR2 serving cells are configured as SCG Scells, the MN does not need to monitor and track the timing of SCG Scells (and current spec does not support the MN to do that), thus the network (MN) can use Pcell timing as a reference as the cost of 1 extra slot interruption.  For FR2 UL gap, the situation is the same that the MN cannot monitor the timing of SCG Scells. So if RAN2 decides to follow RAN4 guidance to only use FR2 serving cell as a timing reference, we must consider how to achieve it in different scenarios and to avoid specifying complex (or even impossible) MN-SN coordination procedures.  Considering this is different from legacy FR2 gap, we think RAN2 cannot simply reuse the framework of legacy FR2 gap. |
| Vivo | No | We think it depends on whether the network has known about the SFTD between MCG and SCG in case of async DC deployment.  Anyway, the network can use Pcell as reference Cell for sync DC or SFTD known case.  We do not exclude the possibility. |
| OPPO | Yes | We think NR-NR DC should not be supported in this release. In this case the coordination between MN and SN as pointed by ZTE is not needed. |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes (proponent) | As illustrated in our contribution R2-2202506, the large MRTD issue makes it not possible to use FR1 Pcell as SFN timing reference for FR2 UL gap when the FR2 band is configured in SCG.  Regarding the ZTE’s comment, we also want to avoid the complex coordination between MN and SN.  For vivo’s comment, though we do not disagree that Pcell can be used for sync DC, what we are trying here is to avoid capturing complicated text in RRC spec. For example, some text is needed to restrict that for async DC deployment with FR2 SCG, FR1 Pcell can not be used as timing reference.  In addition, considering UL gap is driven by RAN4, we should give RAN4 agreement more weight factor. I believe the only reason to follow legacy FR2 measurement gap framework is for simplicity. But we didn’t give enough thoughts on the specialty of UL gap. Now it’s clear that the exact same framework does not fit here, thus we should be open to make a much simpler (but different) solution. |
| Intel | yes | Agree with ZTE |
| Samsung | Yes |  |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | We are fine not to consider FR2-FR2 DC (i.e. both MN and SN have FR2 serving cell(s)) as that use case is quite unlikely to be supported by any UE in the foreseeable future. But at least FR1-FR2 DC (i.e. only SN has FR2 serving cell(s)) has to be supported.  Then on MN-SN coordination, if only SN has FR2 serving cells there are no problems assuming it's SN who provides the UL gap. The problems we have were created because companies wanted MN to provide the UL gap, even in cases where MN has no FR2 serving cells. |
| Ericsson | Yes |  |
| MediaTek | Yes |  |
| LGE | Yes |  |

**Summary:** 11 (out of 12) companies agree to follow with RAN4 agreement that timing reference for FR2 UL gap is based on the SFN/subframe of FR2 serving cell. 1 company mentioned PCell can be used as SFN timing reference in synchronous DC.

**Proposal 2: In NR-DC, timing reference for FR2 UL gap is based on the SFN/subframe of FR2 serving cell.**

**Question 3: If the answer to Question 2 is Yes, do companies agree with the following proposals?**

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| **Proposal 4: SN to configure FR2 UL gap if FR2 bands are only configured in SCG.**  **Proposal 5: No need to support MN and SN coordination to enable FR2 UL gap in NR-NR DC without FR2-FR2.** |

|  |  |  |
| --- | --- | --- |
| Company | Yes / No | Comments |
| ZTE | Yes, but only if NR-NR DC with FR2-FR2 scenario is not considered. | P4 can address the concerns we mentioned in Q2, which means if FR2 serving cells are configured as SCG SCells, it is up to the SN to configure FR2 UL gap, not the MN.  But we think P4 can only be agreed if FR2-FR2 NR-DC scenario is not considered.  If both “NR-DC without FR2-FR2” and “NR-DC with FR2-FR2” cases are supported, and for latter case it is up to the MN to configure FR2 UL gap, then it will cause much more complexities. For example: a UE is configured with FR2 serving cells only in SCG, and the SN already configures FR2 UL gap. Then a moment later, the MN configures more FR2 serving cells in MCG, then how to coordinate between MN and SN so that FR2 UL gap configuration can be “switched” from SN configuration to MN configuration? And complexity exists also when MCG FR2 serving cells are released.  So, for simplicity we are fine to accept P4 with the assumption that “NR-DC with FR2-FR2” is not considered in Rel-17. |
| Vivo | No | We would like keep the last RAN2 agreement. |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes (Proponent) | For FR1 MCG + FR2 SCG, allowing SN to configure FR2 UL gap makes our life much easier, without worrying about any coordination between MN and SN. |
| Intel | Yes |  |
| Samsung | Yes |  |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes but | P4 means SN provides the UL gap configuration to MN, either via XnAP or via RRC INM. In either case, we think the configuration has to be such that MN need not decode the configuration. So the MN-SN coordination **is required** in the sense that SN provides the configuration to MN, who sends it to UE. We can discuss the final details in CR discussion. |
| Ericsson | Yes |  |
| MediaTek | Yes |  |
| LGE | Yes |  |

**Summary:** For NR-DC with FR1 MCG + FR2 (+FR1) SCG, 11 (out of 12) companies agree the following. 1 company agreed with this in the condition that only if NR-NR DC with FR2-FR2 scenario is not considered. 1 company preferred to follow previous RAN2 agreement made in last meeting. In addition, 1 company mentioned some kind of MN-SN coordination is required if the ASN.1 configuration is provided by MN, which can be considered in CR discussion.

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| **Proposal 4: SN to configure FR2 UL gap if FR2 bands are only configured in SCG.**  **Proposal 5: No need to support MN and SN coordination to enable FR2 UL gap in NR-NR DC without FR2-FR2.** |

**Proposal 3: SN configures FR2 UL gap to UE if FR2 bands are only configured in SCG.**

**Proposal 4: In NR-DC without FR2-FR2 band combination, there is no need to support MN and SN coordination to enable FR2 UL gap.**

**Issue 2: Determination on support of NR-DC with FR2-FR2**

RAN4 indicated in [1] that there is no FR2-FR2 band combination specified for NR-DC in RAN4 and leaves it to RAN2 to decide whether to support it from signaling perspective.

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| **Q2:** Are MR-DC/NR-DC deployment scenarios included in this WI (NR\_RF\_FR2\_req\_enh2)? If NR-DC is supported, should the FR2-FR2 band combination be considered in the FR2 UL gap design?  **A2:** Per agreement in RAN#94e, MR-DC/NR-DC are part of this WI, where UL gap should apply. However, there is no FR2-FR2 band combination specified for NR-DC in RAN4 and it is up to RAN2 if FR2-FR2 NR-DC should be supported from signalling perspective. |

[3] has the following proposal:

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| **Proposal 6: RAN2 to discuss if FR2-FR2 DC should be supported. If RAN2 agrees to support it, FR2-FR2 NR-DC is limited to sync DC scenario.** |

**Question 4: About NR-DC with FR2-FR2 band combination, which option do companies prefer in RAN2 signalling design?**

**- Option 1: Support NR-DC with FR2-FR2**

**- Option 2: Do not support NR-DC with FR2-FR2**

|  |  |  |
| --- | --- | --- |
| Company | Support / No support | Comments |
| ZTE | Not support | See our comments to Q3.  As we discussed in gap coordination session, FR2 UL gap is excluded from the common gap framework because its configuration and purpose are different from other gap related features. In our view, even though it seems better to reuse legacy framework, the framework is not applicable here if only FR2 serving cell can be used as a timing reference.  Considering the limited time in Rel-17, it is not realistic/desirable to discuss and specify very complex MN-SN coordination procedures for FR2 UL gap configuration, and NR-DC with FR2-FR2 is not supported by current BCs.  So we suggest to focus on the main scenarios and does not consider NR-DC with FR2-FR2 in Rel-17 or even future releases. |
| Vivo | No strong view |  |
| OPPO | Option 2 |  |
| Huawei, HiSilicon | Option2 |  |
| Apple | Not support | Future proof is not needed to consider as RAN4 didn’t request RAN2 to do it.  And as we pointed out in R2-2202506, due to the large MRTD (125us) between FR2 and FR2 in async DC, it might require separate FR2 UL gaps for MCG FR2 and SCG FR2. We would like to avoid having such complex discussion considering the tight schedule. |
| Intel | Option 2 |  |
| Samsung | Option 2 | As there is no FR2-FR2 band comb for NR-DC, there is no need to support it from signalling perspective at this very late stage. |
| CATT | Option 2 |  |
| Nokia, Nokia Shanghai Bell | Option 2 | Agree with Samsung: FR2-FR2 DC seems unlikely to be supported by any UEs in the foreseeable future. |
| Ericsson | Option 2 |  |
| MediaTek | Option 2 | However, we wonder how to specify this in SPEC. I assume we should say that NW does not configure this feature if FR2 serving cell is configured for both MCG and SCG. |
| LGE | Option2 | On how to capture in the spec, we agree with MTK. |

Summary: 11 (out of 12) companies agree to not support NR DC with FR2-FR2 band combination. 1 (out of 12) company has no strong view. 1 company mentioned to capture something in spec that “NW does not configure this feature if FR2 serving cell is configured for both MCG and SCG”.

**Proposal 5: FR2 UL gap design does not support NR-DC with FR2-FR2 band combination. FFS how to capture the restriction in spec.**

**Question 5: If the answer to Question 4 is “Support”, do companies agree with the following proposals in [3]?**

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| **Proposal 6: RAN2 to discuss if FR2-FR2 DC should be supported. If RAN2 agrees to support it, FR2-FR2 NR-DC is limited to sync DC scenario.**  **Proposal 7: For FR2-FR2 NR-DC, the MN and SN coordination should support SN requests MN for FR2 UL gap configuration.** |

|  |  |  |
| --- | --- | --- |
| Company | Yes / No | Comments |
| ZTE | No | Although we answer “Not support” to Q4, we would like to share our views to this question.  In our understanding, P6 cannot address our concern on MN-SN coordination issues. As we commented to Q3, if both P4 and P6 are agreed, then we need to discuss and specify the MN-SN coordination procedure when MCG (or SCG) FR2 serving cells are released or added.  In addition, if P4 is not agreed but P6 is agreed, it implies that in any cases, it is up to the MN to configure FR2 UL gap, as we commented to Q2, we need to discuss how can MN provide FR2 UL gap configuration (by using FR2 serving cell as timing reference) if SCG SCells are FR2, but MCG and PSCell are FR1.  In summary, we think P6 cannot address the problems we mentioned previously. |
| vivo | No | We are ok to support the FR2-FR2 DC.  We also think async DC also can be supported by last RAN2 agreements. |
| OPPO | No | If we support FR2-FR2 DC, then the timing reference issue need be reopened again. Plus RAN4 doesn’t support the scenario while it is last meeting for RAN2 . |
| Apple | Yes | If async NR DC with FR2-FR2 is to be supported, our understanding is to address the large MRTD (125us), separate UL gaps may be needed for MCG and SCG. This might be too complex for now.  For ZTE’s comment, indeed if we strictly follow RAN4 agreement that only FR2 serving cell is used as timing reference, some extra coordination to exchange FR2 SCG SCell(s) addition/release is needed. |
| Nokia, Nokia Shanghai Bell | Yes | Although we think FR2-FR2 DC need not be supported, if we go that way then limiting to sync cases seems reasonable (since FR2 is anyway TDD only, synchronization is anyway necessary). |
|  |  |  |

**Summary:** Since NR DC with FR2-FR2 band combination is not supported according to the proposal made in Question 4, this question is not valid any more.

## 3.3 UL gap configuration

In RAN4 LS [1], the following parameters on UGL and UGRP are agreed.

|  |  |  |
| --- | --- | --- |
|  | UGL [ms] | UGRP [ms] |
| UL MGP #0 | 1.0 | 20 |
| UL MGP #1 | 1.0 | 40 |
| UL MGP #2 | 0.5 | 160 |
| UL MGP #3 | 0.125 when SCS of active UL BWP  =120kHz  0.25 when SCS of active UL BWP  =60kHz | 5 |

[3] has the following proposal to capture the agreed values in UL gap configuration.

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| **Proposal 1: In TS 38.331, for FR2 UL gap configuration, capture the values of *ugl* with {0.125ms, 0.25ms, 0.5ms, 1.0ms}, and the values of *ugrp* with {5ms, 20ms, 40ms, 160ms}.** |

**Question 6: Do companies agree with that “In TS 38.331, for FR2 UL gap configuration, capture the values of *ugl* with {0.125ms, 0.25ms, 0.5ms, 1.0ms}, and the values of *ugrp* with {5ms, 20ms, 40ms, 160ms}.”?**

|  |  |  |
| --- | --- | --- |
| Company | Yes / No | Comments |
| ZTE | Yes | Prefer to discuss the signalling details during CR discussion. |
| vivo | OK |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| Intel | Yes |  |
| Samsung | Yes |  |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes (see comments) | We assume then that all UEs support all of these values, and it is up to network to determine which values to configure. |
| Ericsson | Yes |  |
| MediaTek | Yes |  |

**Summary:** All (11) companies agree with that “In TS 38.331, for FR2 UL gap configuration, capture the values of *ugl* with {0.125ms, 0.25ms, 0.5ms, 1.0ms}, and the values of *ugrp* with {5ms, 20ms, 40ms, 160ms}.”.

**Proposal 6: In TS 38.331, for FR2 UL gap configuration, capture the values of *ugl* with {0.125ms, 0.25ms, 0.5ms, 1.0ms}, and the values of *ugrp* with {5ms, 20ms, 40ms, 160ms}.**

## 3.4 UE indication on the preferred UL gap patterns

RAN4 agreed on preferred UL gap patterns reporting [1], which was also discussed in RAN2 #116 meeting.

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| **Q5:** In RAN2 discussion, it has been brought up that from signalling point of view it is possible that UE provides its preferred FR2 UL gap patterns. Please RAN4 indicates whether it is beneficial for proper network configurations.  **A5**: In general, it is beneficial of UE to indicate the preferred FR2 UL gap patterns, which are not considered as UE capability. The eventual configured UL gap should be determined by the NW. |

[3] has the following proposal:

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| **Proposal 2: In TS 38.331, capture that UE indicates the preferred FR2 UL gap patterns using UAI message.** |

**Question 7: Do companies agree to capture that UE indicates the preferred FR2 UL gap patterns using UAI message in TS 38.331?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Yes | We are fine to support this, the detailed signalling/IE can be discussed during CR discussion. |
| Vivo | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| Intel | Yes |  |
| Samsung | No strong view | UE assistance could be useful considering the purpose of FR2 UL gap, but it may not be essential. Fine to follow majority view. |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes but | This would still be UE preference, not necessarly what NW configures. For example, UE might request 0.125ms but network could assign 1ms instead. |
| Ericsson | Yes | Agree with Nokia comment. |
| MediaTek | Yes |  |
| LGE | Yes |  |

**Summary:** 11 (out of 12) companies agree to capture that UE indicates the preferred FR2 UL gap patterns using UAI message in TS 38.331. 1 (out of 12) company has no strong view. 2 companies mentioned that the UE preference does not necessarily mean NW configures the same pattern.

**Proposal 7: Capture that UE indicates the preferred FR2 UL gap patterns using UAI message in TS 38.331.**

## 3.5 MAC impact

RAN4 agreed that all RACH procedures should be prioritized over FR2 UL gap as excerpted below [2].

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| On procedures to be prioritized over UL gap,  It was agreed that all the RACH procedure should be prioritized. FFS for other procedures. |

[3] then has the following proposal.

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| **Proposal 8: In TS 38.321, reflects that RACH procedure is prioritized over FR2 UL gap.** |

**Question 8: Do companies agree to reflect that RACH procedure is prioritized over FR2 UL gap in TS 38.321?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | Yes |  |
| vivo | Yes | However we would like tofollow measurement gap text.  For example, |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes | We tend to agree with ZTE, the modifications can be discussed during CR phase. |
| Apple | Yes | Details can be discussed in running CR. |
| Intel | Yes |  |
| Samsung | Yes |  |
| CATT | Yes |  |
| Nokia, Nokia Shanghai Bell | Yes | RACH is normally prioritized over other processes since it can be critical. |
| Ericsson | Yes |  |
| MediaTek | Yes |  |
| LGE | Yes |  |

**Summary:** All (12) companies agree to reflect that RACH procedure is prioritized over FR2 UL gap in TS 38.321.

**Proposal 8: Reflect that RACH procedure is prioritized over FR2 UL gap in TS 38.321.**

## 3.6 UE capability on FR2 UL gap

RAN4 agreed that the FR2 UL gap UE capability is per band [2].

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| On UE capability:  On UL gap for Tx power management UE capability, it was agreed the UL gap capability should be defined per band. |

[3] proposes the following:

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| **Proposal 10: UE indicates the FR2 UL gap support in per band UE capability and indicates the supported UL gap patterns in per UE capability.** |

The rapporteur feels RAN2 only needs to discuss the “per band UE capability” and waits for further progress from RAN4 on “supported UL gap patterns”.

**Question 9: Do companies agree to indicate the FR2 UL gap support in per band UE capability?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| ZTE | See comments | We think per-band UE capability is a bit tricky.  Based on RAN4 LS, they are still discussing the impacted FR2 serving cells when FR2 UL gap is configured. So if the capability is defined as per-band instead of per-UE. More discussions may be needed, e.g.   * If RAN4 concludes the FR2 UL gap only impacts the scheduling in associated FR2 band (for which the UE indicates FR2 UL gap capability): * We need to discuss whether FR2 UL gap is configured per-UE or per-band? Can network configures multiple FR2 UL gaps if more than one FR2 bands (CA) are configured? * Whether the gap (de)activation requirement in UAI is reported per-band level? * Whether the UE can report different preferred gap patterns for different FR2 bands? * If RAN4 concludes the FR2 UL gap impacts the scheduling in all configured FR2 serving cells: * We need to discuss how to determine FR2 UL gap requirement if the UE is configured with FR2 band combinations? Does it mean gap is needed if the UE indicates the capability for at least one configured FR2 band? * Whether the gap (de)activation requirement and preferred gap pattern in UAI are reported per-UE level?   In our understanding, per-UE level capability is simpler, but we are open to hear other companies’ views on this. |
| Vivo |  | We should ask RAN4. |
| OPPO | Yes | The intention of per band UE capability is to allow the band without low transmitting power continue to work even UL gap is configured for another band in the same group. The flexibility of UE capability doesn’t demand the complexity signalling for requesting or configuration i.e. within one cell group only single gap pattern is preferred. And finally we think RAN2 should respect RAN4’s agreement. |
| Huawei, HiSilicon |  | We raised similar comments in Sec 3.1, although it is more related to the network configuration, we are not sure how to understand the UE capability becomes per band while the UL gap is common for all FR2 bands. |
| Apple | Yes | RAN4 already agrees with per band UE capability.  Regarding ZTE’s questions (though we have sympathy), RAN4 is now discussing to apply FR2 UL gap on part of FR2 bands. We can wait for more input. |
| Intel | Yes |  |
| Samsung | Not sure | We have similar questions as Huawei/ZTE. |
| CATT | - | We respect to RAN4 decision, but want to confirm whether a common UL gap will be used for part of FR2 bands, or the number of UL gap for FR2 bands. |
| Nokia, Nokia Shanghai Bell | No | Why would the UE not support the same gap patterns for all of FR2? This is something UE either needs or doesn't, and it doesn't really seem dependent on band. What is the technical justification for requiring per-band capability?  Generally, we think splitting this capability to many parts just makes it less usable. UE should just support all the patterns or nothing. |
| Qualcomm Incorporated | Yes | Different requirements are expected for different FR2 bands, it’s recommended to define the capability per band (as indicated by RAN4).  Whether RAN4 decides to have the UL gap to be applicable across all FR2 bands or only across the bands that support this feature, it’s a completely different discussion and it shouldn’t be addressed in this question (RAN4 to decide). |
| MediaTek | Yes |  |
| LGE | Yes | Similar view with QC, i.e., different requirement may be defined for different FR2 bands. |

**Summary:** 6 (out of 12) companies explicitly agree with “per band” UE capability as RAN4 requested. 5 (out of 12) companies raised questions summarized below:

1. If the UE capability is per band, whether FR2 UL gap is configured per-UE or per-band? Can network configure multiple FR2 UL gaps if more than one FR2 bands (CA) are configured?
2. If the UE capability is per band, whether the gap (de)activation request in UAI is reported per-band level?
3. If the UE capability is per band, whether the UE can report different preferred gap patterns for different FR2 bands? And whether the activation/deactivation request is per UE or per band?

According to rapporteurs’ knowledge, RAN4 is discussing about the relevant points listed above. The rapporteur suggests to hold on UE capability for now and wait for more input from RAN4.

**Proposal 9: Wait for more input from RAN4 on FR2 UL gap UE capability.**

## 3.7 Others

For any other issues not covered above, please feel free to indicate them into the following table.

|  |  |  |
| --- | --- | --- |
| Company | Discussion points | Comments |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

# 4 Phase 2 Discussion

[TBA]

# 5 Conclusion

Based on the discussion above, below are the proposals.

**Proposal 1: RAN4 LS(s) (R2-2202155, R2-2202156) can be noted.**

**Proposal 2: In NR-DC, timing reference for FR2 UL gap is based on the SFN/subframe of FR2 serving cell.**

**Proposal 3: SN configures FR2 UL gap to UE if FR2 bands are only configured in SCG.**

**Proposal 4: In NR-DC without FR2-FR2 band combination, there is no need to support MN and SN coordination to enable FR2 UL gap.**

**Proposal 5: FR2 UL gap design does not support NR-DC with FR2-FR2 band combination. FFS how to capture the restriction in spec.**

**Proposal 6: In TS 38.331, for FR2 UL gap configuration, capture the values of *ugl* with {0.125ms, 0.25ms, 0.5ms, 1.0ms}, and the values of *ugrp* with {5ms, 20ms, 40ms, 160ms}.**

**Proposal 7: Capture that UE indicates the preferred FR2 UL gap patterns using UAI message in TS 38.331.**

**Proposal 8: Reflect that RACH procedure is prioritized over FR2 UL gap in TS 38.321.**

**Proposal 9: Wait for more input from RAN4 on FR2 UL gap UE capability.**

# 6 Previous RAN2 agreements

Agreements from RAN2#116 meeting:

* At least the following three parameters are included in FR2 UL gap configuration.

a) gapOffset

b) ugl

c) ugrp

* Agree to use explicit configuration on *ugl* and *ugrp* for FR2 UL gap configuration (same as in NR meas gap configuration).
* Using UAI message to indicate the need of FR2 UL gap activation/deactivation, if RAN4 agrees with the need.
* Activate/deactivate FR2 UL gap by RRC (no agreement in RAN2 for MAC CE for now).
* Will send LS with questions (discuss details in ph2)

Agreements from RAN2#116bis meeting:

* In SA deployment:

- For timing reference in synchronous FR2 CA configuration, the SFN and subframe of any FR2 serving cell can be used in the gap calculation.

- For timing reference in asynchronous FR2 CA configuration, the SFN and subframe of the serving cell on FR2 frequency indicated by the *refFR2ServCellAsyncCA* (FFS on the field name) is used in the gap calculation.

* The following responsible network entity on FR2 UL gap configuration in different deployment scenario are agreed:

- EN-DC: SN

- NE-DC: MN

* For EN-DC/NE-DC, there is no need to coordinate FR2 UL gap configuration between MN and SN.
* In EN-DC and NE-DC, use FR2 serving cell inside the CG with FR2 band as timing reference for the SFN and subframe calculation in FR2 UL gap calculation.
* For NR-NR DC without FR2-FR2 BC considered, the responsible network entity on FR2 UL gap configuration is MN.
* For NR-NR DC without FR2-FR2 BC considered, FFS on the details on MN-SN coordination.

The Following three points are agreed under condition that R4 would agree to such scenario (otherwise they are N/A):

* 1: For NR-NR DC with FR2-FR2 BC considered (if RAN4 agrees to support), MN is responsible for FR2 UL gap configuration.
* 2: In NR-NR DC with FR2-FR2 BC considered, agree that MN informs SN about the FR2 UL gap pattern configured.
* 3: In NR-DC with FR2-FR2 BC considered, *refServCellIndicator* is used to indicate the timing reference serving cell:

- For FR2 UL gapconfiguration with synchronous CA, for the UE in NR-DC with FR-FR2 band combination configured, the SFN and subframe of the serving cell indicated by the *refServCellIndicator* is used in the gap calculation.

- For FR2 UL gap configuration with asynchronous CA, for the UE in NR-DC with FR2-FR2 band combination configured, the SFN and subframe of the serving cell indicated by the *refServCellIndicator and refFR2ServCellAsyncCA* is used in the gap calculation.

* RAN2 to support that UE explicitly indicates the need of FR2 UL gap activation/deactivation using UAI message.
* From RAN2 perspective, MAC CE based FR2 UL gap activation/deactivation is not supported.
* UE supporting FR2 UL gap should also support R16 MPE reporting.
* Wait for RAN4 on the detailed UE capability reporting.

[4a, Alt2 is agreed]

* For NR-NR DC without FR2-FR2 BC, for timing reference for the SFN and subframe calculation in FR2 UL gap calculation: Follow legacy FR2 gap that the timing reference of FR2 UL gap can be PCell, PSCell or MCG FR2 serving cell, as indicated by *refServCellIndicator.* In asynchronous FR2 CA, *refFR2ServCellAsyncCA* is together used in the gap calculation.
* CRs to be provided for next meeting (Apple)