[95e-04-RAN4-R18-UEFR2RF] - Version 0.0.4
RAN

3GPP TSG-RAN Meeting #95 Electronic RP-220864

Electronic Meeting, March 17 - 23, 2022

Agenda item: 9.1.4

Source: Moderator (Nokia)

Title: Moderator summary for [95e-04-RAN4-R18-UEFR2RF] on new Rel-18 WID NR RF requirement enhancements for frequency range 2 (FR2)

Document for: Information & Decision

1 Introduction

This email discussion aims to find text for the justification section of the new RAN4-led Rel-18 WID on NR RF requirement enhancements for frequency range 2 (FR2). The WID draft from the previous email discussion is used as a starting point for the discussion.

2 Initial Round

2.1 Topic 1: Justification

The following justification section text is proposed in n the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the Justification section and then comment and make proposals for the justification section if needed.

Justification in RP-220056:

For UL 256 QAM, the improved throughput and accompanying capacity increase achieved from UL 256QAM could be extremely useful for research and marketing purposes. Especially in some industry use case, e.g., the machine transmits the photograph with super high resolution to the cloud, which needs Gbps data rate. In such case, the need for 256QAM can be seen. And in such scenario thanks to lower path loss, the possibility to use 256QAM would be higher. However, the actual performance gain and implementation aspects need to be studied.

For RF enhancement in FR2-1 for 39GHz band, the vehicular UE can be the potential use case for FR2. Regarding the 39GHz, n260(above 37GHz(37-40GHz)) is in planning from government around 2025~2026. Considering that the completion of Rel-18 is the end of 2023, Rel-19 is late to meet this schedule in advance.

For inter-band and intra-band DL/UL CA/DC RF enhancement in FR2-1, CA is important feature for all 3GPP RATs.

For enhanced switching time (ON/ON transient time), enhanced switching time (ON/ON transient time) would be beneficial from network point of view. ON/ON transient time has a significant impact on UL performance, especially for high SCS (480/960kHz) scenarios in FR2-2 and [FR2-1]. Improved UE capabilities to support up to 1us ON/ON transient period can be considered for FR2, similar to FR1.

For beam correspondence requirements for RRC_INACTIVE and initial access, UE beam correspondence functionality for RRCCONNECTED, RRCINACTIVE and initial access in IDLE is specified in the RAN1 and RAN2 specifications already in Release 15 but no FR2 UE beam correspondence requirements have been defined for RRCINACTIVE and initial access in IDLE yet. The current UE beam correspondence requirements are only defined for RRCCONNECTED. Without UE beam correspondence requirements for RRC_INACTIVE and initial access it is not possible to ensure good UE RACH and msg1 performance and UL coverage in FR2 deployments due to varying UE performances. Rel-15 RRCINACTIVE and Rel-17 small data transmission (SDT) have a large potential in UE power efficiency, latency and signalling overhead reduction. RRCINACTIVE allows for reduced latency and UE power saving, while SDT further enhances this for small data sessions. Considering that UE power savings are especially important for successful FR2 operations and good end-user experience, it would be important that the networks could efficiently utilize RRCINACTIVE and Small Data Transmissions for FR2 as well. Without well performing UE beam correspondence support wide usage of RRCINACTIVE and Small Data Transmission may not be feasible in practical FR2 deployments. To enable efficient use of RRCINACTIVE and Small Data Transmission in FR2 deployments to save UE power with reasonable latencies we see it important to develop FR2 UE beam correspondence requirements for RRCINACTIVE in Rel-18.

For power-control tolerance, there is potential to improve them to enhance performance. Several procedures reply on pathloss are impacted by the power control tolerance.

For achieving better FR2 coverage and/or performance, 1) In R15/16, maxUplinkDutyCycle-FR2 is reported as part of UE RF capability. Once reported, there is no further update. While dynamic max. UL duty cycle reporting was discussed in R15/R16, there was no consideration of the possible use of body proximity sensor (BPS) to detect if a human tissue is close-by and then decide if P-MPR is needed. With BPS, the use of dynamic maxUplinkDutyCycle-FR2 reporting is more targeted and useful. For instance, instead of incurring a large P-MPR, a UE at the cell edge can rely on a smaller duty cycle to transmit with a high power and still meet MPE requirements. 2)Optional P-MPR reporting was added in R16 so UE can inform gNB of the required P-MPR values for MPE compliance, but the granularity (3dB per notch) can be further improved. 3-A) based on RAN1 agreements, it is not guaranteed that the L1-RSRP of the associated SSBRI/CRI is always reported. In this case, the value of per-beam PMRP reporting is questionable. 3-B) In RAN1 discussion, body proximity sensing capability is assumed when per-beam PMPR reporting is introduced. From UL performance perspective, for the same SSBRI/CRI, UE can have different strategy to report P-MPR depending on human body approximation. If there is no human target around, UE should select the beam with the best EIRP in UL or L1-RSRP in DL and the corresponding P-MPR is reported. When there is human body approximate, the beam with maximum (L1-RSRP-P-MPR) should be selected and reported. Obviously, reporting a single P-MPR per SSBRI/CRI are not sufficient for MPE and UL performance enhancement.

Feedback Form 1: Is the justification section in RP-220056 acceptable?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, in your comments on the text in the justification section should focus on the following text related to UL 256QAM and Beam correspondence requirements for RRC_INACTIVE and initial access:

For UL 256 QAM, the improved throughput and accompanying capacity increase achieved from UL 256QAM could be extremely useful for research and marketing purposes. Especially in some industry use case, e.g., the machine transmits the photograph with super high resolution to the cloud, which needs Gbps data rate. In such case, the need for 256QAM can be seen. And in such scenario thanks to lower path loss, the possibility to use 256QAM would be higher. However, the actual performance gain and implementation aspects need to be studied.

For beam correspondence requirements for RRC*INACTIVE and initial access, UE beam correspondence functionality for RRCCONNECTED, RRCINACTIVE and initial access in IDLE is specified in the RAN1 and RAN2 specifications already in Release 15 but no FR2 UE beam correspondence requirements have been defined for RRCINACTIVE and initial access in IDLE yet. The current UE beam correspondence requirements are only defined for RRCCONNECTED. Without UE beam correspondence requirements for RRC*INACTIVE and initial access it is not possible to ensure good UE RACH and msg1 performance and UL coverage in FR2 deployments due to varying UE performances. Rel-15 RRCINACTIVE and Rel-17 small data transmission (SDT) have a large potential in UE power efficiency, latency and signalling overhead reduction. RRCINACTIVE allows for reduced latency and UE power saving, while SDT further enhances this for small data sessions. Considering that UE power savings are especially important for successful FR2 operations and good end-user experience, it would be important that the networks could efficiently utilize RRCINACTIVE and Small Data Transmissions for FR2 as well. Without well performing UE beam correspondence support wide usage of RRCINACTIVE and Small Data Transmission may not be feasible in practical FR2 deployments. To enable efficient use of RRCINACTIVE and Small Data Transmission in FR2 deployments to save UE power with reasonable latencies we see it important to develop FR2 UE beam correspondence requirements for RRCINACTIVE in Rel-18.

Other parts of the Justification in RP-220056 will be removed following today's GTW endorsement

2 – Apple Italia S.R.L.

In our understanding, beam correspondence during initial access and power control tolerance are related topics and should be handled together. For example, during initial access, the UE can only rely on OL TPC to set its output power, and any requirement on PRACH output power would need to take this into account. Having a second look at the power control requirements can help us achieve the goal of improving overall system performance during the RACH process. If we ignore TPC and only focus on the spatial domain, then the entire feature could become a "lab only" feature with little relevance to improved field performance.

Based on the above, we recommend a slight correction of the power control tolerance part, as follows:

Considering that during initial access the UE can only rely on open loop transmit power control to set its output power, it is recognized that beam correspondence enhancements during initial access can also benefit from a potential improvement of power control.

3 – Nokia France

The relevant paragraphs of the justification are basically fine. We propose a few editorial updates here: https://www.3gpp.org/ftp/tsg*ran/TSG*RAN/TSGR*95e/Inbox/Drafts/%5B95e-04-RAN4-R18-UEFR2RF%5D/RP-220056%20New%20WID%20NR%20RF%20requirements%20enhancement%20for%20FR2*v001_Nok.doc

2.2 Topic 2: Objective: UL 256QAM

The following objectives are proposed for UL 256QAM in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed.

Objectives in RP-220056:

- Investigate and [if feasible], enable UL 256QAM for FR2 (RAN4)
- Study the gain, operating SNR, phase noise model and implementation aspects
- Specify the UE RF requirements
- Specify the BS demodulation performance
- Targeted power classes are PC1 and PC5 device types of UE are CPE/FWA [only].

Feedback Form 2: Are the proposed objectives in RP-220056 acceptable without square brackets?

1 – TELECOM ITALIA S.p.A.

we suggest to remove the text in square brackets

Investigate and ~~[if feasible],~~ enable UL 256QAM for FR2 (RAN4)

2 – Sony Group Corporation

we are fine to limit the scope to PC1/5.

3 – Qualcomm Technologies Int

We agree with Telecom Italia, we should not leave it open if we do this or not.

We would like to enable also PC3. Technically EVM challenge is same for handheld as for FWA.

4 – KT Corp.

KT agree with Telecom Italia to remove the text in the square bracket.

5 – ZTE Corporation

We agree with Telecom Italia to remove the text in the square bracket, we think it's reasonable and necessary to enable the uplink 256QAM in FR2 since DL 256QAM was already supported for FR2.

For the PCx, ok to focus PC1/5 in Rel-18, we could further check its possibility to be enabled on smart phone in future release.

6 – China Telecom Corporation Ltd.

We agree with Telecom Italia to remove the text in the square bracket. Leaving it open will increase RAN4 workload on arguing whether it is feasible or not.

7 – Guangdong OPPO Mobile Telecom.

1. We would like to keep the "if feasible" in the scope considering the difficulty discussion even for DL 256QAM in Rel-16 where the main challenge is in BS side. Now for UE even CPE/FWA type, still it is much more challenge than BS. There is no harm to keep the "if feasible" if companies believe this is feasible in implementation otherwise we would have to define bad requirements and in the end no much meaning in the field.

2. We would like to only consider PC1/PC5 in this release and no PC3.

8 – MediaTek Inc.

- We are fine with the change suggested by Telecom Italia.
- We assume the objective is for FR2-1 only. It would be good to clarify this further.

9 – LG Electronics Inc.

We would like to propose PC1/2/5 as targeted power classes (FWA/vehicular UE type).

10 – Verizon UK Ltd

We agree with the MediaTek comments!

We suggest including PC3 and changing the text as below

− Targeted power classes are PC1, **PC3** and PC5 device types of UE are CPE/FWA ~~[only]~~.

11 – Apple Italia S.R.L.

We agree with removing the square brackets from both "if feasible" and "CPE/FWA only"

12 – Intel Deutschland GmbH

We prefer not to preclude other power classes; we may also consider including PC6

13 – NTT DOCOMO INC.

Our preference is to include PC3. In any case, RAN4 starts from study, so we would like to know the feasibility of 256QAM for PC3 as well. We are open to include PC2.

Proposed changes:

Targeted power classes are PC1**, PC2, PC3** and PC5 ~~device types of UE are CPE/FWA [only].~~

14 – China Mobile Com. Corporation

For the [If feasible] in [], we support to remove them.

For the PC, we share similar view with DOCOMO include more power classes for study.

15 – Orange

We agree with Telecom Italia's suggestion to remove the square brackets

16 – Huawei Technologies France

We agree with Telecom Italia, feasibility wording in [ ] can be removed.

17 – LG Uplus

Regarding the PC, we share similar view with NTT Docomo and CMCC for including more power classes for study.

18 – Nokia France

We propose a few updates here, including deleting "if feasible": https://www.3gpp.org/ftp/tsg*ran/TSG*RAN/TSGR*95e/Inb*
04-RAN4-R18-UEFR2RF%5D/RP-220056%20New%20WID%20NR%20RF%20requirements%20enhancement%20for%

19 – AT&T GNS Belgium SPRL

We agree with Telecom Italia's suggested edits to the objectives. Otherwise, we are fine with the moderator proposal.

2.3 Topic 3: Objective: RF enhancement in FR2-1 for 39GHz band

The following objectives are proposed for FR2-1 for 39GHz band in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed.

Objectives in RP-220056:

- RF enhancement in FR2-1 for PC2(Vehicular UE) n259 [and n260] (39GHz) band (RAN4)
- Vehicular UE requirements for power class 2 in n259 [and n260] (39GHz).
- [Vehicular UE requirements for inter-band UL [and DL] CA with IBM
- n257+n259
- n260+n261]

Moderator's notes:

FFS CA parts should be included based on the outcome of Rel-17 discussion.

Feedback Form 3: Are the proposed objectives in RP-220056 acceptable without square brackets?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, there is no need to comment on this objective as it will not be part of the RAN4 Rel-18 package and this WID.

2.4 Topic 4: Objective: Inter-band and intra-band DL/UL CA/DC RF enhancement in FR2-1

The following objectives are proposed for Inter-band and intra-band DL/UL CA/DC RF enhancement in FR2-1 in the WID draft RP-220056, which was drafted based on the previous RAN email discussion.

Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed. Companies are also invited to propose how to resolve the remaining open items and FFS aspects in the objective proposal.

Objectives in RP-220056:

- Inter-band and intra-band DL/UL CA/DC RF enhancement in FR2-1 depending on operators'requests (RAN4)
- [Study and if feasible,] define RF requirement(s) for support of inter-band UL CA for same frequency group and different frequency groups in FR2-1 based on CBM
- Take the capability alignment between UL and DL CA into account, e.g., only consider the case where DL CBM is available

Moderator's notes:

- If there are no band combination request, the objective of inter-band UL CA for same frequency group and different frequency groups in FR2-1 based on CBM should be deprioritized.
- FSS to include CA within same frequency group in Rel-18 work.
- Further discuss handling of Rel-17 leftover based on the outcome of Rel-17 discussion. Rel-17 leftover should be added in Rel-18 work item if not finished in Rel-17. Potential leftovers are:
    - [DL CA with IBM for same frequency group]
    - DL CA with CBM for [same frequency group] and different frequency groups
    - UL CA with IBM for different frequency groups
        - For Rel-17 leftover topics, potential impact to WG2 unless Rel17 WI completes certain features which need new UE capabilities.

Feedback Form 4: Are the proposed objectives in RP-220056 acceptable without square brackets? How to resolve the remaining FFS aspects and open items?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, there is no need to comment on this objective as it will not be part of the RAN4 Rel-18 package and this WID.

2 – Apple Italia S.R.L.

We are fine with the GTW outcome

2.5 Topic 5: Objective: Enhanced switching time (ON/ON transient time)

The following objectives are proposed for Enhanced switching time (ON/ON transient time) in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed.

Objectives in RP-220056:

- Enhanced switching time (ON/ON transient time)
- Investigate (gain) and if possible, enhance [FR2-1] and FR2-2 switching time (ON/ON transient time)

Moderator's notes:

- Further discuss based on the outcome of Rel-17 discussion.
- Consider the conclusions in FR1 transient period capability discussion as much as possible

Feedback Form 5: Are the proposed objectives in RP-220056 acceptable?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, there is no need to comment on this objective as it will not be part of the RAN4 Rel-18 package and this WID.

2 – Apple Italia S.R.L.

We are fine with the GTW outcome

3 – AT&T GNS Belgium SPRL

We are OK with the moderator proposal but also think that FR2-1 can be removed from the scope since this should target higher SCSs. Companies indicated during the Rel-17 discussion that they were OK to see this item for study and, if needed, specified in Rel-18 as opposed to including in the Rel-17 timeframe. But now, we are in the situation where ON/ON transient time was not considered during the Rel-18 Prep and is now excluded because it was attempted to be resolved in Rel-17. This would be unfortunate.

2.6 Topic 6: Objective: Beam correspondence requirements for RRC_INACTIVE and initial access

The following objectives are proposed for Beam correspondence requirements for RRC_INACTIVE and initial access in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed.

Objectives in RP-220056:

- [Study the need and how to specify beam correspondence requirements[/verification] for RRC_INACTIVE and initial access]
- Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for the UE support SSB-based without UL beam sweeping [RAN4 RF]
- For RRC_INACTIVE at least [necessary] requirements for Random Access SDT and Configured Grant SDT
  - It's not precluded for other transmission within RRC_INACTIVE state
  - For initial access, [necessary] requirements verification of beam correspondence requirements based on msg1 spherical coverage (at least)
- Study the potential impact on testability aspects (i.e., test time).

Feedback Form 6: Are the proposed objectives in RP-220056 acceptable without square brackets?

1 – Qualcomm Technologies Int

[Study the need and how to specify beam correspondence requirements[/verification] for RRC_INACTIVE and initial access]

Will cause unnecessary speculation in WG. We propose to remove the first bullet completely.

2 – Sony Group Corporation

We share a similar view as Qualcomm. In particular, the need of BC requirement for initial access and inactive has been very well discussed and we don't see a strong need of it.

3 – ZTE Corporation

Basically, we agree to remove 'the need and how to specify' in the first bullet, i.e.:

[Study ~~the need and how to specify~~ beam correspondence requirements[/verification] for RRC_INACTIVE and initial access]

RAN1/2 have already specified the BC function for RRCINACTIVE and initial access in IDLE, it should be well known that beam correspondence requirement is critical for RRC_INACTIVE and initial access.

Also, we can agree with QC to remove the whole first bullet.

4 – Guangdong OPPO Mobile Telecom.

This topic is very controversial in the past, and we need to be careful about the wording and be clear about what the group need to do.

1. Up to now there is no consensus whether this beam correspondence for inactive and initial access is needed or not. Therefore, the [ ] in the first sentence need to be removed, and keep "*study the need and how to specify...*".
2. For the RF requirements it can only be specified after RAN4 has consensus on the necessity, i.e. "*the need and how to specify...*", therefore, the 2nd and 3rd sentence need to clarify this.
3. Proposed **changes** as below:

~~[~~Study the need and how to specify beam correspondence requirements[/verification] for RRC_INACTIVE and initial access~~]~~

After the necessity and test feasibility is confirmed, Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for the UE support SSB-based without UL beam sweeping [RAN4 RF]

For RRC_INACTIVE **further discuss which SDT** ~~**at least [necessary]**~~ requirements **need to be specified,** e.g. for Random Access SDT and Configured Grant SDT

- ~~**It's not precluded for other transmission within RRC_INACTIVE state**~~
- ~~**For initial access, [necessary] requirements verification of beam correspondence requirements based on msg1 spherical coverage (at least)**~~

~~**Study the potential**~~ impact on testability aspects (i.e., test time) **will be considered in the study and requirement definition**.

5 – LG Electronics Deutschland

We think the first bullet with a square bracket is necessary to check the feasibility of BC in initial access and RRC_INACTIVE from the UE perspective since we are not sure whether this BC is really necessary and feasible or not. So we propose to keep this sentence as it is without a square bracket. We are also fine with the modification proposed by OPPO.

6 – Apple Italia S.R.L.

Please refer to our comments in 2.1 (Topic 1). We would like to include the following objective in order to achieve the gains anticipated with the beam correspondence enhancement:

Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance; this includes the consideration of replacing OL TPC by setting Tx power to Pcmax for PRACH transmissions.

We also would like to keep the study phase for this objective with the following wording change of the objectives so far provided:

1. Remove bracket for

[Study the need and how to specify beam correspondence requirements[/verification] for RRC_INACTIVE and initial access]

2. Revise

Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for the UE support SSB-based without UL beam sweeping [RAN4 RF]

to

Pending the outcome of the study, specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for the UE support SSB-based without UL beam sweeping [RAN4 RF]

7 – Intel Deutschland GmbH

Our preference is to keep the first bullet point. We may further discuss the wording if needed.

8 – NTT DOCOMO INC.

We have similar view with Qualcomm. Our preference is that RAN4 will focus on discussing how to specify the requirements.

Other parts are fine to us.

9 – Orange

We agree with Qualcomm's view. The benefits should be clear.

10 – Huawei Technologies France

We prefer to keep the first bullet, and the [ ] can be removed. The proposed changes by OPPO is also fine for us.

11 – TELECOM ITALIA S.p.A.

same view as Orange and Qualcomm

12 – Nokia France

We agree with Qualcomm and others that the whole first bullet is unnecessary. Alternatively, we could accept as a compromise the version shown here (together with some additional clarifications and editorial corrections): https://www.3gpp.org/ftp/tsg*ran/TSG*RAN/TSGR*95e/Inbox/Drafts/%5B95e-04-RAN4-R18-UEFR2RF%5D/RP-220056%20New%20WID%20NR%20RF%20requirements%20enhancement%20for%20FR2*v001_N

13 – Ericsson LM

We support the objective and also agree with QC proposal to remove the brackets. The first bullet is the basic objective and having bracket around it is strange. The objective is stable after very long discussion.

14 – AT&T GNS Belgium SPRL

We agree with the QC proposal to remove the brackets. Otherwise, we support the objective proposed by the moderator.

2.7 Topic 7: Objective: Power-control tolerance

The following objectives are proposed for Power-control tolerance in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed.

Objectives in RP-220056:

Power-control tolerance

- Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance: [this includes the consideration of replacing OL TPC by setting Tx power to Pcmax for PRACH transmissions.]

Feedback Form 7: Are the proposed objectives in RP-220056 acceptable without square brackets?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, there is no need to comment on this objective as it will not be part of the RAN4 Rel-18 package and this WID.

2 – Apple Italia S.R.L.

As we commented in 2.6, this objective should be merged with the beam correspondence enhancement

2.8 Topic 8: Objective: Achieving better FR2 coverage and/or performance

The following objectives are proposed for Achieving better FR2 coverage and/or performance in the WID draft RP-220056, which was drafted based on the previous RAN email discussion. Companies are invited to review the proposed objectives and then comment and make proposals for objective updates if needed

Objectives in RP-220056:

1) maxUplinkDutyCycle-FR2 reporting, dynamic or semi-static, which would provide the network timely update to assist scheduling

2) Better granularity of P-MPR reporting from UE

3) Possible enhancements to R17 beam-specific P-MPR reporting

Feedback Form 8: Are the proposed objectives in RP-220056 acceptable?

1 – Nokia Corporation

Moderator's (Sari Nielsen, Nokia) update:

Today's GTW endorsed the following topics for the Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- **UL 256QAM**
- **Beam correspondence requirements for RRC_INACTIVE and initial access**

Therefore, there is no need to comment on this objective as it will not be part of the RAN4 Rel-18 package and this WID.

2 – Apple Italia S.R.L.

We are fine with the GTW outcome

2.9 Topic 9: Other comments and proposals

Companies can make other comments and proposals for the WID preparation here.

Feedback Form 9: Any other comments or proposals for the WID preparation?

1 – Qualcomm Technologies Int For DC location for DL only CA, there are some comments in thread [95e-37-R17-FR2-RF] that it is not acceptable to include this case. If that is the conclusion, and proposal in RP-220469 is not acceptable, or an other wording with the same contents of including DL CA, then we will need to include that objective in Rel-18 and this WI would be a good host for it.
2 – vivo Communication Technology For DC location, it is proposed to finish that in R17 to avoid duplicate work in Rel-18. For Rel-17 CBM part work, it should be cautious to be introduced into Rel-18 even if downscoped from Rel-17. Considering the previous discussion history, we see no easy way to have compromise.

2.10 Summary of Initial Round discussions

Topic 1:

The RAN#95 GTW on March 17 endorsed the following topics for Rel-18 UE FR2 RF enhancements work:

UE FR2 RF enhancements (3 topics)

- Requirement for FR2 multi-Rx chain DL reception (as a separate WID)
- UL 256QAM
- Beam correspondence requirements for RRC_INACTIVE and initial access

Therefore, the justification section is updated to only include parts for UL 256QAM and Beam correspondence requirements for RRC_INACTIVE and initial access. Other parts are removed.

During the initial round discussion small clarifications were proposed to the justification text. Additionally the following text was proposed to justify work on potential improvements of power control:

- Considering that during initial access the UE can only rely on open loop transmit power control to set its output power, it is recognized that beam correspondence enhancements during initial access can also benefit from a potential improvement of power control.

Topic 2: UL 256 QAM

Majority of the companies propose to remove the text [if feasible] form the objective. Different views were expressed what UE power classes should be included to the work. Some companies proposed additional power classes like PC2 and PC3 to be added. Some companies proposed the removal of device types limitation to CPE/FWA.

Topic 3: RF enhancement in FR2-1 for 39GHz band

No discussion on this topic as it is not part of the endorsed Rel-18 RAN4 package.

Topic 4: Inter-band and intra-band DL/UL CA/DC RF enhancement in FR2-1

No discussion on this topic as it is not part of the endorsed Rel-18 RAN4

Topic 5: Enhanced switching time (ON/ON transient time)

No discussion on this topic as it is not part of the endorsed Rel-18 RAN4

Topic 6: Topic 6: Objective: Beam correspondence requirements for RRC_INACTIVE and initial access

Majority of the companies wanted to remove the first objective bullet; [Study the need and how to specify beam correspondence requirements[/verification] for RRC_INACTIVE and initial access]. However, also noticeable amount of companies felt that it is would be important to keep the first sentence as part of the objectives. Also compromise wordings and editorial updates were also proposed.

One company proposed the following additional objective:

- Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance; this includes the consideration of replacing OL TPC by setting Tx power to Pcmax for PRACH transmissions.

Topic 7: Power-control tolerance

No discussion on this topic as it is not part of the endorsed Rel-18 RAN4

Topic 8:Objective: Achieving better FR2 coverage and/or performance

No discussion on this topic as it is not part of the endorsed Rel-18 RAN4

Topic 9: Other comments and proposals

During the initial round it was proposed that if DC location for DL only CA, which is discussed under [95e-37-R17-FR2-RF], is not completed in Rel-17, it should be included to this Rel-18 work item. The discussion under .[95e-37-R17-FR2-RF] is still ongoing and therefore, this topic is not included to the Intermediate round discussion.

3 Intermediate Round

3.1 Topic 1: Justification

Following the RAN#95 GTW agreements for Rel-18 RAN4 package on March 17 the justification text is focused on UL 256 and Beam correspondence requirements for RRC_INACTIVE and initial access.

The text of the justification section is updated based on the clarification proposals made during the initial round

Updated Justification section:

For UL 256 QAM, the improved throughput and accompanying capacity increase achieved from UL 256QAM could be extremely useful for research and marketing purposes, especially in some industry use cases, e.g., the machine transmits the photograph with super high resolution to the cloud, which needs Gbps data rate. In scenarios with lower path loss, the possibility to use 256QAM would be higher. However, the actual performance gain and implementation aspects need to be studied.

For beam correspondence, UE beam correspondence functionality for RRC_CONNECTED, RRC_INACTIVE and initial access in IDLE is specified in the RAN1 and RAN2 specifications already in Release 15 but no FR2 UE beam correspondence requirements have been defined for RRC_INACTIVE and initial access in IDLE yet. The current UE beam correspondence requirements are only defined for RRC_CONNECTED. Without UE beam correspondence requirements for RRC_INACTIVE and initial access it is not possible to ensure good UE RACH msg1 performance and UL coverage in FR2 deployments due to varying UE performances. Rel-15 RRC_INACTIVE and Rel-17 small data transmission (SDT) have a large potential in UE power efficiency, latency and signalling overhead reduction. RRC_INACTIVE allows for reduced latency and UE power saving, while SDT further enhances this for small data sessions. Considering that UE power savings are especially important for successful FR2 operations and good end-user experience, it would be important that the networks could efficiently utilize RRC_INACTIVE and Small Data Transmissions for FR2 as well. Without well performing UE beam correspondence support, wide usage of RRC_INACTIVE and Small Data Transmission may not be feasible in practical FR2 deployments. To enable efficient use of RRC_INACTIVE and Small Data Transmission in FR2 deployments to save UE power with reasonable latencies we see it important to develop FR2 UE beam correspondence requirements for RRC_INACTIVE in Rel-18.

Feedback Form 10: Is the updated text for the justification section above acceptable?

1 – Guangdong OPPO Mobile Telecom.

The following should be **removed** from Justification part since whether the beam correspondence performance can be covered by connected mode is still under discussion and not justified:

- ”~~Without UE beam correspondence requirements for RRC_INACTIVE and initial access it is not possible to ensure good UE RACH msg1 performance and UL coverage in FR2 deployments due to varying UE performances. Rel-15 RRC_INACTIVE and Rel-17 small data transmission (SDT) have a large potential in UE power efficiency, latency and signalling overhead reduction.~~”

2 – Guangdong OPPO Mobile Telecom.

And the following part should be revised to reflect the status of no consensus now on whether RAN4 will definitely introduce requirements specially for initial access beam correspondence:

- To enable efficient use of RRC_INACTIVE and Small Data Transmission in FR2 deployments to save UE power with reasonable latencies we see it important to **study**~~**develop**~~ FR2 UE beam correspondence requirements for RRC_INACTIVE in Rel-18.

3 – Nokia Corporation

Moderator to OPPO: Currently no requirements are defined for RRCINACTIVE and initial access BC. Even if the connected mode requirements were utilized or even copied for RRC_INACTIVE and initial access, it is still definition of requirements.

4 – Nokia France

The moderator's updated text for the Justification is fine.

We do not see good reasons to make the changes proposed by Oppo.

The following additional justification proposal was made by one companies. The corresponding objective updates were also made. During the Intermediate Round this additional proposal will be discussed.

Additional Justification Proposal:

Considering that during initial access the UE can only rely on open loop transmit power control to set its output power, it is recognized that beam correspondence enhancements during initial access can also benefit from a potential improvement of power control.

Feedback Form 11: Is the additional justification text on potential power control improvements acceptable?

1 – Apple Italia S.R.L.

As the proponent company, we support this addition to the justification part

2 – Nokia France

In principle, tighter open loop power control tolerance could be beneficial, but we do have concern that including this aspect could significantly increase the amount of work involved, especially if the actual intent behind the proposal is broader than just tightening the tolerances.

3.2 Topic 2: Objective: UL 256QAM

During the Intermediate Round discussion the aim is to conclude target power classes for UL 256 QAM requirement work and confirm the other objectives for UL 256QAM.

Updated objectives for UL 256QAM

- Investigate and enable UL 256QAM for FR2 (RAN4)
  - Study the gain, operating SNR, phase noise model and implementation aspects
  - Specify the UE RF requirements
  - Specify the BS demodulation performance
  - Targeted power classes are PC1, PC2, PC3 and PC5 device types of UE are CPE/FWA.

Feedback Form 12: Can we add PC2 and PC3 to targeted power classes?

1 – Qualcomm Technologies Int Yes we support adding PC3.
2 – Apple Italia S.R.L. We prefer to keep the work focused on PC1 and PC5.
3 – AT&T GNS Belgium SPRL We support the moderator proposal.
4 – Verizon UK Ltd We support the moderator proposal !
5 – Huawei Technologies France We prefer to keep focusing on PC1 and PC5 FWA UE.
6 – Guangdong OPPO Mobile Telecom. We prefer to keep PC1 and PC5 since this is the original intention of this topic, and not ok to include PC3.
7 – LG Electronics Inc. We're OK adding PC2. Regarding it, device types of UE are CPE/FWA needs to be removed.
8 – KDDI Corporation We support the moderator proposal.
9 – SoftBank Corp. We support the moderator's proposal.

10 – Samsung Electronics Co.

We support moderator proposal

11 – ZTE Corporation

We support moderator proposal

12 – China Telecom Corporation Ltd.

We are ok with the proposal, considering that the support of UL 256QAM is anyway up to UE reporting, and it is no harm to cover more power classes in the specification.

13 – TELECOM ITALIA S.p.A.

I have some concerns with the addition of other power classes / removing CPE/FWA UE types. many companies indicated complexity non-feasibility for smartphones. I am afraid that removing the limitation will cause a lot of discussion in RAN4 and delay the completion of the work. A possible compromise would be to add other power classes / other UE types as second priority.

14 – NTT DOCOMO INC.

We have similar view with China telecom. Regarding device types, our preference is to remove the limitation, but we can accept the current moderator's proposal.

15 – vivo Communication Technology

We prefer to keep the scope to PC1 and PC5.

16 – Nokia France

We are not against adding PC2 and PC3, but they would increase the workload. Perhaps they could be included with second priority, in case time allows.

We would also propose limiting the scope of the UL 256QAM objective to FR2-1 only, to constrain the workload.

Feedback Form 13: Any other comments on the objective text?

1 – Qualcomm Technologies Int

if we add PC3, then this part may need to be removed: "device types of UE are CPE/FWA"

2 – MediaTek Inc.

- Same view as Qualcomm.
- We commented in the initial round to have some clarification that this work is for **FR2-1 only** (agreed by VzW). However, it was not captured in the intermediate round at least to collect views from companies. We hope this part can be clarified.

3 – TELECOM ITALIA S.p.A. support Mediatek's comment to clarify this work is for FR2-1 only. I have some concerns with the addition of other power classes / removing CPE/FWA UE types. many companies indicated complexity non-feasibility for smartphones. I am afraid that removing the limitation will cause a lot of discussion in RAN4 and delay the completion of the work. A possible compromise would be to add other power classes / other UE types as second priority.
4 – Nokia France We support limiting the scope of the UL 256QAM objective to FR2-1 only, to constrain the workload.
5 – China Mobile Com. Corporation I think it is common understanding that UL 256QAM is for FR2-1 only, better to clarify.
6 – Huawei Technologies France It is beneficial to clarfy it for FR2-1 only. Also the core part and perf part should be separated in the WID.

3.3 Topic 6: Objective: Beam correspondence requirements for RRC_INACTIVE and initial access

During the Intermediate Round discussion the aim is to conclude the objectives for the beam correspondence requirements for RRC_INACTIVE and initial access. In the updated objective for the intermediate round the first sentence is removed and editorial update proposals are included. Additionally, the aim is to discuss whether to include additional objective proposed during the Initial Round.

Updated objectives for the beam correspondence requirements for RRC_INACTIVE and initial access:

- Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for SSB-based beam correspondence without UL beam sweeping [RAN4 RF]
    - For RRC_INACTIVE, specify at least requirements for Random Access SDT and Configured Grant SDT
        - Requirements for other transmission within RRC_INACTIVE state are not precluded
    - For initial access, specify requirements and verification of beam correspondence requirements based on msg1 spherical coverage (at least)
- Study the potential impact on testability aspects (i.e., test time).

Feedback Form 14: Can we accept the updated objectives as a compromise considering that majority of companies preferred not to include study phase?

1 – Qualcomm Technologies Int

We support the moderator wording of the objective.

2 – Apple Italia S.R.L.

We still have a preference to keep the study phase for this objective rather than going directly to normative work

3 – Sony Group Corporation

we support the updated objectives.

4 – AT&T GNS Belgium SPRL

We support the moderator proposal.

5 – MediaTek Inc.

- We do not prefer to remove the study phase completely. We still see 5 companies preferring to keep the study phase in the WID from the initial round discussion. Given the different understandings among companies, we believe that adding the study phase is already a very good middle ground for the 2 sides. Adding a study phase is the typical approach to resolve concerns just like we do in many other WIs.
- If there is no consensus to remove it, we suggest to go back to the approved package RP-220068, in which the appendix still have the study phase without [ ].

6 – ZTE Corporation

We are fine with moderator proposal.

7 – Huawei Technologies France

We think the first bullet in intial round shall not be removed, especially the verification part is important for determining whether the requriements are feasible or not, which should be studied firstly.

8 – Huawei Technologies France

Be more specific for above comments, the following changes are provided. SSB based BC requirements w/o UL beam sweeping were already specified in previous releases, not sure why we need it.

- **Study the need and how to specify beam correspondence requirements/verification for RRC_INACTIVE and initial access**
- Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, ~~for SSB-based beam correspondence without UL beam sweeping~~ [RAN4 RF]

- For RRC_INACTIVE, specify at least requirements for Random Access SDT and Configured Grant SDT
    - Requirements for other transmission within RRC_INACTIVE state are not precluded
- For initial access, specify requirements and verification of beam correspondence requirements **if necessary** based on msg1 spherical coverage (at least)

- Study the potential impact on testability aspects (i.e., test time).

9 – Guangdong OPPO Mobile Telecom.

In our view, the study phase is important for this topic, and not see the reason of removing it before thorough study and conclusion on the necessity and feasibility is reached. Therefore, we are not ok to remove the 1st sentence.

- **Study the need and how to specify beam correspondence requirements/verification for RRC_INACTIVE and initial access**

10 – SoftBank Corp.

We support the moderator's proposal.

11 – LG Electronics Deutschland

We think study phase inclusion is necessary to check the feasibility and necessity of BC in initial access/I-NACTIVE state.

12 – TELECOM ITALIA S.p.A.

We support the moderator's proposal

13 – NTT DOCOMO INC.

We support the moderator's proposal. Our preference is that RAN4 will focus on discussing how to specify the requirements.

14 – Ericsson LM

We support the moderator's proposal.

15 – vivo Communication Technology

We think a study phase is still necessary. The feasibility and the way to specify is not that mature for these cases. This has bo be clarified in the WID.

16 – Nokia France

We support the moderator's proposal.

(If any study were to be included, it can only be to study the method, not the need; the need is clear, as described in the justification. similarly, we do not agree to insert "if necessary".)

17 – China Mobile Com. Corporation

OK with moderator proposal.

Additional objective proposed during the Initial Round:

- Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance; this includes the consideration of replacing OL TPC by setting Tx power to Pcmax for PRACH transmissions.

Feedback Form 15: Can we include this additional objective to the beam correspondence objectives?

1 – Qualcomm Technologies Int

We support this additional objective and its addition to the WI objective.

2 – Apple Italia S.R.L.

As the proponent company, we support including this objective in the work scope

3 – Huawei Technologies France

We prefer focusing on the objectives in the Rel-18 summary package in RP-220068, based on the progess of the WI, other objectives can be futher checked later on.

4 – Guangdong OPPO Mobile Telecom.

We are not sure why this is added, this is not part of the Rel-18 package. Suggest to not include it and further discuss in future, e.g. Dec check point together with other topics.

5 – Ericsson LM

We also prefer to stick to the objectives in the Rel-18 summary package in RP-220068. But if there is strong drive to add also the additional objective and TUs are available then it should be limited to the first part i.e.

”Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance”.

It should be up to RAN4 to discuss and decide appropriate solutions to achieve improved absolute and relative tolerances.

6 – vivo Communication Technology

We think this is a separate item that is not included in the package, not sure why this should be specially treated and why not other items.

7 – Nokia France

If there is general agreement to do so, we would be OK to include "Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance". However, "replacing OL TPC by setting Tx power to Pcmax for PRACH transmissions" would be a more fundamental change to the PRACH procedure which would have impacts beyond RAN4; we should therefore not include this part of the proposal.

3.4 Summary of Intermediate Round

Topic 1: Justification

No comments were made on the justification text for UL 256QAM. One company wanted to update the justification text for the beam correspondence requirements. This company questioned also the need for beam correspondence requirements but rather conduct study but majority of companies supported specification work under the topic 6 discussion. Therefore, no further changes are proposed for the justification for the final round review of the WID.

Topic 2: Objective UL 256QAM

Majority of the companies either supported or could accept the Moderator's objective. Additionally, it was proposed to limit the work for FR2-1 only. Some companies wanted to remove limitation to CPE/FWA type of UEs and some wanted to keep CPE/FWA. As limiting the objectives to FR2-1 only reduces work amount in RAN4, the moderator proposes this update to the objective for the final round review of the WID. No other updates are proposed for the final round review.

Topic 6: Objective: Beam correspondence requirements for RRC_INACTIVE and initial access

Majority of the companies either supported or could accept the following objective proposal from the moderator. Some companies requested a study to be conducted first. Following the majority view no further changes related to study phase were are proposed for the Beam correspondence requirements for RRC_INACTIVE and initial access objectives for the final round review.

During the initial round an additional objective to improve both absolute and relative tolerances for power control was proposed. Two companies supported this addition to some majority of the companies expressed concerns to include additional objective on top of the agreed Rel-18 RAN4 package. Some companies commented that if this objective is added it should be limited to improve absolute and relative tolerances but not include work impacting procedures and thus, limit the objective to 'Investigate and if feasible, improve both absolute and relative tolerances for power control in FR2 to enhance performance' if agreed. Since majority expressed concerns and this work is not part of the agreed package, the moderator does not propose this new objective for the final round review.

4 Final Round

The aim of the Final Round discussion is to review the updated WID proposal in https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_95e/Inbox/Drafts/%5B95e-04-RAN4-R18-UEFR2RF%5D/Final%20Round.

Companies are also encouraged to indicate their support to this work item during the Final Round.

Summary of the Final Round Discussion

During the final round discussion most of the discussion focus on small updates. The main technical discussion during the final round was whether UL 256 QAM objectives would be for the whole FR2 or if it should be limited to FR2-1. During the email discussion it was proposed to limit the work only for FR2-1. Number of companies expressed their support for this limitation. One company felt that FR2-2 should be included as it would be beneficial for backhaul scenarios and IAB.

The remaining open issue to complete the objectives is whether to have UL 256 QAM objective for FR2-1 or FR2.

5 Proposal

Considering that number of companies commented that the UL 256 QAM objective should be limited to FR2-1 and only one company so far has expressed concerns, the moderator proposes that the following objectives, where the UL 256QAM objective is limited to FR2-1, are agreed for this new work item.

Moderator proposes the following objectives to be agreed:

5 Objective of SI or Core part WI or Testing part WI

UL 256QAM

- Investigate and enable UL 256QAM for FR2-1 [RAN4]
    - Study the gain, operating SNR, phase noise model and implementation aspects
    - Specify the UE RF requirements
    - Targeted power classes are PC1, PC2, PC3 and PC5 device types of UE are CPE/FWA.

Beam correspondence requirements for RRC_INACTIVE and initial access

- Specify UE beam correspondence requirements for initial access and RRC_INACTIVE state, for SSB-based beam correspondence without UL beam sweeping [RAN4 RF]
- For RRC_INACTIVE specify at least requirements for Random Access SDT and Configured Grant SDT
    - Requirements for other transmission within RRC_INACTIVE state are not precluded.
- For initial access, specify requirements and verification of beam correspondence requirements based on msg1 spherical coverage (at least)
- Study the potential impact on testability aspects (i.e., test time).

5 Objective of Performance part WI

UL 256QAM

- Specify the BS demodulation performance