[95e-13-RAN4-R18-NonColloc] - Version 0.0.5
RAN

3GPP TSG-RAN Meeting #95-e

Electronic Meeting, March 17 – March 23, 2022

Agenda: 9.1.4

Title: [95e-13-RAN4-R18-NonColloc] intra-band non-collocated EN-DC/NR-CA deployment

Source: Moderator (KDDI)

1 Introduction

This email thread is to discuss WID RP-220063 (New WI: intra-band non-collocated EN-DC/NR-CA deployment).

2 Initial round

2.1 Objectives

Based on RP-220063, the potential stabilized objectives are as follows. In an initial round, moderator propose to remove square brackets on 4-layer from objectives of RP-220063.

The core part of the work item includes:

- Phase□:
  - Study the feasibility to support non-co-located scenario for FR1 intra-band non-contiguous EN-DC/NR-CA
    - Investigate the tolerable power imbalance between carriers
    - Investigate the required arrival time difference between CCs
    - Evaluate the UE performance under the power imbalance and arrival time difference
      - Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16
    - Study the feasibility for support of 4Rx chains with up to 4-layer MIMO
      - Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario
      - If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2.

    - Work is limited to CA/EN-DC for EN-DC/NR-CA for bands 42, n77/n78

- Phase II:
  - Phase II work will get started after the feasibility in phase I is confirmed
  - Specify the power imbalance
  - Specify MRTD and MTTD requirements in non-collocated deployment
  - Discuss and decide if the different requirements will be specified based on UE capability of interBandMRDC-WIthOverlapDL-Bands-r16.
  - NOTE: Power imbalance may be specified as the condition in the demodulation performance requirements

The performance part of the work item includes:

- Phase II:
  - Phase II work will get started after the feasibility in phase I is confirmed
  - Specify PDSCH demodulation requirements for non-collocated scenarios for intra-band non-contiguous EN-DC and NR-CA
    - Define PDSCH demodulation performance requirement based on the applicable MRTD and power imbalance values.
    - Power imbalance between the carriers is limited
  - NOTE: Power imbalance may be specified as the condition in the demodulation performance requirements

Please provide your comments below.

Feedback Form 1:

1 – MediaTek Inc.

On Phase I, just one minor comment related to 4-layer MIMO. If the Rx chain number supported per CC is reduced from 4 to 2, then it becomes 2-layer MIMO. Although it can be straightforward, we would suggest the following **clarification**:

Study the feasibility for support of 4Rx chains with up to 4-layer MIMO

- *Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario*
- *If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2* ***with supporting up to 2-layer MIMO****.*

On Phase II, we would suggest to add one sub-bullet as

- *If any change in RAN1 or RAN2 spec is needed, it will be triggered by RAN4 LS*

The intention is to handle the potential impact on RAN1/RAN2 spec with the introduced scenario. For example, the MRTD and MTTD requirements in non-collocated intra-band deployment may have impact on the UE behavior of transmit/receive slots, as specified in clause 4.3.2 in TS 38.211.

2 – Apple AB

In general, the moderator's proposal is OK for us.

Regarding Mediatek's comments on RAN1/2 impacts, if there is, it should be identified in the study phase and RAN1/2 should be further confirmed the feasibility from RAN1/2 perspective. With this, it is proposed to introduce the following note in Phase I

- If any RAN1 and RAN2 impact is identified, the corresponding feasibility should be confirmed by RAN1 and RAN2. The related discussion will be triggered only by RAN4 LS.

3 – QUALCOMM JAPAN LLC.

On Phase I, there shouldn't be any mention of number of Rx chains or layers. The requirements we had for such scenarios were agnostic of the number of receiver chains. The number of MIMO layers supported for each CC in CA is optional(2 or 4) and the signaling framework is already flexible enough, there is no need to open this discussion.

We are not sure there will be a need to specify the power imbalance explicitly, this might be implicitly captured in a performance test. The bullet should be removed.

4 – Guangdong OPPO Mobile Telecom.

For the 4Rx chain or 2Rx chain in each CC are UE capability, is the intention of below bullets to mandatory UE supporting 4Rx chain in each CC if "feasible"?

Study the feasibility for support of 4Rx chains with up to 4-layer MIMO

- Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario
- If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2.

5 – Skyworks Solutions Inc.

for DC42_n77, 4x4 is mandatory on n77 but not on band 42. for collocated scenario, 4Rx FE is sufficient. for non collocated, the study should cover implementations keeping 4Rx chains (2Rx per band), 6Rx (2Rx band 42, 4RX n77) or 8Rx. It is not needed to record these cases explicitly but study should cover a fallback to 2Rx for bands where 4Rx is mandatory and the possibility to declare different level of MIMO support for co-located vs non-collocated.

6 – Intel

In general we support the objectives.

regarding 'If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2', one clarification question is that is this already the case in R17?

7 – SoftBank Corp.

We would like to keep the description of the number of layers for clarifying the target in the study. And we would like to keep the description of the power imbalance for clarifying the scope in the WID.

8 – Huawei Technologies France

We are ok with the moderator's proposal.

9 – KDDI Corporation

> Qualcomm

- Regarding "specify the power imbalance", I understood that in Februaly RAN4 Rel-18 discussion Qualcomm proposed to remove "if needed" and eventually current descriptions was agreed at that time. Do you intend to move "specify the power imbalance" from core part to performance part ?
- Regarding Rx chains or layers, current objectives don't intend the signaling framework but also study whether 4Rx chains or layers per CC are feasible or not.

> OPPO

In my understanding, current objectives don't intend to mandate 4Rx chain in each CC for UE. Rx chain or layers of per band combinations depends on UE implementation and UE can inform it of network with using capability.

10 – NTT DOCOMO INC.

Basically we are fine with proposed objective, but we would like to clarify and add one note as follows.

- In phase I section, there is a description of "*Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16*". This might make confusion as if the current power imbalance and MRTD specification will be modified. Actually, the related requirements for the case of 2-layer MIMO for EN-DC are already specified. Therefore the scope should be clarified by adding one paragraph like "*Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16* ***for 2-layer MIMO case for NR-CA, and 4-layer MIMO case for both EN-DC/NR-CA.***"
- Now the scope of study is described as "*Study the feasibility to support non-co-located scenario for FR1 intra-band non-contiguous EN-DC/NR-CA*". However, in some cases, EN-DC/NR-CA for bands 42, n77/n78 can be contiguous. We guess that the feasibility study is similar between contiguous and non-contiguous. Therefore it is better to add one note if possible like "*NOTE: the technical solutions can be extended to contiguous case, when applicable with no additional work*".

11 – ZTE Corporation Fine with moderator's proposal.
12 – TELECOM ITALIA S.p.A. Fine with the moderator's proposal
13 – Nokia Japan Removing is OK. However, the objective itself needs more clarification. Since RAN4#102e agreed a CR for Type 2 UE with 2Rx each band within EN-DC and clarified no RRM discussion is needed, the below three bullets must not apply for that case. · Investigate the tolerable power imbalance between carriers · Investigate the required arrival time difference between CCs · Evaluate the UE performance under the power imbalance and arrival time difference – Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16 In addition, through the objective, *interBandMRDC-WIthOverlapDL-Bands-r16* must not be applied to CA case.
14 – LG Uplus In general, we support moderator's proposals. Regarding "number of layer", we think only first bullet might sufficiently stand for the intention. *Study the feasibility for support of 4Rx chains with up to 4-layer MIMO* - *Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario* - ~~*If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2.*~~
15 – vivo Mobile Communication (S) We are fine with moderator's proposal.

2.2 Justicications, SI/WI and other aspects

Justifications:

Moderator updated the end of justifications from RP-220063 as follows:

————————- Justifications ————————————————————-

In October Rel-18 email discussion (RP-212682), support of intra-band non-collocated EN-DC/NR-CA

deployment was discussed as one of the potential RAN4 candidates for Rel-18, and identified its clear needs from operators. Specifically, in Rel-17 only co-located requirements are specified for FR1 intra-band non-contiguous EN-DC/NR-CA, but from operators' perspective UE requirements for non-co-located deployment is essential to enhance EN-DC/NR-CA available areas. In other words, Tx antenna co-location at network side is not always available since the co-existence conditions are not always same for all the bands. Actually for some operators, 3 blocks in C-band were allocated at different time, which makes Tx antenna co-location cost-inefficient sometimes infeasible. The objectives of the WI is the same as the one proposed in the outcome from February Rel-18 email discussion (RP-220024)

————————- Justifications ————————————————————-

Please provide your comments below.

Feedback Form 2:

1 – SoftBank Corp. We are fine with the current justifications.
2 – NTT DOCOMO INC. We are fine with the current justifications.
3 – LG Uplus We are fine with the current justifications.

WI or SI

- Dedicated WI with a study phase.

Secondary working group:

- Not include any WG as the secondary work group.

Please provide your comments on WI or SI and secondary working group.

Feedback Form 3:

1 – Apple AB Agree that no other WG at this stage should be included. However, if RAN1/2 impact is identified, the related discussion can be triggered by RAN4 LS.
2 – SoftBank Corp. We support moderator's proposal and comment from Apple.
3 – NTT DOCOMO INC. We support the moderator's proposal, and also support Apple's comment.

4 – Nokia Japan A dedicated WI is fine as proposed. RAN2 should be involved in the WI as secondary.
5 – LG Uplus We support the moderators' proposal and are fine with adding condition mentioned by Apple.
6 – Ericsson LM Fine with the moderator's proposal. We don't expect any significant impact on any other WG. So we don't see any need to add RAN1 or RAN2 as secondary working group. If needed RAN4 can send LS to the other WG

2.3 Summary of initial round

Objectives

6 companies supported current objectives. 9 companies had comment on the objectives. Some of comments were related to DL MIMO layer support on 2-layer or 4-layer, clarification the objectives except for 2-layer MIMO case of EN-DC agreed asn Rel-16 and Rel-17 in a previous RAN4 meeting. Next, some of comments was related to specifying power imbalance. Finally, the other comments were related to possibility of impacts to other WGs.

Regarding MediaTek, Skyworks, Intel and LG Uplus comments of clarification on DL MIMO layer, the moderator would like to propose to discuss this topic in the study at the beggining of Phase 1 in WI.

Regarding Qualcomm comment on signaling scheme of MIMO layer, current objectives should focus to study whether 4-layer is feasible or not. Therefore, the moderator would like to keep current description. And also, regarding Qualcomm comment on the power imbalance, the moderator would like to keep the description of it for clarifiying the scope in the WID. However, the intention of comments can be discussed continuously after initial round.

Regarding Docomo and Nokia comments on clarification to avoid duplicated works already done in Rel-16 and Rel-17, the moderator is fine.

MediaTek and Apple propose to consider impacts to RAN1 and RAN2, the moderator is fine.

Based on the comments received, the moderator proposes the following objectives for discussion in the intermediate round.

- Phase I:
    - Study the feasibility to support non-co-located scenario for FR1 intra-band non-contiguous EN-DC/NR-CA except for 2-layer case of EN-DC already specified in Rel-16 and Rel-17.

    - Study the feasibility for support of 4Rx chains with up to 4-layer MIMO
        - Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario
        - If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2
    - Investigate the tolerable power imbalance between carriers
    - Investigate the required arrival time difference between CCs
    - Evaluate the UE performance under the power imbalance and arrival time difference
        - Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16 for 2-layer MIMO case for NR-CA, and 4-layer MIMO case for both EN-DC/NR-CA
    - Work is limited to CA/EN-DC for EN-DC/NR-CA for bands 42, n77/n78
    - If any change in RAN1 or RAN2 spec is needed, it will be triggered by RAN4 LS
    - NOTE: the technical solutions can be extended to contiguous case, when applicable with no additional work

- Phase II:
    - Phase II work will get started after the feasibility in phase I is confirmed
    - Specify the power imbalance
    - Specify MRTD and MTTD requirements in non-collocated deployment
    - Discuss and decide if the different requirements will be specified based on UE capability of interBandMRDC-WIthOverlapDL-Bands-r16.
    - If any change in RAN1 or RAN2 spec is needed, it will be triggered by RAN4 LS
    - NOTE: Power imbalance may be specified as the condition in the demodulation performance requirements

In the intermediate round, the moderator encourages companies to check and discuss the proposed objectives.

Justifications

3 companies supported current justifications. This topic was also discussed in RAN4 Rel-18 discussion held in Februaly. Justifications seems to be already stable.

Secondary working group

5 companies supported not to add other WGs as secondary WG. Nokia proposed to add RAN2 as secondary WG. Considering Nokia, Apple, Docomo and LG Uplus comment, the moderator updated objectives toward intermediate round as they proposed.

3 Intermediate round

3.1 Objectives

The modified objectives are as follows.

- Phase I:
  - Study the feasibility to support non-co-located scenario for FR1 intra-band non-contiguous EN-DC/NR-CA except for 2-layer case of EN-DC already specified in Rel-16 and Rel-17.
    - Study the feasibility for support of 4Rx chains with up to 4-layer MIMO
      - Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario
      - If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2
    - Investigate the tolerable power imbalance between carriers
    - Investigate the required arrival time difference between CCs
    - Evaluate the UE performance under the power imbalance and arrival time difference
      - Discuss and decide reference UE architecture considering the UE capability of interBandMRDC-WithOverlapDL-Bands-r16 for 2-layer MIMO case for NR-CA, and 4-layer MIMO case for both EN-DC/NR-CA
    - Work is limited to CA/EN-DC for EN-DC/NR-CA for bands 42, n77/n78
    - If any change in RAN1 or RAN2 spec is needed, it will be triggered by RAN4 LS
    - NOTE: the technical solutions can be extended to contiguous case, when applicable with no additional work
- Phase II:
  - Phase II work will get started after the feasibility in phase I is confirmed
  - Specify the power imbalance
  - Specify MRTD and MTTD requirements in non-collocated deployment
  - Discuss and decide if the different requirements will be specified based on UE capability of interBandMRDC-WIthOverlapDL-Bands-r16.
  - If any change in RAN1 or RAN2 spec is needed, it will be triggered by RAN4 LS
  - NOTE: Power imbalance may be specified as the condition in the demodulation performance requirements

Please provide your comments below.

Feedback Form 4:

1 – QUALCOMM JAPAN LLC.

We still disagree with the study of the feasibility of supporting 4L MIMO. Can the proponents pleas explain what would be studied and what is the expected outcome? supporting 4L MIMO or not should be left to UE implementation.

For the ”specify the power imbalanace”, this should be modified. Our proposal is:

- Investigate whether the power imbalance should be explicitly(e.g. as an RF requirement) or implicitly specified (e.g. through a demodulation performance test). Specify the power imbalance based on the outcome of the investigation.

The note from Phase II can be erased.

2 – Apple AB

In general, we are OK with the moderator’s proposal.

To Qualcomm, although it is not our proposal to study 4L MIMO, we, however, understand this proposal is to study the tradeoff between # of MIMO layers (# of Rx) and the performance degradation due to large MRTD. More specifically, 4Rx, where 4 independent Rx chains are assumed, is currently mandated for all the target bands. When MRTD between non-contiguous CCs is too large, there is another possibility that 2 Rx chains are dedicated for one CC and another 2 Rx chains are used for another CC. We are OK to study this as an alternative solution, although it does have a profound impact on both RRM and demod performances.

We are OK with Qualcomm’s proposal on power imbalance.

3 – KDDI Corporation

We would like to keep the current description of MIMO layers.

To Qualcomm, above comments from Apple would be an answer to your questions and comments.

Regarding power imbalance, we can understand Qualcomm’proposal and intention and accept them.

4 – LG Electronics Deutschland

We are fine with the phased approach and related description. One question for clarification is whether this WI is targeting DL only or both (DL and UL). If UL is considered, we think power imbalance specification can include UE Tx related RF requirements like MPR or A-MPR.

5 – Samsung Electronics GmbH

We are okay with the moderator’s proposal.

For 4-layer MIMO objective, we think the proposed objective for ”studying the feasibility”

is fair enough which is intended to trigger not only the discussion on the feasibility but also the side condition for UE supporting such 4-layer (if it is regarded as feasible). With that understanding, we will support this objective of feasibility study.

6 – NTT DOCOMO INC.

We are fine with moderator's proposal and agree with Apple's comment of 4-layer MIMO study. Also we are fine with power imbalance study clarification.

7 – SoftBank Corp.

We support the moderator's proposal and would like to keep the description of MIMO layers. For the Qualcomm's proposal for power imbalance, we are fine with it.

8 – MediaTek Inc.

We are OK with the moderator's proposal and fine to consider the alternative in the feasibility study if 4L-MIMO is not feasible, as commented by Apple. We are OK with Qualcomm's proposal on power imbalance.

9 – Guangdong OPPO Mobile Telecom.

For the 4Rx chain and 4 layer MIMO, it seems here assumes UE have 4Rx chain per-band, and use this 4Rx chain to support the intra-band NC CA in non-collocated scenario. If this is the correct understanding, then it propose to clarify this in the SID. Proposed changes as below:

Study the feasibility for support of 4Rx chains **per-band** with up to 4-layer MIMO

- Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario
- If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2

10 – TELECOM ITALIA S.p.A.

We are ok with the moderator's proposal

11 – Intel

we are fine with the recommended proposal and the current objectives.

12 – Skyworks Solutions Inc.

the text "Study the feasibility for support of 4Rx chains with up to 4-layer MIMO" is a bit confusing since for on collocated scenario with large power imbalance the UE may need 8 receive chains to support 4x4MIMO on both bands. Is this rather suggesting that the study looks into how much power imbalance can be managed with 4RX and supporting 4x4 MIMO on each CC? This is why we believe that if the study focused on have only 4RX chains then at one point the UE may have to fallback to 2Rx per CC. To be crystal clear the wording should state the total number of Rx and number of MIMO layers per band.

13 – KDDI Corporation

To LG Electronics, I propose to focus on only DL MIMO in Rel-18.

14 – LG Uplus We are OK with moderator's proposal.
15 – Huawei Technologies France Thanks moderator for the proposal. We are not sure why there is statement in the first main bullet of Phase I "... except for 2-layer case of EN-DC.." Even for 2-layer case of EN-DC, there seems no requirements for demodulation with the proper power imbalance and timing difference, the sentence "**except for 2-layer case of EN-DC already specified in Rel-16 and Rel-17**" should be removed. For Phase II, it should be divided into core part and perf part. In Appendix of RP-220068 the objectives seem more clear. Can we have performance part? Or the common understanding is that whehter to have performance part, i.e., demodulation performance requirements, needs further confirmation. If going with the perf part objectives in RP-220068, then the NOTE in phase II can be removed.
16 – vivo Mobile Communication (S) We are in general fine the moderator's proposal. We also share similar view that 4 Rx chains should be clarfified. Is it per band or per CC?

3.2 Other comments and proposals

Companies can make other comments and proposals for the WID preparation based on RP-220063 here.

Feedback Form 5:

3.3 Summary of intermediate round

The main comments for objectives were mainly related to specifing power imbalance and DL 4-layer MIMO.

Regarding specifing power imbalance, Qualcomm proposed to modify it and many componies agreed this. The moderator is fine.

Regarding Rx chains and DL 4-layer MIMO, 10 companies (5 UE/chipset vendors and 5 operators) supported descriptions proposed by the moderator. Qualcomm disagree with any descriptions on DL 4-layer MIMO. OPPO, Skyworks and Vivo proposed clarification on number of Rx chains and layers on DL MIMO, for example, per band or per CC.

Regarding Huawei comments on dividing core/perf part and missing demodulation of 2-layer EN-DC case, the moderator was aware of taking a mistake on intermediate round and fixed it for final round.

Regarding 4-layer MIMO ,LG Electronics proposed to clarify only for DL or both DL and UL. The moderator clarify only for DL in Rel-18.

Based on the comments and responses, the draft WID including modified and fixed objective is provided in

the following section of final round for further checking.

Regarding Rx chains and DL 4-layer MIMO, the moderator would like to keep current objectives continuously toward final round considering the result of above intermediate round.

4 Final round

4.1 Objectives

Regarding the WID, companies please check the updated WID in the following link. If you have any comments on the WID, please directly provide your revisions in the draft inbox:

Draft WID

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_95e/Inbox/Drafts/%5B95e-13-RAN4-R18-NonColloc%5D/Revision%20of%20RP-220063_WID_RAN4-R18_Intra-band%20non-collocated%20EN-DC%2CNR-CA_v00.doc

4.2 TU

It is believed the TU sheet can be drafted based on the endorsed RP-220068. If you have different view on TU, pls. provide views here.

Feedback Form 6:

4.3 Supporting list

Check preference to be included in supporting IM list, if not yet expressed in offline manner.

Feedback Form 7:

1 – TELECOM ITALIA S.p.A. Please add Telecom Italia as supporting company. Thanks!
2 – NTT DOCOMO INC. Please also add NTT DOCOMO as supporting company.
3 – Nokia Japan Please add Nokia and Nokia Shanghai Bell to IM table. Strictly speaking, we think that justification needs some minor modifications since the current situation is different from the situation that we started this discussion.

4 – Samsung Electronics GmbH Please also add Samsung as supporting company.
5 – SoftBank Corp. Please add SoftBank Corp. to the supporting company list.
6 – LG Electronics Deutschland Please add LG Electronics as supporting company
7 – Skyworks Solutions Inc. Please add Skyworks as supporting company
8 – vivo Mobile Communication (S) Please add vivo as supporting company. Thanks.
9 – MediaTek Inc. Please add MediaTek as supporting company
10 – Huawei Technologies France Please add Huawei, HiSilicon as supporting company, thanks

4.4 Summary of Final round

15 companies contributed to this RAN4 Rel-18 topic. 13 companies supported to be included in supporting IM list.

Nokia fixed the justification considering latest situtation. The moderator is fine.

Qualcomm still disagree with any description on 4Rx and 4-layer MIMO. SoftBank would like to keep above current description and study them in WI. The moderator would like to propose way forward as follows.

Huawei pointed out that description related to 2-layer case of EN-DC already specified in Rel-16/17 and power imbalance are still needed to modify. The moderator is fine.

Open Issue

The following Objectives on the feasibility study for support of 4Rx chains with up to 4-layer MIMO has not been concluded yet after final round.

- Study the feasibility for support of 4Rx chains with up to 4-layer MIMO. This 4-layer is only for DL in Rel-18.
    - Study if the 4Rx chains with supporting up to 4-layer per CC can be supported for the intra-band non-contiguous non-collocated scenario

- If not, study if the Rx chain number supported per CC is allowed to be reduced from 4 to 2

Way forward proposal (to have extended email discussion)

The moderator propose to keep the above objectives and also add the following note. RAN4 will be able to study and clarify the above feasibility in WI.

- Note: This work does not mandate UE to support 4Rx chain per CC for EN-DC/NR-CA, UE still have the freedom to indicate 2Rx chain with its capabilities for EN-DC/NR-CA.