**3GPP RAN WG4 Meeting #112 R4-2412814**

**Maastricht, Netherlands, August 19th – 23rd, 2024**

**Agenda item: 7.1**

**Source:** Moderator (Huawei)

**Title:** Topic summary for [112][112] LTE\_NR\_Other\_WI

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this summary (e.g. list of treated agenda items).*

The contributions for the following agenda items are summarised in this document:

7.9 Rel-19 Additional NR bands for NR features

7.10 Rel-19 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink

7.11 Simultaneous Rx/Tx band combinations for NR CA/DC, NR SUL and LTE/NR DC in Rel-19

7.12 Adding channel bandwidth(s) support to existing NR bands and CA/ENDC combinations in REL-19

# Topic #1: Rel-19 Additional NR bands for NR features

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2411324**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411324.zip) | **Draft CR** for TS 38.101-1[R19] 4Rx handheld UE for n13 | Samsung, TELUS, Bell Mobility, ZTE Corporation | Include band n13 to support 4Rx operation for handheld UE. |
| [**R4-2411740**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411740.zip) | (NR\_bands\_xFeature\_R19-Core) **Draft CR** for 38.101-1 to introduce n34 support 8Rx | CMCC, ZTE Corporation | Introduce n34 support 8Rx |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

No open issues.

# Topic #2: Rel-19 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2411150**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411150.zip) | On DL interruption for Tx switching across 3 and 4 bands | Apple | *Observation #1:*   * *For TDD+TDD band combinations with the same UL-DL duplex mode, DL interreuption is not required* * *For FDD+TDD combos, DL interruption applicabilty is per DL band. For example, interruption is not required when there is a wide frequecny separation between the DL band and the UL bands involved in the switching.*   ***Observation #2****: For Tx switching scenario across 3 or 4 bands, applying DL interruption on the unaffected band(s) depends on the frequency separations, the UL-DL frame patterns, and whether or not there is a mandatory simultaneous RX/Tx between one of the bands involved in the switching and the unaffected band.*  ***Proposal #1:***  *Based on the already defined RAN4 rules, DL interruption for TX switching among 3 or 4 bands is DL band-dependent and the following criteria should be used to decide on its applicability:*   * *Whether the same UL-DL duplex mode is used for the DL band(s) and the UL band(s)* * *Frequency separation between the DL band and the bands involved in the Tx switching* * *Mandatory simultaneous RX/TX capability between the DL band(s) and the UL band(s)*  |  |  |  | | --- | --- | --- | | ***CA combination*** | ***Configured Uplink Combos*** | ***DL interruption allowed?*** | | CA\_n1-n5-n78 | CA\_n1-n5 |  | | CA\_n1-n78 | No | | CA\_n5-n78 | No | | CA\_n3-n5-n78 | CA\_n3-n5 |  | | CA\_n3-n78 | No | | CA\_n5-n78 | No | | CA\_n1-n3-n5-n78 | CA\_n1-n3 |  | | CA\_n1-n5 |  | | CA\_n1-n78 | No | | CA\_n3-n5 |  | | CA\_n3-n78 | No | | CA\_n5-n78 | No | |
| [**R4-2412468**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412468.zip) | TR 37.887 0.0.1 TR skeleton for Rel-19 downlink interruption for NR and EN-DC band combinations at dynamic Tx Switching in Uplink | China Telecom | TR skeleton |
| [**R4-2413318**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413318.zip) | DL interruptions for mid band combinations | Qualcomm Incorporated | **Proposal: For bands withing same frequency range using same antenna groups, DL interruption is always allowed for TX switching.** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 DL interruption applicability

**Issue 2-1-1: Applicability criteria**

* Proposals:
  + - Proposal 1 (Apple):

Based on the already defined RAN4 rules, DL interruption for TX switching among 3 or 4 bands is DL band-dependent and the following criteria should be used to decide on its applicability:

* Whether the same UL-DL duplex mode is used for the DL band(s) and the UL band(s)
* Frequency separation between the DL band and the bands involved in the Tx switching
* Mandatory simultaneous RX/TX capability between the DL band(s) and the UL band(s)
  + - Proposal 2 (Qualcomm):

For bands within same frequency range using same antenna groups, DL interruption is always allowed for TX switching.

* Recommended WF
  + Try to reach consensus and apply it to the proposed combos

**China Telecom: We are OK with these criteria. For the first and third bullets they are the same. For second bullet, we had discussion before. For frequency gap for TDD and FDD, we had some agreement. For Qualcomm proposal, it is for some special configuration. More discussions are needed for this specific architecture. We can have WF.**

**CHTTL: Apple proposal can be used as starting point. For proposal 2, is it for FR1 with 2T?**

**Qualcomm: It is good to have WF.**

### Sub-topic 2-2 DL interruption requirements

**Issue 2-2-1: DL interruption applicability for the proposed CA combos**

* Proposals:
  + - Proposal 1 (Apple):

|  |  |  |  |
| --- | --- | --- | --- |
| ***CA combination*** | ***Configured Uplink Combos*** | ***DL interruption allowed?*** | ***Moderator’s Remark*** |
| CA\_n1-n5-n78 | CA\_n1-n5 |  | **Completed in Rel-18** |
| CA\_n1-n78 | No |
| CA\_n5-n78 | No |
| CA\_n3-n5-n78 | CA\_n3-n5 |  |
| CA\_n3-n78 | No |
| CA\_n5-n78 | No |
| CA\_n1-n3-n5-n78 | CA\_n1-n3 |  | Rel-19 |
| CA\_n1-n5 |  |
| CA\_n1-n78 | No |
| CA\_n3-n5 |  |
| CA\_n3-n78 | No |
| CA\_n5-n78 | No |

* Recommended WF
  + TBA

**China Telecom: we are OK for the table for TDD+FDD bands. The same principle in Rel-18 is reused. For FDD+FDD, we have further discussions.**

# Topic #3: Simultaneous Rx/Tx band combinations for NR CA/DC, NR SUL and LTE/NR DC in Rel-19

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2411157**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411157.zip) | On simultaneous Rx/Tx | Apple | **Proposal 1**: Capture the Rel-17 agreement on mandatory simultaneous Rx/Tx for FR1+FR1 FDD-TDD in TS 38.101-1 and TS 38.101-3.  **Observation**: Due to close frequency distance of n40 and n41 these bands are typically grouped together to reduce implementation complexity and number of required antennas. In case of simultaneous Rx-Tx between n40 and n41 it is challenging to share antennas for uplink and downlink as filter isolation is marginal due to the close frequency separation of the two bands. The challenge increases if support for MIMO and its related features e.g. antenna switching are considered in addition. If an implementation is done for simultaneous Rx/Tx and MIMIO then additional antennas might be needed to cover the frequency range. Integrating additional antennas for this frequency range might not be an issue for FWA/CPE type devices but it is a challenging task for handhelds due to the small form factor.  **Proposal 2**: Consider relaxing four Rx requirement for n41 when carrier aggregation with band n40 and simultaneous Rx-Tx operation is configured. As alternative a new signalling could be introduced to indicate that a UE supporting MIMO and simultaneous Rx/Tx cannot support both features at the same time for a specific combination. |
| [**R4-2411158**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411158.zip) | Draft CR to 38.101-1 to clarify simultaneous Rx/Tx applicability for FDD-TDD combinations | Apple | Clause 5.5A.0 is updated with an statement clarifying that for FR1+FR1 FDD-TDD CA combinations the simultaneous Rx/Tx is the default capability. |
| [**R4-2411159**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411159.zip) | Draft CR to 38.101-3 to clarify simultaneous Rx/Tx applicability for band combinations | Apple | Clause 5.5A.1.0 is updated with an statement clarifying that for FR1+FR1 FDD-TDD CA combinations the simultaneous Rx/Tx is the default capability. |
| [**R4-2411256**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411256.zip) | Discussion on simultaneous Rx-Tx of CA\_n40-n41 | Murata Manufacturing Co Ltd. | Observation 1: Large MSD is expected for n40 Rx and n41 Rx with n41 4x4 DL MIMO using 4 antennas.  Observation 2: Tx leakage of ACLR2 might not be a big concern except cell edge area.  Proposal 1: Relax 4 Rx requirement to 2 Rx when UE is near cell edge and keep 4 Rx requirement when UE requires high data T-put using 4x4 DL MIMO.  Proposal 2: How to switch 4 Rx and 2 Rx is FFS. Interesting companies are invited to provide their views at the next meeting. |
| [**R4-2412539**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412539.zip) | Revised WID Simultaneous RxTx band combinations for NR CADC, NR SUL and LTENR DC in Rel-19 | Huawei, HiSilicon | Revised WID |
| [**R4-2412540**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412540.zip) | Discussion on Rel-19 simultaneous Rx-Tx issues | Huawei, HiSilicon | Observation 1: The reasons of non-simultaneous Rx-Tx operation for CA\_n77-n79 and CA\_n78-n79 illustrated in NOTE 5 and NOTE 7 are same.  Observation 2: The simultaneous Rx-Tx capability must not be reported for CA\_n77-n78, as limited in RAN2 spec that the capability does not apply to the inter-band CA where the frequency range of one TDD band is a subset of the frequency range of the other NR TDD band.  Proposal 1: NOTE 5 and NOTE 7 can be merged for CA\_n77-n79 and CA\_n78-n79.  Proposal 2: NOTE 9 should be applied to CA\_n77-n78 in Table 5.2A.2.1-1.  Proposal 3: we propose the following change of Note for simultaneous Rx-Tx operations.   |  |  |  | | --- | --- | --- | | **NR CA Band** | **NR Band**  **(Table 5.2-1)** | **DL interruption allowed (Note 8)** | | CA\_n77-n789 | n77, n78 |  | | CA\_n77-n795 | n77, n79 |  | | CA\_n78-n795 | n78, n79 |  | | NOTE 5: For UEs supporting band n77, the minimum requirements apply only when there is non-simultaneous Rx/Tx operation between n78-n79 or n77-n79 NR carriers. This restriction applies also for these carriers when applicable NR CA configuration is part of a higher order configuration.  NOTE 7: void.  NOTE 9: Only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx. Same restrictions are applied when applicable NR CA configuration is part of a higher order configurations. | | | |
| [**R4-2412541**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412541.zip) | drafCR to 38.101-1: On Rel-19 simultaneous Rx-Tx | Huawei, HiSilicon | 1. Change the note for CA\_n77-n78 to NOTE 9.  2. Merge NOTE 7 with NOTE 5, and remove NOTE 7 |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1 simultaneous Rx-Tx requirements

**Issue 3-1-1: Relaxation of simultaneous Rx-Tx requirements for CA\_n40-n41**

* Proposals:
  + - Proposal 1 (Apple):

**Alt-1a)** Consider relaxing four Rx requirement for n41 when carrier aggregation with band n40 and simultaneous Rx-Tx operation is configured.

**Alt-1b)** As alternative a new signalling could be introduced to indicate that a UE supporting MIMO and simultaneous Rx/Tx cannot support both features at the same time for a specific combination.

* + - Proposal 2 (Murata):

Relax 4 Rx requirement to 2 Rx when UE is near cell edge and keep 4 Rx requirement when UE requires high data T-put using 4x4 DL MIMO. FFS how to switch between 4Rx and 2Rx.

* Recommended WF
  + TBA

**CMCC: We cannot accept the relaxation of requirements. UE cannot support both simultaneous Rx-Tx and MIMO at the same time. We should not relax RF.**

**Apple: This relaxation could allow the implementation of MIMO. The De-refsens would be better.**

**Murata: The high MSD will be observed. We are open for further discussion. Relaxation of 4Rx should be one feasible option for high MSD situation.**

**Skyworks: there is request for n40+n41C, which is even worse and 2Rx performance is better than 4Rx with uplink 41C.**

**Apple: This is very important topic. Ask CMCC to clarify.**

**CMCC: If UE could not support 4Rx and MIMO at the same time, we do not want relax the 4Rx requirements.**

**Murata: if UE is not in the cell edge and maximum Tx power is not used, we can keep the existing requirements.**

**Skyworks: To Murata point, it is quite difficult to set the threshold.**

**Issue 3-1-2: Simplification on Notes**

* Proposals:
  + - Proposal 1 (Huawei):

NOTE 5 and NOTE 7 can be merged for CA\_n77-n79 and CA\_n78-n79.

* + - Proposal 2 (Huawei):

NOTE 9 should be applied to CA\_n77-n78 in Table 5.2A.2.1-1.

* Recommended WF
  + Check if draftCR R4-2412541 is agreeable or not

**Issue 3-1-3: Default simultaneous Rx/Tx capability for FR1+FR1 FDD-TDD**

* Proposals:
  + - Proposal 1 (Apple):

Capture the Rel-17 agreement on mandatory simultaneous Rx/Tx for FR1+FR1 FDD-TDD in TS 38.101-1 and TS 38.101-3.

* Recommended WF
  + Check if draftCR R4-2411158/9 are agreeable or not

# Topic #4: Adding channel bandwidth(s) support to existing NR bands and CA/ENDC combinations in REL-19

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2411148**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411148.zip) | n48 100MHz UL | Apple | ***Observation 1****: There is NS\_27 defined for n48 UL due to a stringent FCC emissions requirement. For 40MHz UL carriers the A-MPR is up to 11.5dBm.*  ***Observation 2****: For 100MHz UL carriers in n48 the NS\_27 definition needs to be extended to cover the additional CBWs and ABWs resulting in up to 15dBm A-MPR in most of the use cases. This significantly reduces the coverage of the cell.*  ***Proposal 1****: Due to the high power reduction needed to fulfill the FCC emissions requirements for a 50…100MHz UL bandwidth on band n48 reducing the coverage of the cell, it is proposed RAN4 does not specify 50…100MHz UL CBW or ABW for n48.* |
| [**R4-2412486**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412486.zip) | Draft revised basket WI on adding new channel BW in existing NR bands | Ericsson | Draft revised basket WI |
| [**R4-2412511**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412511.zip) | TR 37862 skeleton for the basket WI on adding new channel BW in existing NR bands | Ericsson | TR 37862 skeleton |
| [**R4-2413200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413200.zip) | On NS\_27 A-MPR for larger than 40MHz UL CBW for n48 | Skyworks Solutions Inc. | **Observations: The request aims to provide support from 50MHz up to 100MHz CBW in UL compared to the current maximum UL CBW of 40MHz. However, it seems that the support of 50MHz CBW with 30kHz SCS is not requested.**  **Proposal: Proponent should clarify whether 50MHz CBW at 30kHz SCS is needed or not.**  **Observation: with increased CBW beyond 40MHz, the number of channels and allocation that are not affected by the -40dBm/MHz stringent emission requirement reduces significantly, while the UE testing becomes significantly more complex.**  **Proposal:**   * **RAN4 studies Band n48 NS\_27 A-MPR for 50, 60, 70, 8, 90 and 100MHz CBW** * **Based on the number of channels and allocations benefiting from moderate A-MPR, it may be decided to still limit the UL CBW below 100MHz to avoid complex UE testing for limited user benefit in the field.** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1 Adding new CBWs for band n48

New CBWs have been requested for band n48 as below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Band** | **Channel bandwidth**  **and SCS** | **Contact name, company** | **Other supporting companies** | **Justification** |
| n48 | 50 MHz (15, 30 and 60kHz SCS)  60, 70, 80, 90, 100 MHz (30 and 60 kHz SCS) | Ruoyu Sun, Cable Labs | Charter, Comcast, Samsung | This channel BWs are already supported in DL, they should be supported in UL as well, see RP-241541. |

**Issue 4-1-1: Whether to add CBWs of 50-100MHz for band n48**

* Proposals:
  + - Option 1 (Apple):

Due to the high power reduction needed to fulfill the FCC emissions requirements for a 50…100MHz UL bandwidth on band n48 reducing the coverage of the cell, it is proposed RAN4 does not specify 50…100MHz UL CBW or ABW for n48.

* + - Option 2 (Skyworks):

RAN4 studies Band n48 NS\_27 A-MPR for 50, 60, 70, 8, 90 and 100MHz CBW

* Based on the number of channels and allocations benefiting from moderate A-MPR, it may be decided to still limit the UL CBW below 100MHz to avoid complex UE testing for limited user benefit in the field.
* Recommended WF
  + Down-select between option 1 and 2

Cablelabs: this is joint request from operators who own CBRS bands.

Apple: There is always IMD3. There is significant power reduction there, which makes it not useful.

Charter: We could use small cell inside. We want the work to be continued.

Skyworks: can we avoid the lengthy evaluation? We can make A-MPR value simple?

Nokia: When 48 is done, there were quite a lot of simulation to show it is not useful.

Google: we support cable labs and Charter. We can do initial study.

### Sub-topic 4-2 Adding 3 MHz channel BW in the WID

**Issue 4-2-1: Whether to add 3 MHz CBWs in the WID**

* Proposals: Add 3 MHz channel BW for bands below 1 GHz to the list of considered channel BW in the WI
  + Agree (Ericsson, AT&T)
  + Disagree
* Recommended WF
  + Approve the revised WID in R4-2412486

Apple: for 3MHz, is it for SA or intention to aggregate it with other bandwidth like contiguous CA.

AT&T: There is no intermediate intent. There is SA request.

Samsung: This 3MHz for additional band is optional?

AT&T: It is optional for the release where it is introduced. 3MHz core work is done in Rel-18. There is no place to request 3MHz.

Ericsson: It could be done in other basket rather than this basket. The only thing here is MSD.

Skyworks: Is it mandatory or optional support? BCS4/5? There is signalling to support 3MHz.

AT&T: we do not need to rely on CA.

T-Mobile USA: BCS4/5 does not make CBW mandatory. BCS4/5 indicates if UE supports CBW for certain band, it supports such bandwidth for CA. We should figure out how to handle the signalling. If we use BCS5 instead of BCS4, that is the solution.

Agreement: RAN4 suggests to add optional 3MHz channel bandwidth to support single carrier operation in the basket WI “Adding channel bandwidth(s) support to existing NR bands and CA/ENDC combinations in REL-19”