**3GPP TSG-RAN WG4 Meeting # 104-e**

**Electronic Meeting, 15– 26 August 2022**

**Agenda item:** 9.14.9

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for [104-e][110] NR\_ext\_to\_71GHz\_Part\_1

# Introduction

*This document summarizes the main system parameter issues to discuss in GTW session*

# Topic #1: General

## Open issues

### Sub-topic 1-1: UE feature list

*An optional capability for improved ON/ON transient period is proposed in R4-2212118*

**Issue 1-1: Improved ON/ON transient period feature**

* Recommended WF
  + Feedback on this feature will be addressed in the [**Rel-17 UE feature list thread [141]**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Inbox/Drafts/%5B104-e%5D%5B141%5D%20R17_feature_list)
  + ON/ON transient period for 480 and 960 kHz SCS will be discussed in [**thread [111]**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Inbox/Drafts/%5B104-e%5D%5B111%5D%20NR_ext_to_71GHz_Part_2)

### Sub-topic 1-2: LS reply to RAN1

*RAN4 received an LS from RAN1 with the following question (R1-2200796):*

**Question to RAN4**: How many symbol(s) is/are needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz respectively, in FR2-2?

For reference, the following was specified in Rel-15 (38.214 Section 6.2.1.2) for subcarrier spacing up to 120 kHz:

**Table 6.2.1.2-1: The minimum guard period between two SRS resources of an SRS resource set for antenna switching**

|  |  |  |
| --- | --- | --- |
|  |  | ***Y* [symbol]** |
| 0 | 15 | 1 |
| 1 | 30 | 1 |
| 2 | 60 | 1 |
| 3 | 120 | 2 |

**Issue 1-2: LS reply to RAN1**

* Proposals
  + Option 1: CATT, R4-2211697
    - **Answer from RAN4:** The absolute switching time for FR2-2 is the same as the capability evaluated in R15, i.e., the antenna switching time is 15 µsec. The detail evaluation results for every possible switching scenario are included in the R15 reply LS R4-1710048 [1]. The decision on the symbol(s) needed to accommodate the required minimum guard time for SRS antenna switching for 480 and 960 kHz SCS is up to RAN1 discussion based on the absolute switching time in R4-1710048.
  + Option 2: Huawei, R4-2213370
    - **Answer to RAN1:** The SRS antenna switching time is 15us for both 480 and 960 kHz in FR2-2. The minimum guard time needed to accommodate the required antenna switching time could be calculated as 7.2 symbols for 480kHz SCS and 14.4 symbols for 960kHz SCS, which are rounded up in below table. RAN1 could further discuss and determine on the final values.
* Recommended WF
  + Companies are encouraged to provide comments on the specific wording and content of the LS reply. Draft LS reply R4-2211697 can be taken as baseline and updated based on feedback received.

## GTW discussion

### Open issues

Issue 1-1: UE feature list

* No discussion needed under this thread

Issue 1-2: LS reply to RAN1

* Return to this issue if time allows. Draft LS reply R4-2211697 can be taken as baseline and updated based on feedback received.

# Topic #2: Operation bands and system parameters

## Open issues summary

### Sub-topic 2-1: FR2 band for unlicensed operation

**Issue 2-1: Note on unlicensed operation**

* RAN4 to agree between the alternatives below
  + - Alt. 1: NOTE 1: This band is for unlicensed operation (Apple, R4-2211873)
    - Alt. 2: NOTE 1: This band is for unlicensed operation and subject to regional and/or country specific regulations (Apple, R4-2211873)
    - Alt. 3: NOTE 1: This band is restricted to operation with shared spectrum channel access as defined in TS 37.213 [reference for 37.213]. (First round feedback)

### Sub-topic 2-2: Operating bands and channel arrangement for CA

**Issue 2-2a: Operating bands for CA**

* Proposal (Nokia, R4-2212845)
  + Add NR CA band CA\_n263 to table 5-2A.1-1 in TS 38.101-2 together with a note clarifying that only contiguous CA is applicable for this band.

|  |  |
| --- | --- |
| NR CA Band | NR Band  (Table 5.2-1) |
| CA\_n257 | n257 |
| CA\_n258 | n258 |
| CA\_n259 | n259 |
| CA\_n260 | n260 |
| CA\_n261 | n261 |
| CA\_n263 (Note) | n263 |
| NOTE: Only contiguous CA is applicable for this operating band. | |

* Recommended WF
  + Companies should share their views on the proposal and note wording. Agreement will be captured in a CR for TS 38.101-2.

**Issue 2-2b: NR CA bandwidth class**

* Proposals (Nokia, R4-2212845)
  + Proposal 1: In Rel-17 only support for n\*100 MHz and m\*400 MHz contiguous CA is specified.
  + Proposal 2: No new bandwidth classes are specified for n\*100 MHz
  + Proposal 3: Two new bandwidth classes are specified and placed within fallback group 1 to cover 4\*400 MHz and 5\*400 MHz. These new bandwidth classes are applicable only for FR2-2.

|  |  |  |  |
| --- | --- | --- | --- |
| **NR CA BW class** | **Aggregated channel bandwidth** | **# cont. CC** | **Fallback group** |
| A | BWChannel ≤ 400 MHz | 1 | 1,2,3,4,5 |
| B | 400 MHz < BWChannel\_CA ≤ 800 MHz | 2 | 1 |
| C | 800 MHz < BWChannel\_CA ≤ 1200 MHz | 3 |
| V (Note 4) | 1200 MHz < BWChannel\_CA ≤ 1600 MHz | 4 |
| W (Note 4) | 1600 MHz < BWChannel\_CA ≤ 2000 MHz | 5 |
| NOTE 3: In this release of the specification, the minimum requirements for intra-band contiguous CA configurations apply for aggregated channel bandwidths up to 1600 MHz for FR2-1 (this note is not relevant for UE capability parsing by the network).  NOTE 4: In this release of the specification, this bandwidth class is applicable only for operating bands within FR2-2. | | | |

* Recommended WF
  + Verify whether proposals are agreeable

**Issue 2-2c: Channel spacing for CA**

* Proposals
  + Proposal 1: For NR operating bands in FR2-2, nominal channel spacing is when the center frequencies of two closest channels are multiple of 100.8MHz or multiple of 100.8MHz plus 50.4MHz and the two channels do not overlap. Note CA of 2000MHz CBW with another CBW is not considered. (Apple, R4-2211873)
  + Proposal 2: Specify channel spacing for adjacent NR carriers and channel spacing for CA using the following rules: (Nokia, R4-2212845)
    - Channel centers are integer multiple of 100.8 MHz apart and
    - Channels are centered at closest available RF raster point with no overlap between carriers
  + Proposal 3: Align channel spacing for CA for FR2-2 between TS 38.104 and TS 38.101-2. (Nokia, R4-2212845)
* Recommended WF
  + Discuss the three proposals listed
  + Note that this issue can be sub-divided into two parts: channel spacing for adjacent carriers and the definition of contiguous CA
    - Proposal 1 and Proposal 2 are aligned on channel spacing for adjacent carriers
    - For contiguous CA definition, revisions may be needed
    - Consider the definition below

Nominal Channel spacing = ceil((BWChannel(1) + BWChannel(2))/100.8 MHz) \* (100.8/2) [MHz]

**Issue 2-2d: Configurations for intra-band contiguous CA**

* Proposals (Nokia, R4-2212845)
  + Proposal 1: Include CA configurations up to 5\*400 MHz and 8\*100 MHz.
  + Proposal 2: Include a note in CA configuration table to clarify that only multiples of the same channel bandwidth are allowed for FR2-2.

| NR CA configuration / Bandwidth combination set / Fallback group | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configs. | Uplink CA configs. | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | Max aggregated  BW (MHz) | BCS | Fallback group |
| CA\_n263B | CA\_n263A | 400 | 400 |  |  |  |  |  |  | 800 | 0 | 1 |
| CA\_n263C | CA\_n263A | 400 | 400 | 400 |  |  |  |  |  | 1200 | 0 | 1 |
| CA\_n263V | CA\_n263A | 400 | 400 | 400 | 400 |  |  |  |  | 1600 | 0 | 1 |
| CA\_n263W | CA\_n263A | 400 | 400 | 400 | 400 | 400 |  |  |  | 2000 | 0 | 1 |
| CA\_n263G | CA\_n263A | 100 | 100 |  |  |  |  |  |  | 200 | 0 | 3 |
| CA\_n263H | CA\_n263A | 100 | 100 | 100 |  |  |  |  |  | 300 | 0 | 3 |
| CA\_n263I | CA\_n263A | 100 | 100 | 100 | 100 |  |  |  |  | 400 | 0 | 3 |
| CA\_n263J | CA\_n263A | 100 | 100 | 100 | 100 | 100 |  |  |  | 500 | 0 | 3 |
| CA\_n263K | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 |  |  | 600 | 0 | 3 |
| CA\_n263L | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 | 100 |  | 700 | 0 | 3 |
| CA\_n263M | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 800 | 0 | 3 |
| NOTE 1: Void  NOTE 2: For the NR CA configuration with more than two component carries, the bandwidths in a BCS which may introduce combinations more than requested unintentionally should be listed in a row separately.  NOTE 3: In this release of the specification, contiguous DL CA configurations within FR2-2 may only contain multiples of the same channel bandwidth. | | | | | | | | | | | | |

* Recommended WF
  + Companies should share their views on the proposed configurations captured in the above table

## GTW discussion

### Open issues

Issue 2-1: Note on unlicensed operation

Consider the alternatives below:

* Alt. 1: NOTE 1: This band is for unlicensed operation (Apple, R4-2211873)
* Alt. 2: NOTE 1: This band is for unlicensed operation and subject to regional and/or country specific regulations (Apple, R4-2211873)
* Alt. 3: NOTE 1: This band is restricted to operation with shared spectrum channel access as defined in TS 37.213 [reference for 37.213]. (First round feedback)

Discussion:

Issue 2-2a: Adding n263 to Operating bands for CA table

Discussion:

Issue 2-2b: NR CA bandwidth class

* Proposal 1: In Rel-17 only support for n\*100 MHz and m\*400 MHz contiguous CA is specified.
* Proposal 2: No new bandwidth classes are specified for n\*100 MHz
* Proposal 3: Two new bandwidth classes are specified and placed within fallback group 1 to cover 4\*400 MHz and 5\*400 MHz. These new bandwidth classes are applicable only for FR2-2.

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| **NR CA BW class** | **Aggregated channel bandwidth** | **# cont. CC** | **Fallback group** |
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| NOTE 3: In this release of the specification, the minimum requirements for intra-band contiguous CA configurations apply for aggregated channel bandwidths up to 1600 MHz for FR2-1 (this note is not relevant for UE capability parsing by the network).  NOTE 4: In this release of the specification, this bandwidth class is applicable only for operating bands within FR2-2. | | | |

Discussion:

Issue 2-2c: Channel spacing for CA

* Proposals
* Proposal 1: For NR operating bands in FR2-2, nominal channel spacing is when the center frequencies of two closest channels are multiple of 100.8MHz or multiple of 100.8MHz plus 50.4MHz and the two channels do not overlap. Note CA of 2000MHz CBW with another CBW is not considered. (Apple, R4-2211873)
* Proposal 2: Specify channel spacing for adjacent NR carriers and channel spacing for CA using the following rules: (Nokia, R4-2212845)
  + Channel centers are integer multiple of 100.8 MHz apart and
  + Channels are centered at closest available RF raster point with no overlap between carriers
* Proposal 3: Align channel spacing for CA for FR2-2 between TS 38.104 and TS 38.101-2. (Nokia, R4-2212845)
* Recommended WF
  + Note that this issue can be sub-divided into two parts: channel spacing for adjacent carriers and the definition of contiguous CA
    - For contiguous CA definition, revisions may be needed
    - Consider the definition below

Nominal Channel spacing = ceil((BWChannel(1) + BWChannel(2))/100.8 MHz) \* (100.8/2) [MHz]

Discussion:

Issue 2-2d: Configurations for intra-band contiguous CA

* Proposal 1: Include CA configurations up to 5\*400 MHz and 8\*100 MHz.
* Proposal 2: Include a note in CA configuration table to clarify that only multiples of the same channel bandwidth are allowed for FR2-2.

| NR CA configuration / Bandwidth combination set / Fallback group | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA configs. | Uplink CA configs. | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | BWChannel (MHz) | Max aggregated  BW (MHz) | BCS | Fallback group |
| CA\_n263B | CA\_n263A | 400 | 400 |  |  |  |  |  |  | 800 | 0 | 1 |
| CA\_n263C | CA\_n263A | 400 | 400 | 400 |  |  |  |  |  | 1200 | 0 | 1 |
| CA\_n263V | CA\_n263A | 400 | 400 | 400 | 400 |  |  |  |  | 1600 | 0 | 1 |
| CA\_n263W | CA\_n263A | 400 | 400 | 400 | 400 | 400 |  |  |  | 2000 | 0 | 1 |
| CA\_n263G | CA\_n263A | 100 | 100 |  |  |  |  |  |  | 200 | 0 | 3 |
| CA\_n263H | CA\_n263A | 100 | 100 | 100 |  |  |  |  |  | 300 | 0 | 3 |
| CA\_n263I | CA\_n263A | 100 | 100 | 100 | 100 |  |  |  |  | 400 | 0 | 3 |
| CA\_n263J | CA\_n263A | 100 | 100 | 100 | 100 | 100 |  |  |  | 500 | 0 | 3 |
| CA\_n263K | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 |  |  | 600 | 0 | 3 |
| CA\_n263L | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 | 100 |  | 700 | 0 | 3 |
| CA\_n263M | CA\_n263A | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 800 | 0 | 3 |
| NOTE 1: Void  NOTE 2: For the NR CA configuration with more than two component carries, the bandwidths in a BCS which may introduce combinations more than requested unintentionally should be listed in a row separately.  NOTE 3: In this release of the specification, contiguous DL CA configurations within FR2-2 may only contain multiples of the same channel bandwidth. | | | | | | | | | | | | |

Discussion:

# Topic #3: FR1+FR2-2 DC/CA band combinations

## Open issues summary

### Sub-topic 3-1: Defining a band combination for FR1 + FR2-2 DC/CA

*At least one band combination for the case of FR2-2 DC/CA with an anchor in FR1 needs to be included to complete the work item. Alignment on an approach to take is encouraged.*

**Issue 3-1: Approach to introduce an FR2-2 DC/CA with an anchor in FR1 combination**

* Option (Intel, R4-2212118)
  + RAN4 targets completing one example band combination FR2-2 DC/CA with an anchor in FR1 within the maintenance phase of the WI
  + Additional band combinations can be added in a release-independent manner as part of a Release 18 basket WI
  + To specify the example band combination FR2-2 DC/CA with an anchor in FR1, RAN4 could take a corresponding FR2-1 DC/CA combination with anchor in FR1 as a baseline in this meeting, with square brackets around the requirements, and aim to remove the brackets in the maintenance phase
* Recommended WF
  + Please share your views on the suggested approach, and any modifications or recommendations to introduce band combinations
  + Based on operator interest, companies are asked to consider n48 + n263 as a potential FR2-2 DC/CA + FR1 band combination to be completed within this work item

## Companies views’ collection for 1st round

### Open issues

Issue 3-1: Approach to introduce FR2-2 DC/CA with an anchor in FR1 band combinations

Recommended WF: Based on feedback thus far, companies agree with the option presented

Discussion: