**3GPP TSG-RAN WG4 Meeting # 97-e R4-xxxx**

**Electronic Meeting, 2 - 13 November 2020**

**Agenda item:** 7.1.1 & 7.1.3

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [97e][106] NR\_unlic\_SysParameters

**Document for:** Information

# Introduction

This document summarizes the email discussion on topics related to NR-U system parameters in AIs 7.1.1 and 7.1.3.

Based on the contributions, following main topics are discussed in this thread:

* Spectrum Utilization and Channelization
* Wideband Operation
* NR-U CA BW Classes

Proposals 1&2 from R4-2015372 are also considered in this thread.

# Topic #1: Spectrum Utilization

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2014496** | Skyworks Solutions, Inc. | **Proposal: Brackets can be removed from 38.101-1 Table 5.4.2.3-3 values.** |
| **R4-2015372** | Nokia | ***Proposal 1: It is proposed to removed brackets for NR-ARFCN for band n96 in*** ***table 5.4.2.3-1 in Note 2 in TS 38.104 (BS core spec)***  ***Proposal 2: It is proposed to removed brackets for GSCN for band n96 in Note 6 in table 5.4.3.3-1 of TS 38.104.*** |
| **R4-2015694** | Huawei, HiSilicon | ***Proposal 1: It is proposed to revise channel raster, GSCN and transmission bandwidth configuration as proposed in section 2.*** |
| **R4-2014887** | Apple Inc. | **Proposal: For 60kHz SCS, adopt alternative 1 for intra-carrier guard bands (i.e. 5 RBs for in-carrier guard band with 23-5-23 pattern).** |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1:** NR-ARFCN for band n96

* Proposals
  + Option 1: Remove Brackets from 38.101-1 Table 5.4.2.3-3 and TS 38.104 Table 5.4.2.3-1 in Note 2 values (Nokia, Skyworks)
  + Option 2: One 60MHz channel with Fc=7095MHz (NREF=873000) is missing. Revise 38.101-1 Table 5.4.2.3-3 and TS 38.104 Table 5.4.2.3-1 in Note 2 by adding NREF=873000 (Huawei)
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 1-2

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2:** GSCN for band n96

* Proposals
  + Option 1: Removed brackets for GSCN for band n96 in Note 6 in table 5.4.3.3-1 of TS 38.104(Nokia)
  + Option 2: Revise GSCN for band n96 in Note 4 in table 5.4.3.3-1 of TS 38.101-1 and Note 6 in table 5.4.3.3-1 of TS 38.104 as below: [Huawei]

GSCN = [9548, 9562, 9575, 9589, 9603, 9617, 9631, 9645, 9659, 9673, 9687, 9700, 9714, 9728, 9742, 9756, 9770, 9784, 9798, 9812, 9826, 9840, 9853, 9867, 9881, 9895, 9909, 9923, 9937, 9950, 9964, 9978, 9992, 10006, 10020, 10034, 10048, 10062, 10075, 10089, 10103, 10117, 10131, 10145, 10159, 10173, 10187, 10200, 10214, 10228, 10242, 10256, 10270, 10284, 10298, 10312, 10325, 10339, 10353]

* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 1-3

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3:** Revise Table 5.3.2-1: Transmission bandwidth configuration NRB for FR1in 38.101-1 as follows (text in blue is added):

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 5  MHz | 10  MHz | 15  MHz | 20 MHz | 25 MHz | 30  MHz | 40 MHz | 50 MHz | 60 MHz | 70  MHz | 80 MHz | 90  MHz | 100 MHz |
| NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB | NRB |
| 15 | 25 | 52 | 79 | 106 | 133 | 160 | 216 | 270 | N/A | N/A | N/A | N/A | N/A |
| 30 | 11 | 24 | 38 | 51 | 65 | 78 | 106 | 133 | 162 | 189 | 217 | 245 | 273 |
| 60 | N/A | 11 | 18 | 24  251 | 31 | 38 | 51 | 65 | 79 | 93 | 107 | 121 | 135 |
| Note 1 It is only applied for Band n46 and n96. | | | | | | | | | | | | | |

* Proposals
  + Option 1: Agreeable
  + Option 2: Not Agreeable
  + Option 3: Define 25 RB for single carrier and 5RB for in-carrier guard band (Compromised proposal from Huawei)
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 1-4

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-4:** For 60kHz SCS, adopt alternative 1 for intra-carrier guard bands (i.e. 5 RBs for in-carrier guard band with 23-5-23 pattern). (Apple)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **SCS** | **20MHz Channels** | **40MHz Channels** | | **60MHz Channels** | | **80MHz Channels** | |
| 15KHz | 106 | 105-6-105 | Max. 216 | N/A | | N/A | |
| 30KHz | 51 | 50-6-50 | Max. 106 | 50-6-50-6-50 | Max. 162 | 50-6-50-5-50-6-50 | Max. 217 |
| Alt. 1 60KHz | 24 | [23-5-23] | Max. 51 | [23-5-23-5-23] | Max. 79 | [23-5-23-5-23-5-23] | Max. 107 |
| Alt. 2 60KHz | [25] | [24-3-24] | Max. 51 | [24-3-25-3-24] | Max. 79 | [24-4-24-3-24-4-24] | Max. 107 |

* Proposals
  + Option 1: Agreeable
  + Option 2: Not Agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 1-1: We support option 1. For option 2 it might not be possible to introduce additional 60 MHz channel as this would not be contained within an 80MHz channel.  Issue 1-2: We propose option 1 to remove the brackets. For option 2 we can not agree as this would violate the RAN1 design as CORESET#0 is not possible to configure within the RB-set for e.g. 40, 60 and 80 MHz channels. |
| ZTE | Sub topic 1-1: no strong opinions on adding additional 60MHz at the upper edge of 6GHz band, however how to meet the FCC requirement -27dBm/MHz should be clarified.    Sub topic 1-2: our results are more aligned with option 2, for lots of GSCN, there are still some guardband between carrier GB and SSB ;  Sub topic 1-3: support the option 1 which is aligned with agreement [R4-1910537](file:///D:\\RAN4\\TSGRAN4_92\\Docs\\R4-1910537.zip).  Sub topic 1-4: support the |
| Qualcomm | Sub-topic 1-1: We are ok to add the 60 MHz channel at Fc=7095  Sub-topic 1-2: We are checking the new GSCN.  Sub-topic 1-3: Option 2, not agreeable  Sub-topic 1-4: Option 1, agreeable to Alt 1. |
| Charter Communications Inc. | Sub-topic 1-1: We agree with Nokia and Skyworks. GSCN for n96 should follow the wi-Fi channel bonding configuration for proper co-existence. Option 1  Sub-topic 1-2: We agree with option 1  Sub-topic 1-3: Not agreeable, option 2  Sub-topic 1-4: Agreeable to alt 1, option 1 |
| Skyworks | Issue 1-1: if the additional 60MHz channel proposed by Huawei is following channel bonding rules (it might be considered the case as there is no WiFi 80 MHz channel and it does not overlap partially with any WiFi 80 MHz channel) , we are OK to add it.  Issue 1-2: according to 1-1 above we are OK with option 2 if according to channel bonding rules AND remove brackets |
| Huawei | Issue 1-3 and Issue 1-4: these issues have been discussed for several meetings without progress. As a compromise, we propose 25 RB for single carrier and 5 RB for in-carrier guard band, is it agreeable? |
| CableLabs | Sub-topic 1-1: We agree that NR-U channel should follow the Wi-Fi channel bonding configuration for proper co-existence. It looks like the last 80 MHz Wi-Fi channel in U-NII-8 band ranges 6985-7065 MHz, and the rest of spectrum from 7065-7125 could be utilized by a 60 MHz channel. We agree with option 2.  IEEE 802.11ax group released a IEEE P802.11ax™/D8.0 version in October which is newer than the D6.1 version used in Nokia’s contribution R4-2014496, where Table E-4 (on page 805) defined a 20 MHz channel starting from 5925 MHz. This conflicts with Observation 1. We should consider adding this 20 MHz channel from 5925-5945 MHz to NR-U band n96.    Sub-topic 1-2: we are checking the GSCN.  Sub-topic 1-3: option 2: Not Agreeable. We expressed our concern about coexistence issues introduced by 25 PRBs in the August meeting.  Sub-topic 1-4: we support option 1 and alternative 1. |
| Apple | Issue 1-3: Option 2 (not agreeable). We cannot accept making 25RB as the mandatory number of RBs for a UE supporting 60kHz SCS and NR-U. As explained in our paper, a UE supporting 60kHz SCS will most likely support it for a number of bands, where number of RBs will be 24. In that sense it is not clear why we have to support 25RBs if the baseline number of RBs is 24 for other bands.  Issue 1-4: Option 1 (alternative 1). Referring to the explanations for issue 1-3 above, as 25RBs cannot be a mandatory number of RBs for the NR-U band, the [23-5-23] pattern cannot be applied either, i.e. we can rely only upon [24-3-24]. In fact, the overall value of the [24-3-24] pattern is rather marginal because the total number of schedulable RBs is the same. |
| Intel | Iussue 1-3: Option 1 (Agreeable)  Issue 1-4: Option 2. We suggest to remove 20 MHz case from the table as the table indeed for wideband operation (>20MHz). 20 MHz single carrier will be specified in the table 5.3.2-1 as in the issue 1-3. |
| Ericsson | Issue 1-1: we remark that alignment with Wi-Fi channel bonding may not be required if CAT4 LBT is performed on all LBT sub-bands in case the 6 GHz rules are aligned (still draft) with EN 301 893  Issue 1-3: we prefer Option 2  Issue 1-4: Option 1 |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1-1**  NR\_ARFCN | *Tentative agreements:* No Agreement  *Candidate options:* Options Remain the same as in section 1.2  *Option 1: Nokia, Charter*  *Option 2:* Qualcomm, Skyworks, CableLabs  *ZTE is neutral.*  *Recommendations for 2nd round:* Companies continue the discussion |
| **Sub-topic#1-2**  GSCN | *Tentative agreements:* No Agreement  *Candidate options:* Options Remain the same as in section 1.2  *Option 1:* Nokia, Charter  *Option 2:* ZTE, Skyworks,  *Recommendations for 2nd round:* Companies continue the discussion |
| **Sub-topic#1-3**  Spectrum Utilization, Single Carrier | *Tentative agreements:* No Agreement  *Candidate options:* Options Remain the same as in section 1.2  *Option 1:* ZTE, Huawei, Intel  *Option 2:* Qualcomm, Charter, CableLabs, Apple, Ericsson  *Recommendations for 2nd round:* Companies continue the discussion and consider Huawei proposal for compromise |
| **Sub-topic#1-4**  Spectrum Utilization,  Wideband | *Tentative agreements:* No Agreement  *Candidate options:* Options Remain the same as in section 1.2  *Option 1:* Qualcomm, Charter, CableLabs, Apple, Ericsson  *Option 2:* Huawei, Intel  *Recommendations for 2nd round:* Companies continue the discussion and consider Huawei proposal for compromise |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

Please provide your 2nd round comments in the table below. Issues are outlined in section 1.2.

|  |  |
| --- | --- |
| Issue1-1:  NR\_ARFCN | Nokia: If compagnies prefers to add the additional 60MHz channels to the raster we are okay to do so. For the rest of the raster points we still propose to remove brackets. |
| Charter Communications: We agree with Nokia. We an accept the additional 60 MHz channel but for the rest we will like to keep the values in the CR and remove square brackets |
| Skyworks: we believe it is beneficial to add the last 60MHz channel and then remove the brackets |
| CableLabs: We agree to add the additional 60 MHz channel. We also recommend to add the additional 20 MHz channel from 5925-5945 MHz. |
| Ericsson: ok to add the 60 MHz additional carrier with a corresponding GSCN. For operations in the EU, alignment with Wi-Fi channel bonding may not be required if CAT4 LBT is performed on all LBT sub-bands in case the 6 GHz rules (still draft) are aligned with EN 301 893 for 5 GHz. The latter standard is governing the 5 GHz channel raster for LAA and alignment with the IEEE 802.11 channel bonding as specified in 36.104. |
| Huawei: We support option 2 as we proposed in our paper. |
| ZTE: after further consideration, it’s nice to have this channel arrangement, however how to meet FCC requirement just next to 60MHz carrier edge should be clarified. |
| Issue1-2:  GSCN | Nokia: It is important not to change the defined raster and as previously commented we cannot agree to change this. The reason being that the proposed changes would violate the RAN1 design as CORESET#0 then would not be possible to configure within the RB-set for e.g. 40, 60 and 80 MHz channels. |
| Charter Communications: Same comment as Nokia |
| Skyworks see issue 1-1: at least add last 60MHz raster point |
| Huawei: we support option 2 which follows the same rules as we did for band n46: 1. The Minimum frequency separation from sub-band edge to guarantee compliance with inter-carrier and intra-carrier minimum guard-bands for all possible channel bandwidths 2. Maximize spectrum utilization for the case in which SSB is frequency multiplexed with RMSI or CSI-RS |
| Qualcomm: According to our calculations, the CORESET would still fit with the slight shift of the SSB. For coreset #0, we can still indicate 0-3 RB offset to move the starting point of coreset #0 lower. For the raster points with problem, before we shift the raster, we have lower guard of 805KHz and 985KHz respectively. If we shift the raster point, we will shift 1.44MHz higher to get 2245KHz and 2425KHz. If we use 3 RB offset, we will have 1165KHz and 1345KHz. Consider coreset 0 is 48RBs, we will have 1555KHz and 1375KHz on the top as guard. We would like to understand Nokia’s concern in case we misunderstood something. |
| ZTE: the updated GSCN can still guarantee the enough guardband between lower carrier edge and SSB, therefore it’s not necessary to further shift upwards. Encourage to have more offline discussion on calculation spreadsheet. |
|  | Nokia:  According our calculations, there are an issues for some updated GSCN numbers for 40/60/80 MHz channels. These are still 1RB too short. According RAN1 specification allowed CORSET offsets are 0,1,2,3. Some example (there are more): |
| Issue 1-3:  Spectrum Utilization  Single carrier | Ericsson: we prefer Option 2. |
| Apple: Issue 1-3: Option 2 (not agreeable). We cannot accept making 25RB as the mandatory number of RBs for a UE supporting 60kHz SCS and NR-U. As explained in our paper, a UE supporting 60kHz SCS will most likely support it for a number of bands, where number of RBs will be 24. In that sense it is not clear why we have to support 25RBs if the baseline number of RBs is 24 for other bands. |
| Huawei: Issue 1-3 and 1-4, Option 3 as a compromise, 24 RB means less than 90% SU for single carrier and 25 RB was agreed long time ago. |
| ZTE: prefer option 1 |
| Issue 1-4:  Spectrum Utilization  Wideband | Apple: Issue 1-4: Option 1 (alternative 1). Referring to the explanations for issue 1-3 above, as 25RBs cannot be a mandatory number of RBs for the NR-U band, the [23-5-23] pattern cannot be applied either, i.e. we can rely only upon [24-3-24]. In fact, the overall value of the [24-3-24] pattern is rather marginal because the total number of schedulable RBs is the same. |
| Huawei: Issue 1-3 and 1-4, Option 3 as a compromise, 24 RB means less than 90% SU for single carrier and 25 RB was agreed long time ago. |
| ZTE: we need to conclude on issue 1-3 firstly, then further discuss the Issue 1-4. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Wideband Operation

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2014621** | *MediaTek inc.* | Proposal 1: UL wide-band transmission mode 1 assumes that LBT is successful in all LBT sub-bands of BWP, irrespective of which sub-bands are scheduled with data.  Proposal 2: For UL WB operation, only Mode 1 is introduced as a basic feature, while Mode 2A and 2B should be removed according to Section 4.2.1.0.4 of TS 37.213.  Proposal 3: For DL WB operation, Mode 1 is introduced as a basic feature, while Mode 2 and 3 are introduced as optional features. |
| **R4-2014888** | *Apple Inc.* | Proposal 1a: DL wide-band mode 1 can be construed as the baseline NR-U functionality.  Proposal 1b: DL wide-band mode 2 and 3 must be differentiated from mode 1.  Proposal 1c: Discuss further whether DL mode 2 and 3 should have separate capabilities or they can be covered by the same "mode 2/3" capability.  Proposal 1c: DL wide-band mode 1 UE performance requirements apply only if sub-bands of the configured channel contain serving gNB transmission.  Proposal 2a: A UE should perform LBT only for those sub-bands where data is scheduled.  Proposal 2b: If Proposal 2a is agreeable, then UL wide-band mode 1 is not needed as the UE behaviour will always correspond to UL mode 2A/2B.  Proposal 2c: It is preferable to have differentiation between 2A and 2B accounting for different UE LBT capabilities.  Proposal 3: Add the corresponding NR-U capabilities into the RAN WG4 feature list and inform other WGs about it. |
| **R4-2015251** | Nokia, Nokia Shanghai Bell | Proposal 1: Agree that there is no difference in UE capability between DL Cases 2a/2b/3 and DL Case 4.  Proposal 2: No UE capabilities are needed for DL wideband operation.  Observation 1: RAN2 did not reserve any bits for non-agreed UE capabilities based on the RAN1 request.  Proposal 3: Further discus UE capabilities for UL wideband operation. |
| **R4-2016438** | Qualcomm Incorporated | Proposal: From a RAN4 perspective, none of the feature groups is needed for Rel-16 since requirements are not available or the feature group is already part of the baseline assumption that all UE’s are expected to support. |
| **R4-2015972** | Ericsson | CR to TS 38.101-1 on Correction to the intra-cell guard band definition for wideband operation  38.101-1 v16.5.0 CR-0550 Cat: F (Rel-16)  The 38.101-1 defines ‘wideband operation’ as  Wideband operation: For a UE that supports shared spectrum channel access, wideband operation refers to operation within a channel larger than 20 MHz in which intra-cell guard bands may be configured to distinguish individual RB-sets  hence not including operations with the 10 MHz and 20 MHz channel bandwidths. However, it is not obvious from sub-clause 5.3.3 that that there are no intra-cell GB for these bandwidths; the 20 MHz channel bandwidth is nevertheless included in Table 5.3.3-2 defining the nominal GB for wideband operations.  Since 38.331 refers to 38.101-1 for the guard-band sizes when the above IEs are absent, the intra-cell GB configuration must be clearly defined for all channel bandwidths. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1

*Sub-topic description:* NR-U UL Wideband operation

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1:** UL Wideband operation

* Proposals
  + Option 1: wide-band transmission mode 1 assumes that LBT is successful in all LBT sub-bands of BWP, irrespective of which sub-bands are scheduled with data. (MediaTek)
  + Option 2: A UE should perform LBT only for those sub-bands where data is scheduled. Then UL wide-band mode 1 is not needed as the UE behaviour will always correspond to UL mode 2A/2B (Apple)

Agreement: A UE should perform LBT only for those sub-bands where data is scheduled. (GTW, Nov 3rd )

**Issue 2-1-2:** UE capabilities for UL wideband operation.

* Proposals
  + Option 1: For UL WB operation, only Mode 1 is introduced as a basic feature, while Mode 2A and 2B should be removed according to Section 4.2.1.0.4 of TS 37.213. (MediaTek)
  + Option 2: If Option 2 of Issue 2-1-1 is adopted, it is preferable to have differentiation between 2A and 2B accounting for different UE LBT capabilities. (Apple)
  + Option 3: From a RAN4 perspective, none of the feature groups is needed for Rel-16 since requirements are not available or the feature group is already part of the baseline assumption that all UE’s are expected to support. (Qualcomm)

Agreement: From RAN4 perspective, no UL capability is needed assuming the max. UL channel bandwidth is 80MHz and UL TX is contiguous for Rel-16. (GTW, Nov 3rd )

### Sub-topic 2-2

*Sub-topic description:* NR-U DL wideband operation

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1:** DL wide-band mode 1 UE performance requirements apply only if sub-bands of the configured channel contain serving gNB transmission.

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

**Issue 2-2-2:** UE capabilities for DL wideband operation.

* Proposals
  + Option 1: There is no difference in UE capability between DL Cases 2a/2b/3 and DL Case 4. No UE capabilities are needed for DL wideband operation in addition to FG 4-1.(Nokia)
  + Option 2: From a RAN4 perspective, none of the feature groups is needed for Rel-16 since requirements are not available or the feature group is already part of the baseline assumption that all UE’s are expected to support. (Qualcomm)
  + Option 3: (Apple, MediaTek)
    - Proposal 1a: DL wide-band mode 1 can be construed as the baseline NR-U functionality.
    - Proposal 1b: DL wide-band mode 2 and 3 must be differentiated from mode 1.
    - Proposal 1c: Discuss further whether DL mode 2 and 3 should have separate capabilities or they can be covered by the same "mode 2/3" capability or they can be optional capabilities

**Agreement:** (GTW, Nov 3rd )

UE support of DL wide-band mode 1 is mandatory.

* + FFS whether a feature group needs to be specified for support of mode 1
  + FFS UE support of mode 2 and 3
* Recommended WF
  + Companies provide their views on the following issues:
    - Whether a feature group needs to be specified for support of mode 1
    - UE support of mode 2 and 3

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | **Issue 2-1-1:**  Although we proposed Option 1, we are also fine with the 1st sentence of Option 2.  Regarding the 2nd sentence in Option 2, we think we share the same argument with Apple, but different in conclusion. We suggest to keep Mode 1 only and delete Modes 2A and 2B which are essentially Mode 1 according current RAN1 spec (Section 4.2.1.0.4 of TS 37.213).  **Issue 2-1-2:**  Support Option 1.  According to Section 4.2.1.0.4 of TS 37.213, UE will not transmit anything if any of the LBT subband overlapped with the UL signal has LBT failure. In that case, Mode 2A/2B is essentially Mode 1.  **Issue 2-1-3:**  Support Option 2.  We believe the intention of the original proposal should be “DL wide-band mode 1 UE performance requirements apply only if all sub-bands of the configured channel contain serving gNB transmission.” However, it is up to network. Rel-15 NR already allows network to schedule PDSCH on only partial PRBs in a carrier. It would be strange to limit network behavior in Rel-16.  **Issue 2-2-2:**  Support Option 3  Although we agreed that Mode 1/2/3 are the same from RF perspective, they still have large difference in baseband complexity in terms of the hypotheses UE needs to handle for PDCCH blind detection. |
| Qualcomm | Issue 2-1-1: We think that UL LBT is only performed on those sub-bands for which the UE is scheduled for transmission. In that sense, we don’t see the value in having a capability for Mode 1 but we’re open for discussion. In our understanding, mode 2B is the baseline mode but we don’t see the need to have a capability for it.  Issue 2-1-2: We don’t see the value of signaling capability for any of mode 1, 2A, or 2B.  Issue 2-2-1: The proposal might be too restrictive. Agree that specifications for jammers inside of the channel are not available, but to say that only serving gNB transmission suggests that even if the sub-bands were unoccupied, the requirements would not apply.  Issue 2-2-2: We agree that DL mode 1 is supported by the RAN4 specs, but mode 2 and 3 do not have requirements. However, we don’t necessarily agree that there needs to be capability signaling for mode 2 and 3 separate from mode 1, especially at this time. The capability can preferably be decided as a package with the requirements for mode 2 and 3 when available. |
| Nokia | **Issue 2-1-1:** We support option 2.  **Issue 2-1-2:** We support option 3 but could be fine with option 2 if only a capability for 2B is included. This to separate UEs capable of performing either single or multiple LBT for transmission in either single or multiple contiguous 20MHz LBT sub-bands.  **Issue 2-2-1:** We would like to understand from which contribution this comes from and/or at least which performance requirements are referred.  **Issue 2-2-2:** We firmly insists on option 1 as there are no RF differences. If, as some compagnies mention, other issues related to baseband exists this should have been discussed in RAN1 as they have the expertise to asses these matters. Therefore, we suggest that no UE capabilities are needed from a RF perspective.  Our understanding was that in RAN1, the only issues identified were AGC and RF filter adaptation. Hence, the request to have RAN4 further discuss the need for capacities in the RAN1 LS [R4-2009509].  When it comes to baseband issues, PDCCH blind detection is a RAN1 matter. However, we can add here that there is no difference between the wideband modes with respect to the PDCCH blind detection limits or monitoring. It is suggested that companies with concerns on this matter check with their RAN1 colleagues, there is already an FG 10-20 as well as FG 10-29 which already has its own capability bits and are optional. |
| Charter Communications, Inc. | **Issue 2-1-1:** We support option 2  **Issue 2-1-2:** We support Option 3  **Issue 2-2-1:** Agreeable, option 1  **Issue 2-2-2:** We agree in option 1 |
| Skyworks | Issue 2-1-1: we support option 2 which has been the main assumption for R16 UL work for WB operation |
| Huawei | Issue 2-1-1: Option 2  Issue 2-1-2: option 3, no UL capability is needed.  Issue 2-2-1: Option 2 not agreeable, in our understanding for Mode 1, BS will transmit all sub-bands although it may be allocated to different UEs  Issue 2-2-2: no additional capability is needed for DL case 2a/2b and DL case 3 and 4, except FG 4-1. |
| Apple | Issue 2-1-1 (Option 2) and 2-1-2 (Option 2): For the UL operation, our preference is to perform LBT only in those sub-bands where a UE is scheduled with data. It is not clear why a UE would need to perform LBT in sub-bands, where it does not have to transmit. And if LBT is always performed only in those sub-bands where data is sent, then UL mode 1 is not needed at all, i.e. the UE operation will correspond to either 2A (single scheduled sub-band) or 2B (several contiguous sub-bands). And accounting for the fact that different UEs might have different capabilities, it is preferrable to differentiate between them.  Issue 2-2-1 (Option 1):  Issue 2-2-2 (Option 3): As mentioned in several discussion papers, we do not even have performance requirements for DL mode 2 and 3, so either we conclude that they are not available at all, or we can reserve the corresponding capability bits. |
| Nokia | Returning to the open items for Issue 2-2-2 after the GTW. We still insists that there is no RF or baseband impact due to the different modes but since it now seems that the issue is the potential missing requirements for the case when the gNB does not transmit on all the RB sets we can try to be constructive in the sake of progress and propose the following as a package:  Proposal 1a: Mandatory when UE supports NR-U DL without additional capability except FG 4-1 for the case when gNB transmits on all RB-sets of a carrier.  Proposal 1b: Optional support with capability for the case when gNB does not transmit on all RB-sets of a carrier. |
| Apple | Referring to the comment from Nokia above, the DL mode 2/3 have an additional implementation impact to a UE when compared to the DL mode 1, and thus we disagree with the Nokia statement that “*there is no RF or baseband impact due to the different modes*”. In addition to that, since there are no DL mode 2/3 RF requirements either, it is already a compromise that we consider defining optional DL mode 2/3 capability (whereupon at least Apple is open to have just one capability covering both DL mode 2 and 3). Otherwise, we will have no option but to conclude that DL mode 2/3 are not defined at all as some companies suggest. |
| Ericsson | Issue 2-2-1: Option 1.  Issue 2-2-2: Option 2 should be discussed. It is essential that the gNB is made aware of which RB sets and guard bands that can be scheduled for each UE, through capability signaling if necessary. |
| LG Electronics | UL: we do not see need for additional capability information.  DL: Issue 2-2-2: As described in our contribution R4-2015798 we think that modes DL-1 and DL-2 (DL case 2a/b) should be supported as baseline. We understand that current RF requirements support only DL-1, but we do not see that as blocking point for DL-2. Capability info is needed for DL-3 (Reception in intra-carrier guard band). |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| **R4-2015972** | Apple: The general feedback is that the CR should be further revised based on the outcome of the wide-band capability discussion. For instance, "If a UE supporting wideband operation…" is changed to "For a UE supporting wideband operation…" may give a wrong impression that a UE has to support DL mode 2 and 3 because intra-cell guard bands, as a concept, make sense only in those modes. DL mode 1 with "all-or-nothing" approach does not require intra-cell guard band configuration. Similarly, our understanding is that if RAN4 agrees that DL mode 1 is baseline wideband functionality, then we need to revise what presence/absence of intraCellGuardBandsUL-List and intraCellGuardBandsDL-List IEs mean, and what default values are. |
| Nokia: We see not need to change the already agreed definition of the intra-cell guardbands. This CR can not be agreed. |
| Ericsson:  to Apple: the CR can be revised in accordance with the outcome of the DL wideband capability discussion  to Nokia: this CR does not change the definition of the intra-cell guard bands. A summary of changes and corrections is   1. Table 5.3.3-2: the column for 20 MHz is removed (not wideband operation according to the definition replicated below). 2. the intra-cell GB configuration are defined for the 10 MHz and 20 MHz bandwidths; the 38.331 refers to 38.101-1 for the guard-band sizes when the GB IEs are absent, the intra-cell GB configuration must be clearly defined for all channel bandwidths. there are no intra-cell GB for these bandwidths and the RB set size is one for the 10 and 20 MHz bandwidths; 3. the GB IE names are corrected to be in accordance with the latest 38.331.   These changes and corrections should be made (subject to further changes, if any, following the capability discussion).  **Wideband operation**: For a UE that supports shared spectrum channel access, wideband operation refers to operation within a channel larger than 20 MHz in which intra-cell guard bands may be configured to distinguish individual RB-sets |
| Nokia: We have provided a revised version to the draft inbox. For 1) there is no need to change the 20Mhz column as it is clear that no intra-cell guardband are defined herein and information would be lost by removing this. For 2) this sentence is already included in 38.214 [10] and there is no need to add is also here. For 3) we are fine to update the naming according to the latest version of 38.331[7] |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 2-1-1:** UL Wideband operation | *Agreement: A UE should perform LBT only for those sub-bands where data is scheduled. (GTW, Nov 3rd )*  *Recommendations for 2nd round: No further discussion* |
| **Issue 2-1-2:** UE capabilities for UL wideband operation. | *Agreement: From RAN4 perspective, no UL capability is needed assuming the max. UL channel bandwidth is 80MHz and UL TX is contiguous for Rel-16. (GTW, Nov 3rd )*  *Recommendations for 2nd round: No further discussion* |
| **Issue 2-2-1:**  DL wideband operation | *Tentative agreements: No Agreement*  *Candidate options:* DL wide-band mode 1 UE performance requirements apply only if sub-bands of the configured channel contain serving gNB transmission.   * + Option 1: Agreeable   + Option 2: Not agreeable   *Recommendations for 2nd round: Companies continue the discussion* |
| **Issue 2-2-2:**  UE capabilities for DL wideband operation. | **Agreement:** (GTW, Nov 3rd )  UE support of DL wide-band mode 1 is mandatory.  *Candidate options: Options agreed in* GTW, Nov 3rd   * + whether a feature group needs to be specified for support of mode 1   + UE support of mode 2 and 3   *Recommendations for 2nd round: Companies continue the discussion* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| **R4-2015972** | *to be revised* |

## Discussion on 2nd round (if applicable)

**Issue 1:** DL wide-band mode 1 UE performance requirements apply only if sub-bands of the configured channel contain serving gNB transmission.

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable

**Issue 2:** UE capabilities for DL wideband operation.

* + Issue 2-1: whether a feature group needs to be specified for support of mode 1
  + Issue 2-2: UE support of mode 2 and 3
* Recommended WF
  + Companies provide their views

**Agreement: (GTW, Nov 3rd and 9th )**

**DL:**

* UE support of DL wide-band mode 1 is mandatory.
* [UE support of DL wide-band modes 2 and 3 is optional.] QC would like to check

**UL:**

* UL: A UE should perform LBT only for those sub-bands where data is scheduled.

* From RAN4 perspective, no UL capability is needed assuming the max. UL channel bandwidth is 80MHz and UL TX is contiguous for Rel-16.
* It is agreed not to capture the agreement in the UE feature list, but in the specification.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | **Consequence if the feature is not supported by the UE** | Mandatory/Optional |
| 4-1 | DL reception in intra-carrier guardband | Capability of reception in the non-zero intra-cell guardband between contiguous RB sets in DL wideband carrier operation wider than 20MHz when LBT is successful only in a subset of RB sets | 4-2 | UE cannot receive in the intra-cell guardband specified in 38.101-1 | Optional with capability signalling |
| 4-2 | DL reception when gNB does not transmit on all RB sets of a carrier as a result of LBT | Capability of reception in a wideband carrier when LBT is successful in a subset of the configured RB sets, which are either contiguous or non-contiguous, of [the carrier]. |  | UE can guarantee the performance only when gNB transmission occupies all RB sets | Optional with capability signalling |

**FG 4-1 is agreed, subject to further clarification on the term “RB sets”**

**Issue 3:** How to capture the agreement “A UE should perform LBT only for those sub-bands where data is scheduled” in the specifications?

**Issue 4:** Clarify the term RB set

Recommended WF:

Companies provide their views on issues 3 and 4

Please provide your 2nd round comments in the table below.

|  |  |
| --- | --- |
| **Issue 1:**  DL wideband operation | Nokia: As commented in last round we would like to understand which performance requirements are referred to. We do not fully understand the purpose of agreeing this as formulated now. |
| MTK: Given the discussion in Nov 9th GTW, we think it should be clear now that in DL WB operation Mode 1, UE can only guarantee the performance when the gNB transmission occupies the all RB sets. In this case, we think we also reached the conclusion for this issue. |
| Apple: Echoing the MTK comments, the intention of the proposal was to clarify that DL mode 1 performance can be guaranteed only when RB sets contain serving gNB transmission (or not transmission at all). Based on the latest agreements for DL mode 2 and 3, we hope that we reached the conclusion for this issue. |
| Huawei: we do not see the need to agree on this proposal since RAN4 reached the agreements on the DL wideband operation capability. |
| Qualcomm: There seems to be common agreement now that Rel-16 specifications are not applicable in case there is an interferer within the wideband channel. However, we think this needs to be documented somehow in the specifications. |
| **Issue 2:**  UE capabilities for DL wideband operation. | Nokia: We have tried to understand the perspective if other compagnies via offline discussions and have on the basis hereof made a proposal for UE capabilities which we have uploaded as *[106]NR\_unlic\_SysParameters- UE capabilities* to the draft inbox. We do hope this can facilitate progress on this topic. |
| Huawei: regarding DL wideband operation capability, i.e., UE support of DL wide-band modes 2 and 3 is optional, we are still not fully convinced.  If gNB configures CORESET across LBT subbands, UE should assume that gNB will adopt mode 1. The r16 new mechanism such as *freqMontiorLocation*, PDCCH skipping based on RB set indication and etc is developed to support mode 2 and 3. The UE capability to configure *freqMontiorLocation* can fully reflect the capability of reception wideband mode 2 and 3 in downlink. |
| Mode 1, 2 and 3 are not relevant to UE capability. UE can always assume gNB use mode 1. But if the capability is specified in a way that implies only if gNB conducts LBT successful in all the sub-bands gNB can transmit on the carrier, then it would put too much restriction on gNB scheduling. In real field, it is difficult for gNB to schedule DL transmission. |
| Qualcomm: We are still not convinced of the need for Mode 1, 2, and 3 capability indication. Mode 1 is the baseline mode and its conditions should be documented in the specifications. For mode 2/3, requirements either RF or demod are not defined so from a UE perspective, it doesn’t make sense for the UE to declare or not declare a capability for which there are no requirements. From a basestation scheduler’s perspective it needs to know whether UE’s can be scheduled if some RB sets fail LBT. We think that given there is no performance guarantee in Rel-16, then the conclusion should be that mode 2/3 are not supported in Rel-16 RAN4 specifications and scheduling should not be done according to mode 2/3. Wideband operation in mode 2/3 should be properly specified with requirements in the future at which time their capabilities can be introduced if needed. |
| **Issue 3:** | Ericsson: a first stab for 38.101-1 (and perhaps also for 38.101-4) without using ‘LBT sub-bands’: “minimum requirements for the UL are specified for transmissions on one scheduled RB set or ≥ 1 scheduled contiguous RB set(s) with all RB sets available for UL transmissions according to the channel access procedures in [37.213]. The requirements also apply when the UL intra-cell guard bands of non-zero size between the said contiguous RB are scheduled and available for UL transmissions.”  The scope of the RAN4 specifications is minimum requirements. |
| Apple: We are checking with our RAN1 colleagues whether we need to capture agreement for the UL operation in RAN1 or RAN4 specs, or both. For the sake of procedural clarity, we can consider sending LS to RAN1 and RAN2 with the latest RAN4 agreements, whereupon RAN1 can also decide whether RAN1 specs have to be updated. |
| Huawei: In our view, the agreement should be captured in either way forward or RAN1 specification. In RAN4 specification, there seems no LBT and thus it would be difficult to implement the agreement. Besides this agreement is relevant to UE implementation. Maybe capturing it in the way forward is sufficient. |
| **Issue 4:** | Ericsson: the RB set is defined by “The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively.” according to 38.214. Hence the RB sets are the PRBs separated by the intra-cell GB. For 15k and 30k SCS, “For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.” Hence the bandwidth (in MHz) of an RB set cannot be wider than 20 MHz.  The notion ‘LBT sub-band’ is not used in RAN1 specifications, it should be avoided. The notion RB set can be used at least for 15k and 30k. |
| Huawei: RAN1 specification uses RB set representing LBT bandwidth. It can be used to replace LBT subband(s) in RAN4 agreements.  And we want to add the clarification of RB set(s) in the corresponding capability description and in RAN4 specification:  A RB set corresponds to 20MHz channel bandwidth on which a channel access procedure is performed in shared spectrum. |
|  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: NR-U CA BW Classes

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2014889** | Apple Inc. | Proposal 1: Revise NR CA BW classes definition based on the changes shown in Table 2.1-3 to support NR-U intra-band contiguous CA.  Proposal 2: Merge NR-U CA configurations CA\_n46G, CA\_n46H, and CA\_n46I into CA\_n46M, n46N, and n46O respectively as shown in Table 2.2-2.  Proposal 3: Remove CA BW class “I” from NR-U DL CA Rx requirements for ACS, in-band blocking, and out-of-band blocking as it can be covered by CA BW class “O”. |
| **R4-2015973** | Ericsson | CR to TS 38.101-1 on Correction to CA bandwidth classes M, N and O  38.101-1 v16.5.0 CR-0551 Cat: F (Rel-16)  The aggregated bandwidth of CA BW classes M, N and O should support bandwidth combinations down to 10 + 2\*20 MHz, 3\*20 MHz and 4\*20 MHz, respectively. This is not allowed by the strict inequalities in the lower limits for M and N.  The upper limits of the aggregated bandwidths are within square brackets, the tentative limits based on \*60 MHz. Aggregation of up to four carriers with 80 MHz and 100 MHz channel bandwidths is covered by the respective classes B, C, D and E. To that end, the square brackets for M and N can be removed. For 5 CC a new (general) CA BW class applicable for all relevant bands can be defined when needed.  Use of BCS is likely regardless of the value of the upper limit. |
| **R4-2014954** | ZTE Corporation | The notation of NR-U CA BW class is still unclear and need further clarifications.  Observation 1: The fallback group for NR CA bandwidth class “D” and “E” in the current specification does not match the agreement captured in [4].  Proposal 1: Keep the description of FBG 3 for NR CA bandwidth classes D and E unchanged in the current specification as it is.  Proposal 2: It is reasonable for classes M and N to capture sign “=” in the lower limits of aggregated channel bandwidth 50MHz and 80MHz respectively.  Proposal 3: It is suggested not to use notation N for NR CA BW class in FR1. |
| **R4-2014955** | ZTE Corporation | CR to TS 38.101-1 on NR CA bandwidth classes for unlicensed spectrum (Rel-16)  38.101-1 v16.5.0 CR-0522 Cat: F (Rel-16) |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-1:** Keep the description of FBG 3 for NR CA bandwidth classes D and E unchanged in the current specification as it is. (ZTE)

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 3-2

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 3-2:** Revise NR CA BW classes definition based on the following changes:

1. Define the aggregated channel BW upper limits for classes M, N, and O as below: (Apple)

|  |  |  |
| --- | --- | --- |
| BW Class | Aggregated BW | No. of CC |
| M | 50 MHz ≤ BWChannel\_CA ≤ 200 MHz | 3 |
| N | 80 MHz ≤ BWChannel\_CA ≤ 300 MHz | 4 |
| O | 100 MHz ≤ BWChannel\_CA ≤ 400 MHz | 5 |

Also the aggregated channel BW lower limits of classes M, N and O in current specifications should have the “=” sign (ZTE, Apple)

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 3-3

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-3:** Proposal 2: Merge NR-U CA configurations CA\_n46G, CA\_n46H, and CA\_n46I into CA\_n46M, n46N, and n46O respectively as shown in Table 2.2-2 in R4-2014889 (Apple)

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 3-4

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-4:** Remove CA BW class “I” from NR-U DL CA Rx requirements for ACS, in-band blocking, and out-of-band blocking as it can be covered by CA BW class “O”. (Apple)

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

### Sub-topic 3-5

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-5:** It is suggested not to use notation N for NR CA BW class in FR1 since NR band number begins with the letter “n”, CA BW class “N” is absent in FR2 to avoid unnecessary confusion. (ZTE)

* Proposals
  + Option 1: Agreeable
  + Option 2: Not agreeable
* Recommended WF
  + Collect companies’ views in the 1st round discussions

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 3-2: Support Option 1, since BW Class O proposed aggregated BW is up to 400MHz, would BW Class M/N need to have aggregated BW up to 240/320MHz?  Issue 3-3: Option 1 |
| ZTE | Sub topic 3-1: Option-1.  Although the agreement of fallback groups for BW classes C, D and E in RP-202117 are different from the current spec, it seems that the fallback groups for BW classes C, D and E in current spec having the fallback groups “1, 3” are reasonable. In Apple’s contribution R4-2014889, it also suggests the fallback groups for classes D and E are “1, 3”, which is the same as the current spec. However, we can merge the fallback groups for classes C, D and E in one row with the value of “1, 3”.  Sub topic 3-2:  We suggest the aggregated channel BW lower limits of classes M and N in current spec should use the sign of “≤” similar to class O, since the aggregated CH BW 10 + 2\*20 MHz and 3\*20 MHz should also be supported for classes M and N.  As for the upper limits of classes M, N and O, it’s better to keep the current aggrement of using \*60MHz. The aggregation of carriers with 80MHz and 100MHz CH BW can be covered by the current classes C, D and E.  Sub topic 3-3: Option 1  Classes G, H and I can be merged into classes M, N and O for CA\_n46. The detail configurations of CA\_n46M, n46N, and n46O can be further discussed after the definition of FBG 3 is fixed in topic 3-2.  Sub topic 3-4: Option 1  It depends on how to deal with the NR CA BW classes G, H and I in FBG 2.  Sub topic 3-5: Option 1  For the notation of newly introduced CA BW class “N”, considering that NR band number begins with the letter “n”, and also to be consistent with current FR2 spec in which CA BW class “N” is absent, in order to avoid unnecessary confusion, it is suggested to not use CA BW class “N” in FR1. |
| Qualcomm | Issue 3-1: Agreeable  Issue 3-2: Agreeable  Issue 3-3: Agreeable  Issue 3-4: Agreeable  Issue 3-5: Prefer to keep BW class N as it doesn’t really seem to cause confusion and NR band designation, but open for discussion. |
| Charter Communications Inc | Issue 3-2: Agreeable, option 1  Issue 3-3: Agreeable, option 1  Issue 3-4: Agreeable, option 1 |
| Skyworks | Issue 3-2: Option 1 agreeable (note this may require change for the n46M/N/O channel configurations it there are cases where the (NumberCC-1)\*100MHz can be used)  Issue 3-3: agreeable but may even extend the cases to wider aggregated channel BW if useful in n46 and there is potential operator request rather than defining another BCS later  Issue 3-4: agreeable |
| Huawei | Issue 3-1: Option 1  Issue 3-2: Option 1  Issue 3-3: Option 1  Issue 3-4: Option 1 |
| CableLabs | Issue 3-2: we support option 1: agreeable  Issue 3-3: we support option 1: agreeable |
| Apple | 3-1: Option 1: Agreeable  Issue 3-2: Option 1: Agreeable  Issue 3-3: Option 1: Agreeable  NR-U CA configurations CA\_n46G, CA\_n46H, CA\_n46I were proposed before NR-U specific CA BW classes M, N, O were officially introduced. The supported aggregated bandwidth ranges for CA BW classes G, H, and I are quite limited and can be well covered by CA BW classes M, N, and O respectively. It is also better not to split the NR-U CA support into two different fallback groups. Therefore, we propose to merge the CA\_n46G, CA\_n46H, and CA\_n46I into CA\_n46M, CA\_n46N, and CA\_n46O respectively.  Issue 3-4: Option 1: Agreeable  If Issue 3-3 can be agreeable, Issue 3-4 can also be agreeable since CA\_n46I would be merged into CA\_n46O.  Issue 3-5: Option 2: Not agreeable  We do not think CA BW class “N” would be confused with NR band naming which uses a lower-case letter “n” before the band number while CA BW class uses upper-case letter which is attached at the end of the band number. On the other hand, CA BW class “N” has been proposed since RAN4 #94-e meeting and the issue for confusing with NR band has never been brought up since then. We are not sure why it would become an issue now. |
| CHTTL | Issue 3-2: tend to share the view as ZTE.  Issue 3-3, Issue 3-4: tentative Option 2, the channel BW combinations of CA\_n46M. CA\_n46N, CA\_n46O in the current spec are intended to be defined with the 20Mhz channel BW support only, which doesn’t require to support wide band operation, with this merging proposal, does it mean that the UE need to support all the channel BW and support wide band operation with these merged combinations? |
| Ericsson | Issue 3-1: Option 1  Issue 3-2: Option 1  Issue 3-3: Option 1  Issue 3-4: Option 1 |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| **R4-2014955** | Qualcomm: Need to resolve the above discussion points first before considering the CR. |
| Nokia: Discussions are still ongoing for multiple points. |
| Skyworks CR should be discussed later |
| Apple: Apple: We do not think CA BW class “N” would be confused with NR band naming with a lower-case letter “n”. Hence there is no need to skip CA BW class “N”. We agree that “=” is needed for CA BW classes M and N aggregated channel BW lower limits. |
| **R4-2015973** | Qualcomm: Need to resolve the above discussion points first before considering the CR. |
| Nokia: Discussions are still ongoing for multiple points. |
| Skyworks CR should be discussed later |
| Apple: Apple: We propose to change the CA BW classes M, N, O aggregated channel BW upper limits from 180 MHz, 240 MHz, and 300 MHz to 200 MHz, 300 MHz, and 400 MHz respectively, or the BW combinations such as (80 + 80 + 40) MHz and (80 + 80 + 60 + 60) MHz etc. cannot be supported. We agree that “=” is needed for CA BW classes M and N aggregated channel BW lowerlimits |
| Ericsson: should be revised or merged to capture the final outcome. |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Issue 3-1** | *Tentative agreements:* Keep the description of FBG 3 for NR CA bandwidth classes D and E unchanged in the current specification as it is  Agreeable: ZTE, Qualcomm, Huawei, Ericsson  Not agreeable: No companies  *Candidate options:*  *Agreeable*  *Recommendations for 2nd round: No further discussions* |
| **Issue 3-2** | *Tentative agreements:* Define the aggregated channel BW upper limits for classes M, N, and O as in R4-2014889  *Candidate options:*  Agreeable: Qualcomm, Huawei, Ericsson, Nokia, Charter, Skyworks, CableLabs, Apple  Not agreeable: ZTE, CHTL  *Recommendations for 2nd round: Proponent companies answer issues raised by ZTE, CHTL and Nokia* |
| **Issue 3-3** | *Tentative agreements:* Merge NR-U CA configurations CA\_n46G, CA\_n46H, and CA\_n46I into CA\_n46M, n46N, and n46O respectively  Agreeable: Qualcomm, Huawei, Ericsson, Nokia, Charter, Skyworks, CableLabs, Apple, ZTE  tentative: CHTL  *Candidate options:*  *Agreeable*  *Recommendations for 2nd round: Proponent companies answer issues raised by CHTL* |
| **Issue 3-4** | *Tentative agreements:* Remove CA BW class “I” from NR-U DL CA Rx requirements for ACS, in-band blocking, and out-of-band blocking as it can be covered by CA BW class “O”.  Agreeable: Qualcomm, Huawei, Ericsson, Charter, Skyworks, Apple, ZTE  tentative: CHTL  *Candidate options:*  *Agreeable*  *Recommendations for 2nd round: Proponent companies answer issues raised by CHTL* |
| **Issue 3-5** | *Tentative agreements:* It is suggested not to use notation N for NR CA BW class in FR1 since NR band number begins with the letter “n”, CA BW class “N” is absent in FR2 to avoid unnecessary confusion  Agreeable: ZTE  Not agreeable: Qualcomm, Apple  *Candidate options:*  *Not Agreeable*  *:*  *Recommendations for 2nd round: No further discussions* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| **R4-2014955** | *to be revised, merged with R4-2015973* |
| **R4-2015973** | *to be revised, merged with R4-2014955* |

## Discussion on 2nd round (if applicable)

**Issue 3-2:** Revise NR CA BW classes definition based on the following changes:

1. Define the aggregated channel BW upper limits for classes M, N, and O as below: (Apple)

|  |  |  |
| --- | --- | --- |
| BW Class | Aggregated BW | No. of CC |
| M | 50 MHz ≤ BWChannel\_CA ≤ 200 MHz | 3 |
| N | 80 MHz ≤ BWChannel\_CA ≤ 300 MHz | 4 |
| O | 100 MHz ≤ BWChannel\_CA ≤ 400 MHz | 5 |

Also the aggregated channel BW lower limits of classes M, N and O in current specifications should have the “=” sign (ZTE, Apple)

* Option 1 : Agreeable ( Qualcomm, Huawei, Ericsson, Nokia, Charter, Skyworks, CableLabs, Apple)
* Option 2: Not agreeable ( ZTE, CHTL)

*Recommendations for 2nd round: Proponent companies answer issues raised by ZTE, CHTL and Nokia in the 1st round comments*

Nokia: *since BW Class O proposed aggregated BW is up to 400MHz, would BW Class M/N need to have aggregated BW up to 240/320MHz*?

ZTE and CHTTL: *For the upper limits of classes M, N and O, it’s better to keep the current agreement of using \*60MHz. The aggregation of carriers with 80MHz and 100MHz CH BW can be covered by the current classes C, D and E.*

**Issue 3-3:** Merge NR-U CA configurations CA\_n46G, CA\_n46H, and CA\_n46I into CA\_n46M, n46N, and n46O respectively as shown in Table 2.2-2 in R4-2014889 (Apple)

* Proposals
  + Option 1: Agreeable (Qualcomm, Huawei, Ericsson, Charter, Skyworks, Apple, ZTE)
  + Option 2: Tentative (CHTL)
* Recommended WF
  + *Proponent companies answer issues raised by CHTL and adopt Option 1*

CHTL: *the channel BW combinations of CA\_n46M. CA\_n46N, CA\_n46O in the current spec are intended to be defined with the 20Mhz channel BW support only, which doesn’t require to support wide band operation, with this merging proposal, does it mean that the UE need to support all the channel BW and support wide band operation with these merged combinations?*

**Issue 3-4:** Remove CA BW class “I” from NR-U DL CA Rx requirements for ACS, in-band blocking, and out-of-band blocking as it can be covered by CA BW class “O”. (Apple)

* Proposals
  + Option 1: Agreeable (Qualcomm, Huawei, Ericsson, Charter, Skyworks, Apple, ZTE)
  + Option 2: Tentative (CHTL)
* Recommended WF
  + *Proponent companies answer issues raised by CHTL and adopt Option 1*

Please provide your 2nd round comments in the table below.

|  |  |
| --- | --- |
| **Issue 3-2:**  Revise NR CA BW classes | Charter Communications: Option 1, agreeable. |
| Skyworks: option 1 agreeable |
| CHTTL: ok after further offline discussion with apple. |
| CableLabs: we support Option 1, agreeable. |
| Nokia: we are fine to extend maximum aggregated BW to 400MHz for Class O. However, as asked in the first round, shall Class M and N have maximum aggregated BW of 240 and 320MHz, respectively? |
| Ericsson: Option 1 agreeable, also the Nokia proposal for M and N. |
| Apple: Thanks for Nokia’s question in first round discussions. The reason that the upper limits of M and N are specified at 200 MHz and 300 MHz instead of 240 MHz and 320 MHz is that above 200 MHz for 3 CCs, it can be covered by class D and above 300 MHz for 4 CCs, it can be covered by class E. The proposal is to avoid the ambiguity for overlapping ranges between two classes of the same CC number if n\*80MHz is defined as the upper limits for M and N.  We also have offline discussions with CHTTL and ZTE and would like to hear if ZTE has any further comments. |
| ZTE: after further consideration, we are also fine with option 1 |
| Nokia: thank you for Apple’s response. We are aware Class C and D could cover such scenario. New classes M, N and O are defined for NR-U operation only so further extending class M and N would not create ambiguity in our opinion. In order to make it less complex and cover 3 and 4 carriers by one class only, we propose to extend class M and N. |
|  | Skyworks: we belive it is not useful to have overlap of BW class as with higher channel BW in the future (100MHz?) it may create even further confusion and class C/D/E may be needed anyhow |
| **Issue 3-3:**  Merge NR-U CA | Charter Communications: Option 1, agreeable |
| Skyworks: option 1 agreeable |
| CHTTL: after offline discussion with apple, we are ok in general, but we slightly prefer to merge them with separate BCS sets, would like to hear other companies views, thanks. If no further view, we are also fine with this change. |
| CableLabs: we support Option 1, agreeable. |
| Ericsson: the maximum channel bandwidths supported for the DL and UL are indicated in the respective *supportedBandwidthDL* and *supportedBandwidthUL* capabilities. Indication of CA BW Class M, N and O, or any of the merged versions, does not mean that the UE must support the maximum aggregated bandwidth of these classes; additional BCS can be defined. |
| **Issue 3-4:**  Remove CA BW class “I” | Charter Communications: Option 1, agreeable |
| Skyworks: option 1 agreeable |
| CHTTL: ok after further offline discussion with apple. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: Others

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2016123** | ZTE Corporation | Proposal 1: further discuss how to apply the FCC requirements and AFC or non-AFC policy for the carriers across U-NII bands;  Observation: it is very challenging to achieve the required attenuation for lower edge and upper edge of 6GHz assuming -27dBm/MHz emission limit needed out of 6GHz band in FCC report.  Proposal 2: to achieve emission limit -27dBm/MHz required by FCC, either lower the BS output power or reserve more guard band or reserve guard band and put the fitter within the 6GHz band. |
| **R4-2016501** | Skyworks Solutions Inc. | Proposal: Companies views on NRU continuation work in 2021/Release 17 should be collected in order to enable small enhancement steps from Release 16 and devise a strategy for December plenary RAN#90e. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 4-1:** Based on FCC report, for different U-NII-bands, there are different EIRP limit and different usage policy from regulator e.g. AFC or non-AFC, therefore it is necessary for further discuss how to apply the requirements and AFC policy for those carries across the U-NII bands. (ZTE)

* Recommended WF
  + Collect companies’ views on how to apply the FCC requirements and AFC or non-AFC policy for the carriers across U-NII bands

### Sub-topic 4-2

*Sub-topic description:* It is very challenging to achieve the required attenuation for lower edge and upper edge of 6GHz assuming -27dBm/MHz emission limit needed out of 6GHz band in FCC report. (ZTE)

*Open issues and candidate options before e-meeting:*

**Issue 4-2:** How to achieve emission limit -27dBm/MHz required by FCC?

* Proposals
  + Option 1: lower the BS output power
  + Option 2: reserve more guard band
  + Option 3: reserve guard band and put the fitter within the 6GHz band
  + Option 4: other proposals
* Recommended WF
  + Collect companies’ views

### Sub-topic 4-3

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 4-3:** Companies views on NRU continuation work in 2021/Release 17 should be collected in order to enable small enhancement steps from Release 16 and devise a strategy for December plenary RAN#90e.(Skywork)

* Recommended WF
  + Collect companies’ views on NRU continuation work in 2021/Release 17

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Issue 4-1: As commented by the number of companies (including Nokia) in RAN4#96e, AFC (similar way as SAS for Band 48/n48) is out of the scope of 3GPP specifications. Since there are different EIRP limits, it can be clarified further in specification in which frequency blocks of n96 MR BS class is supported.  Issue 4-2: As commented for the draft summary we do think this discussion is more relevant in the BS thread. However, since still included here we would like to comment that how to achieve regulatory compliance is an implementation related issue and therefore should be at the descension of the induvial vendors. Notes on regional requirements for operation with shared spectrum channel access are already included in BS core specification 38.104 in subclause 4.5 for Tx requirements*.* |
| ZTE | Sub topic 4-1/2: seek to collect the views from system parameter session.  Sub topic 4-3: fine with bandcombination work for NR-U and 100MHz carrier bandwidth, however for PC3 UE, we need further discussion on that. |
| Qualcomm | Issue 4-1: Our understanding is that the AFC and higher EIRP allowances apply to standard power AP’s and their clients, but not to low power. We think that at least AFC is outside the scope of 3GPP specifications.  Issue 4-2: We assume that the proposals here pertain only to the basestation and only for SP since UE has already been covered by NS\_54 and LP should not be a problem. For SP AP, how to meet the emission requirement can be a matter of implementation. It is understood that some basestations may perform better than others because of various tradeoffs. For the basestations which are not able to meet emissions, they can lower power, avoid edge channels, etc., as needed by their own implementation. Spec changes should be minimal, if any.  Issue 4-3: Since the core technology for NR-U has been completed in Rel-16, we are supportive of the proposal to continue work on various aspects under baskets or other Rel-17 work items. We do not anticipate a RAN4-led Rel-17 dedicated work item on NR-U enhancements. |
| Charter Communications Inc. | Issue 4-1: We agree that AFC is outside the scope of 3GPP.  Issue 4-2: We believe is an implementation related issue and it should be left at the vendors option to meet the regulatory emission limits  Issue 4-3: We are supportive of the proposal to continue working NR-U to enable enhancements from Rel-16. Whether this work can be done as a dedicated work item on NR-U enhancements or under other Rel-17 work items is a subject that should get further discussion. We will like to understand the pro’s and con’s as a dedicated work item on NR-U enhancements or under other Rel -17 work items |
| Skyworks | Issue 4-2: from UE prospective we have A-MPR to be able to comply and we should not increase guard band by removing channels since those are useful in indoor deployment whether all channels are used for outdoor is an implementation choice on the network side. Actually we already have skipped some channels based on aligning with WiFi which is considering EU rail ITS in the first 10MHz of the band which is not required in the US. Any further guard band would make NRU worse in using the spectrum.  Issue 4-3: Skyworks understands that it is difficult to assess what can be done under the R17 scope. May be at least it would be good if we could agree within RAN4 that some items are moved to basket/generic WI:   * CA/DC Band combinations with n46/n96 moved to related baskets * 100MHz for n46/n96 moved to NR\_bands\_R17\_BWs WI   This will leave only UL CA and PC3 cases that could still be discussed for TEI under the TxDiv and FR1 enhencement WI. If Europe unlicensed band work starts we could also cover some of the aspects there. |
| Huawei | Issue 4-2: Option 3  Issue 4-3: we prefer to discuss PC3 and 100 MHz in a dedicate agenda. It will be ok to move them to the WI for introduction of lower 6GHz NR unlicensed spectrum in Europe. |
| CableLabs | Issue 4-1: AFC coordinates NR-U/Wi-Fi frequencies and low-power indoor (LPI) device does not need AFC. We agree AFC is out of scope of 3GPP.  Issue 4-2: band n46 also have the -27 dBm/MHz emission limit according to FCC Part 15.407(b), which is the same requirement as band n96. Why can’t we apply the same method used in band n46 to band n96?  Issue 4-3: FCC is considering to release U-NII-4 band (5850-5895 MHz) for unlicensed use, RAN4 may consider to define a new band or extend band n46 to include the new 45 MHz spectrum in R17, depending on the FCC decision. |
| Apple | Issue 4-1: Our view is that AFC is outside the scope of 3GPP.  Issue 4-2: This issue concerns more the BS side.  Issue 4-3: It seems that there are several Rel-16 leftovers, and if there is an interest from companies to enhance further NR-U, we are open to consider those enhancements. Whether it is done via a separate WI or not can be discussed further, but the general principle is that it should be a separate WI so that we can track later the corresponding changes. |
| CHTTL | Issue 4-3: prefer to separate the general part from the basket WI if there is any. |
| Ericsson | Issue 4-1: AFC is not in the scope of the 3GPP standard. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#4-1 and 4-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round: Discuss the topic in GTW* |
| **Sub-topic#4-3** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round: Companies can continue providing their views and the views can be captured in chairman notes* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

Please provide your 2nd round comments in the table below.

|  |  |
| --- | --- |
| **Issue 4-2** | Nokia: We have checked the calculation from ZTE in R4-2016123 and found that they in our understanding is not complete. In these analyses the ACLR have not been applied. This calculation shows what filter attenuation is needed to suppress wanted signal below the emission limit, we think this is not correct analysis. The figure is showing the achievable filter rejection (blue curve) with the corresponding matching (return) loss (red curve), then any extra rejection to meet the -27dBm/MHz limit will need to be provided by the RF filtering shown in the figure. Also, only the wanted signal PSD for 20 MHz carrier with 38 dBm output EIRP is calculated. This is slightly 2 dB higher than 23 dBm/MHz (Maximum Power Spectral Density for Standard-Power class from FCC regulation). Therefore, there is in total 37 dB error (35 dB from ACLR and 2 dB from too high wanted signal PSD). In our understanding the issue that ZTE still discuss is a purely implementation aspect. As commented previously the implementation aspect is already covered as Notes on regional requirements for operation with shared spectrum channel access are already included in BS core specification 38.104 in subclause 4.5 for Tx requirements*.* |
| Charter Communications: As we commented in round 1, we believe this is an implementation related issue and it should be left at the vendors option to meet the regulatory emission limits |
| ZTE: this issue has been recognized in RAN4 by other companies, we think RAN4 needs to address the implementation issues and more discussions on filter evaluation are needed.  FCC requirement [-27dBm/MHz]is just next to 7125MHz, you cannot apply ACLR requirement to 7125MHz, right? UEM mask will look like as slope instead of rectangular shape, otherwise it’s meaningless to define UEM mask. From our understanding, implementation difficulty in RAN4 did matter when we are defining the requirements.  IMG_256 |
| **Issue 4-3:** | Charter Communications: As stated in round 1, we are supportive of the proposal to continue working NR-U to enable enhancements from Rel-16. Whether this work can be done as a dedicated work item on NR-U enhancements or under other Rel-17 work items is a subject that should get further discussion. We will like to understand the pro’s and con’s as a dedicated work item on NR-U enhancements or under other Rel -17 work items |
| Company B |
|  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |