**3GPP TSG-RAN WG4 Meeting #97-e R4-2016951**

**Electronic Meeting, November 2nd – 13th 2020**

**Agenda item:** 7.1.2

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for RAN4#97e\_#107\_NR\_unlic\_UE\_RF

**Document for:** Information

# Introduction

This document summarizes the email discussion on topics related to NR-U UE RF requirements in Agenda 7.1.2, 7.1.2.1, and 7.1.2.2.

# Topic #1: Tx requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2014903](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014903.zip" \t "_parent)** | Apple Inc. | PC5 NR-U MPR for NS\_53 and NS\_54  Proposal: Remove brackets for all A-MPR found in NS\_53 and NS\_54 |
| **[R4-2015697](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015697.zip" \t "_parent)** | Huawei, HiSilicon | A-MPR evaluation for NR-U  Proposal 1: A-MPR for NS\_54 is defined in Table 2-2. |

## Open issues summary

### A-MPR for NS\_53 and NS\_54

Simulation results from R4-2014903 have confirmed A-MPR for NS\_53. Moderator recommends that square brackets can be removed from A-MPR table for NS\_53.

For NS\_54 A-MPR, there is a proposal in R4-2015697 to reduce a few values by 0.5 dB due to the increased guard band.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Agree to remove square brackets for NS\_53. For the proposal on NS\_54, we are still evaluating. |
| Charter Communications Inc | Agree to remove square brackets for NS\_53 and NS\_54 |
| Skyworks | Sub topic 1.1: agree to remove brackets, for improved values we have a question for clarification: are the wideband operation cases considered in this proposal. We found that these have a slightly worse behavior in some partial sub-band cases where the image is symmetrized in the OOB domain. |
| Huawei | To Skyworks: we evaluated two cases: full allocation case and interlace case |
| Apple | We agree to remove square brackets for NS\_53 and NS\_54 and keep the current values. |

### 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** |
| [**R4-2016436**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016436.zip) | Qualcomm: Will need to revise and merge based on outcome of this meeting. |
| Charter Communications, Inc.: We support the removal of the square brackets for 38.101-1 NR-U |
| Skyworks: we will check later based on the outcome of round 1 |
| [**R4-2014916**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014916.zip) | Qualcomm: Will need to revise and merge based on outcome of this meeting. |
| Charter Communications, Inc.: We support the removal of the square brackets for 38.101-1 NR-U |
| Skyworks: we will check later based on the outcome of round 1 |
| Nokia: We can not agree to the introduction of reference to capabilities in section 4.3 and 5.3.3. Other corrections can when agreed be merged with R4-2016436. |

## 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** | *Tentative agreements:*  Companies agreed to removing the square brackets around the A-MPR for NS\_53.  For NS\_54 A-MPR, Huawei proposed slightly tightened values for 8 of the 16 values in the table. The other 8 values can be considered agreeable. Qualcomm is still checking the proposed tightening, but Apple prefers to keep the existing values and remove the square brackets.  *Candidate options:*  *Recommendations for 2nd round:*  Continue to discuss the NS\_54 A-MPR values proposed to be tightened by 0.5 dB. |

*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”* |
| [**R4-2016436**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016436.zip) | Removal of square brackets for 38.101-1 NR-U (Qualcomm Incorporated)  Moderator recommentation: To be revised  To include the agreeable parts of R4-2014916. |
| [**R4-2014916**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014916.zip) | CR for TS 38.101-1: NR-U UE RF open requirements (Apple Inc.)  Moderator recommendaton: Noted |

## Discussion on 2nd round (if applicable)

### Open issues

Comments from companies for 2nd round discussion

* Continue to discuss the NS\_54 A-MPR values proposed to be tightened by 0.5 dB.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Skyworks | Still not clear whether the proponent looked into image folding issue for wideband operation with partial sub-band being activated. We will crosscheck our data |
| Huawei | To Skyworks: partial sub-band cases of wideband operation is not considered in the simulation. We can provide results next meeting. Did we include the case into the simulation assumption for NS\_54? |
| Skyworks | We did evaluate those cases in our measurements and also discussed the effect of image symmetrisation for these cases in our previous contribuions. |

### 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** |
| [**R4-2016799**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016799.zip) | Removal of square brackets for 38.101-1 NR-U (Qualcomm Incorporated) (Revision of [**R4-2016436**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016436.zip)**)** |
| Qualcomm: Draft revision has been uploaded as “Draft R4-2016799 (revision of R4-2016436).docx” |
|  |

## 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*

The NS\_54 A-MPR was discussed but it was clarified that the proposal in [**R4-2015697**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015697.zip)did not consider partial sub-band cases of wideband operation. It is therefore suggested to remove the square brackets around the existing values as proposed in [**R4-2014903**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014903.zip)given the recognition that the values are not too tight and that emissions can be met with them. The possibility to tighten edge channels due to the increased guard band can continue to be discussed next meeting if new simulation results are made available and the values can be corrected if justified.

The CR in [**R4-2016799**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016799.zip) is a merge between CR’s from Qualcomm and Apple. It removes square brackets and implements changes according to agreements or majority views from this meeting. The moderator recommends that this CR be agreed to fulfill some of the open items listed on the exception sheet.

*Moderator 2nd round recommendations*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2016799**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016799.zip) | Removal of square brackets for 38.101-1 NR-U (Qualcomm Incorporated)  Moderator recommendation: Agree |

# Topic #2: Rx requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014185**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014185.zip) | MediaTek Inc. | Discussion and TP for NR-U UE ACS  Proposal 1: ACS for NR-U UE is 25dB for 20MHz channel bandwidth  Moderator’s comment: There is no TP in this document. |
| [**R4-2015018**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015018.zip) | MediaTek Inc. | Architecture and REFSENS discussion for NR-U 6GHz  Proposal 1: RAN4 shall agree on FE architecture and total loss for n96 REFSENS evaluation assumption first  Proposal 2: We propose n96 REFSENS as below table   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Operating band / SCS / Channel bandwidth | | | | | | | Operating Band | SCS kHz | 20 MHz (dBm) | 40 MHz (dBm) | 60 MHz (dBm) | 80 MHz (dBm) | | n96 | 15 | -88 | -84.9 |  |  | | 30 | -88.2 | -85 | -83.1 | -81.9 | | 60 | -88.4 | -85 | -83.3 | -81.9 |   Proposal 3: 6GHz front-end loss assumption shall be at least 6dB  Proposal 4: We propose n79 REFSENS as below table (1.6dB relaxation than current values) according to FE architecture change |
| [**R4-2014497**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014497.zip) | Skyworks Solutions Inc. | [NRU] UE REFSENS for NRU Band n96  Proposal:  • Band n96 REFSENS is specified as the same than n46  • The only aspect that is different from n46 is a 20% frequency increase and a 4% increase in fractional bandwidth. Only a 0.5dB relaxation could be acceptable to account for this. |
| [**R4-2015799**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015799.zip) | Charter Communications, Inc, Qorvo, Inc. | UE Reference Sensitivity considerations for band n96  Proposal: The reference sensitivity for n96 should be derived by the standalone case. For more complex architectures were multiple bands are integrated with n96, analysis should dictate what the ΔRIB,c. values shall be for such aggregation. The reference sensitivity values for n96 should be the same as n46, worse-case scenario 0.3 dB higher. |
| [**R4-2016294**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016294.zip) | Apple Inc. | REFSENS for n96  Proposal 1: For band n96 a margin of 0.5 dB should be considered compared to band n46 for the REFSENS requirement, as shown in Table 1. |
| [**R4-2016437**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016437.zip) | Qualcomm Incorporated | Reference sensitivity for NR-U band n96  It is proposed to adopt the same value as already agreed for Band n46, which is already significantly relaxed compared to other 3GPP bands and compared to studies conducted by RAN4 in the context of IMT parameters in the same frequency range. |

## Open issues summary

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

### ACS value

The compromise value is [24] dB. Proposal in R4-2014185 is 24.5 dB which is then rounded to 25 dB. Since the previous compromise value was already 24 dB and the calculated value in R4-2014185 is 24.5 dB, the calculated value is no closer to proposal of 25 dB than it is to compromise from many companies of 24 dB. Moderator suggests to accept the 24 dB ACS value and remove the square brackets in the specification. Can companies agree?

### Refsens

It is proposed in R4-2015018 to first agree on a reference architecture and FE loss for Band n96 (at least 6 dB) before deciding reference sensitivity. Do companies feel it is mandatory for RAN4 to agree on a reference architecture and FE loss for band n96 before RAN4 can agree to a reference sensitivity value? The view of the moderator is that reference architecture and FE loss are not requirements that will be specified in 38.101-1, so while it may be helpful it is not absolutely required to agree upon them. It is only required to agree on the reference sensitivity value itself. Do companies have the same or different view?

Reference sensitivity value: Contributions mentioned refsens values 0 dB, 0.3 dB, 0.5 dB, 1.7 dB degraded compared to Band n46. All contributions on this topic included technical justification for their proposals. Reasons cited include increased FE loss due to sharing with other bands, increased LNA noise figure due to wider bandwidth and higher frequency. Moderator requests companies to share views on what value to agree upon for refsens.

It is proposed in R4-2015018 to revisit reference sensitivity for Band n79 due to expected common RF FE with 5 and 6 GHz bands. Proposal to relax Band n79 reference sensitivity by 1.6 dB. The view of the moderator is that the reference sensitivity for Band n79 has already been defined some time ago and network operators may have already planned deployment with this understanding. It seems unfair and inappropriate to degrade the reference sensitivity on an existing band because a new band in a nearby frequency range has been defined. If this were to become a norm, new bands would never be allowed since they might negatively impact another operator’s existing band. At the minimum, before degrading Band n79 reference sensitivity, the opinion of the impacted operators should be sought.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sub topic 2.2.1 ACS: Agree to remove square bracket around 24 dB value.  Sub topic 2.2.2 Refsens: We don’t think that formal agreement on reference architecture and parameters such as FE loss are required since it is only the final refsens value that will be specified and different companies may have different architectures or loss budgets for their evaluation. For the reference sensitivity value, we support the same as Band n46. We do not support revisiting the reference sensitivity for n79 due to the introduction of n46 and n96. |
| Charter Communications Inc | Sub-topic 2.2.1 ACS: We are in agreement of removing the square bracket around 24 dB.  Sub-topic 2.2.2 Ref Sens: Several companies have made proposals with values ranging from 0 dB, 0.3 dB, 0.5 dB (2 companies) and one company at 1.7 dB. The average is 0.6dB.  Our proposal is reference sensitivity the same as n46, worse case 0.3dB. For purposes of converging to a value quickly, we are open to the average value. |
| Skyworks | Sub-topic 2.2.1: 24dB ACS is the consensus  Sub-topic 2.2.2: we believe that most of the architecture and additional component aspects that are presented as a delta value to n46 is actually already embedded in the large margin agreed for LAA thus the difference if any is small and can be absorbed in the margin but as discussed in our paper, for the sake of compromise we are OK with an additional 0.5dB. For that same reason n46 cannot be taken as the baseline for n79 numbers and n79 already account for RF front end aspects together with n77: n79 REFSENS should not be re-discussed |
| Huawei | ACS value: as discussed in previous meeting, the relaxed ACS compared to WIFI is not desired. We agree MTK proposal.  Reference sensitivity value: we think extra LNA is a normal impletation which can be considered. Hence lower reference sensitivity can be achieved. We support 0 dB or even lower. |
| MediaTek | Sub-topic 2.2.2: To Skyworks, if I read TR 38.814, it is difficult to tell that band n79 already account for RF front end together with n77 since n79 filter insertion loss is as high to 2.5dB that FE loss may be near 4dB with T/R switch, if adding band switch it will definitely over 4dB FE loss which the number was RAN4 common understanding. Further, it did not consider implementation loss such PCB trace loss, matching components loss as well as connector loss and other components loss such as diplexer/triplexer. And there was only band n79 around the 5GHz range without considering FE configuration with existing LAA.  Regarding R4-2014497, it seems WiFi REFESNS is -82dBm, this number is much worse than any proposal of n46/n96, is there misunderstanding?  We think RAN4 need to consider that from implementation aspect, 5GHz range FE architecture would be different when new NR-U bands are introduced. And RAN4 shall agree on reasonable FE architecture/loss assumption and their impact to REFSENS as well as PA target output power design criteria.  Regarding re-visit n79 REFSENS, if REFSENS of n46 is agreed as is which is 3dB relax than n77 that gives us a hint that n79 REFSENS is too stringent after introducing new NR-U bands. If the n79 REFSENS is not changed, and FE loss were still within 4dB for n79 as well as new NR-U bands, to us it looks like RAN4 would force n46/n79/n96 to using individual antenna for every bands for implementation. Then how man antennas do we need if considering a world phone?  With above clarifications, we think our proposals are reasonable. |
| Qorvo | Sub-topic 2.2.2  We agree with the moderator’s proposal that only the final REFSENS value needs to be agreed and that reference architecture agreement is not essential to achieve this  We support a REFSENS value the same as n46  In terms of n79, we should not degrade the agreed n79 value of REFSENS but instead consider whether the combination of n79 and n46/n96 requires some other more combination specific provision such as delta Rib |
| Ericsson | Sub-topic 2.2.1: 24 dB for the 20 MHz channel bandwidth.  Sub-topic 2.2.2: the same requirement as n46. The NF for 5 GHz already contains margins that should be able to absorb the claimed 1.6 dB difference for the RFFE architecture discussed in R4-2015018. Any impairment of n79 performance can be handled with a specific relaxation for UEs also supporting n46/n96. |
| LG Electronics | We are OK with 24dB ACS.  We do not see need for agreeing nor capturing the reference architecture at this point. We support adopting same REFSENS value for n96 as for n46.  We should not change earlier agreed requirement like n79 REFSENS, but OK to discuss relaxations to certain combinations via using already agreed mechanisms like delta Rib. |
| ATT | Sub-topic 2.2.2: We support a REFSENS value for n96 with 0dB difference from n46 based on the margin already considered in the REFSENS for n46. As a compromise, we would consider an additional 0.5dB difference from n46 to reach consensus. We agree with LG Electronics that any further relaxations for multi-band support need to utilize existing mechanisms. |
| Apple | Sub topic 2-1: It took several meeting to have an agreement on the ACS level and the compromise value was 24 dB. We don’t agree on increasing the value to 25 dB and the square brackets can be removed from the specification.  Sub topic 2-2: Our proposal for the REFSENS is to consider a 0.5 dB margin for n96, which takes into account the impact in the NF from the LNA. We disagree that a larger value is required. |
| Intel | Sub topic 2-1: We support 24 dB ACS |

### 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** |
| [**R4-2015974**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015974.zip) | Skwyworks: we will review by end of round1 |
| Qualcomm: We don’t agree with the modification of the boundary between IBB2 and OBB. Scaling to bandwidth as it is in the spec today is our preference. |
| Apple: We don’t agree on the modification of the IBB and OBB requirements. |

## 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 #2.2.1 ACS** | This topic was discussed during the GTW on Nov. 04, but no agreement could be reached. Company views are as follows:  24 dB: Qualcomm, Charter, Skyworks, Ericsson, LGE, Apple, Intel  25 dB: Huawei, MediaTek  *Tentative agreements:*  *Candidate options:*  Options for round 2 can include 24 dB, 25 dB, or a compromise 24.x dB (x needs to be decided).  *Recommendations for 2nd round:*  Continued discussion on ACS. |
| **Sub-topic #2.2.2 Reference sensitivity** | This topic was discussed during the GTW on Nov. 04. In addition to the tentative agreements listed below, the following proposal was also discussed, but any decision on it will require discussion with all RAN4 delegates involved   * Allow RIB (FFS the concrete values) for UEs supporting n79, even without support CA/DC, if the UEs also support n46 and/or n96   *Tentative agreements:*   * Reference sensitivity for Band n96 is to be the same as refsens for Band n46 + X, where X = [0.5]. * Allow RIB (FFS the concrete values) on top of X for n96 reference sensitivity if the UEs support CA/DC (FFS specific conditions) * Reference sensitivity of other 6 GHz bands (EU, China, etc) will be discussed separately in the respective WIs   *Candidate options:*  *Recommendations for 2nd round:*  Finalize the details of the tentative agreement, including removal of square brackets on X. |

*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”* |
| [**R4-2015974**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015974.zip) | Correction to receiver requirements for shared spectrum channel access (Ericsson)  Moderator recommendation: To be revised.  The change to IBB/OBB was not acceptable to Qualcomm and Apple, but there were no concerns expressed with the other proposed changes in the CR. |

## Discussion on 2nd round (if applicable)

### Open issues

Comments from companies for 2nd round discussion

**Sub-topic 2.2.1: ACS**

Options for round 2 can include 24 dB, 25 dB, or a compromise 24.x dB (x needs to be decided).

**Sub-topic 2.2.2: Reference sensitivity for n96**

Finalize the details of the tentative agreement, including removal of square brackets on X.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MediaTek | **Sub-topic 2.2.1: ACS**  We propose to have 25dB ACS for NR-U bands.  In terms of design, there is no obvious difference between 25dB ACS and 24dB ACS.  In TR 36.889, ACS range from 22dB to 29dB are able to cover extreme cases in which Wi-Fi has poor performance or better performance. The average value is 25.5dB, which is close to our recommended value.  For having progress, we wonder whether ACS level of other 6 GHz bands (EU, China, etc) will be discussed separately in the respective WIs.  **Sub-topic 2.2.2: Reference sensitivity for n96**  We are not OK with X=0.5 even in square bracket. As technical justifications in our contribution, 1st round comments and GTW on-line discussion, we can compromise to X=[1].  For REFSENS of n79, as GTW dsicussion outcome, we support the idea to allow DRIB (FFS the concrete values) for UEs supporting n79, even without support CA/DC, if the UEs also support n46 and/or n96. Further, DTIB also need to be allowed since there’s no reason to treat TX and RX in different ways that sharing same common path. |
| Charter Communications | **Sub-topic 2.2.1: ACS**  We support 24 dB ACS for NR-U bands  **Sub-topic 2.2.2: Reference sensitivity for n96**  A question for clarification for the moderator. It was our understanding that reference sensitivity as n46 + 0.5dB was a GTW agreement. We are confused with MTK comments above. We support GTW round 1 agreement for reference sensitivity as n46 +0.5 dB without square brackets.  With regards to the idea to allow DRIB(FFS the concrete value) for UE it is my understanding that this is used for implementation of CA/DC support. We are in favor for this but with support of CA/DC. Same conclusion for DTIB as in DRIB. |
| Skyworks | REFSENS at [0.5]dB was agreed in GTW. We can’t discuss anything else further unless this is clearly esrtablished and it is not helping if previous ageements are ignored. |
| Qualcomm | **Sub-topic 2.2.1: ACS**  At the GTW session on Nov 4, 7 companies supported 24 dB while 2 companies supported 25 dB. Averaging all these together gives a value of 24.2 dB. For the sake of progress, we are willing to accept this average.  **Sub-topic 2.2.2: Reference sensitivity for n96**  At the GTW session on Nov 4, the agreement was X = [0.5] since there was only one company in disagreement. Unless that company is able to convince all the other companies of a different value (and that doesn’t seem to be the case), we should stay with the GTW agreed value and remove the square bracket. |
| Ericsson | **Sub-topic 2.2.1**  We propose ACS = 24 dB for the 20 MHz channel bandwidth and a 20 MHz interferer, no need to add fractions of dB. It is more important that the ACS is verified with a 20 MHz interferer (nominal channel bandwidth in regulations) and that the ACS for CA and wideband operation are scaled properly.  **Sub-topic 2.2.2**  We should follow the GTW agreement. |
| Huawei | **Sub-topic 2.2.1: ACS**  We support ACS =25 dB since we did not do simulation for the WI and reuse the co-existence simulations from LAA. LAA ACS =27 dB and we actually have 2 dB relaxation compared to LAA.  And as we have discussed on REFSENS, the ACS for other 6GHz bands should be discussed separately.  **Sub-topic 2.2.2: REFSENS**  We are ok to follow GTW agreement |
| Apple | **Sub-topic 2.2.1**  ACS level of 24 dB was already a compromise between companies. We are not ok to change the agreement that took several meetings to reach.  **Sub-topic 2.2.2**  We are ok to set X = 0.5 dB as agreed in the GTW. |
| Skyworks | **Sub-topic 2.2.2** X = 0.5 dB as agreed in the GTW. |

### 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** |
| [**R4-2016800**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016800.zip) | Correction to receiver requirements for shared spectrum channel access (Ericsson) (Revision of [**R4-2015974**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015974.zip)**)** |
| Ericsson: for IBB our understanding is that an interferer bandwidth fixed at 20 MHz was agreed for all cases. Then for wideband channel and CA the wanted signal level is scaled with the wanted wideband/aggregated bandwidth. Alternatively, the wanted signal level could have been fixed and the interferer offset scaled with the wanted channel bandwidth. In the current version both the interferer offset and the wanted signal level are scaled which lead to a lax requirement. The OOBB applies outside the IBB requirements. But we are open to further discussion and ready to revise the CR (needed in any case). |
|  |

## 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*

### ACS value

On ACS, there was no change in company views compared to the first round. Qualcomm offered a compromise proposal taking the average considering that the two camps are only 1 dB apart (!), but the compromise proposal received no support.

Therefore, since the value of 24 dB is already in square bracket with a majority of companies supporting that value and no agreement to change it, the moderator suggests to finalize the specification with 24 dB removing the square brackets.

### Refsens

It is agreed in the GTW session on Nov 04 to specify reference sensitivity for Band n96 according to X=[0.5] dB. One company continues to disagree with this value while all other companies who expressed a view support finalizing the requirement according to the GTW agreement and removing the square bracket. Other related agreements from the GTW are

* Allow DRIB (FFS the concrete values) on top of X for n96 reference sensitivity if the UEs support CA/DC (FFS specific conditions)
* Reference sensitivity of other 6 GHz bands (EU, China, etc) will be discussed separately in the respective WIs

and were not contested.

The moderator suggests finalizing the value with X = 0.5 dB and removing the square bracket. DRIB values are discussed in the context of CA and DC. One CA combination has already been agreed by CR and captured in 38.101-1 and others are included in CR and draft CR of Topic #3.

### Correction to receiver requirements

A revised CR in [**R4-2016800**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016800.zip) was recommended by the moderator, but a draft for review was uploaded very late without time for review. However, at the conclusion of Round 1, the moderator had recommended to modify the CR to include only those aspects not related to IBB and OOBB since those aspects received no concerns. Since the revised CR reflects exactly that recommendation and since there were no concerns raised during the first round on those aspects of the CR, the moderator recommends that the CR can be agreed unless objections are received before closing of the meeting.

*Moderator 2nd round recommendations*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2016800**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016800.zip) | Correction to receiver requirements for shared spectrum channel access (Ericsson)  Moderator recommendation: Agree |

# Topic #3: Dual connectivity requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2015927**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015927.zip) | Ericsson, Charter Communications, T-Mobile US | Rel-16 CR 38.101-3 NR-U EN-DC band combinations |
| [**R4-2015803**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015803.zip) | Charter Communications, Inc. | Draft CR to add NR-DC\_n48-n46 combinations |

## Open issues summary

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

Technical requirements for EN-DC combinations with NR-U Band n46 are provided in R4-2015927 as a CR to 38.101-3. However, the general requirements for EN-DC with NR-U (suffix F) are not available. Will there be a “big CR” made available for 38.101-3 or is R4-2015927 intended for that purpose? Are suffix F general requirements needed?

NR-DC combinations are introduced in R4-2015803 to 38.101-1 in a draft CR. However, general requirements for NR-DC with NR-U are not yet available. For example, ACS is defined for NR-U in clause 7.5F of 38.101-1, with NR-U CA in sub-clause 7.5F.2. DC with NR-U could possibly be added as sub-clause 7.5F.3 but a discussion is welcomed. Furthermore, while NR-DC is included in the NR-U WID [RP-192926] as scenario E, it is included in the Objective section of the WID that scenario E “will be treated with lower priority in the context of this WI.” There are no band combinations listed for Scenario E in Annex A of the WID so the band combinations in R4-2015803 are without support in the WID and there is no mention of NR-DC in the work item exception sheet [RP-202099]. The moderator recommends to have brief discussion and collect comments on R4-2015803, but that this topic should be treated with lower priority since the focus of this meeting should be to complete those items listed in the WID and in the exception sheet.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | EN-DC combinations, we think that suffix F general requirements are still needed. If it is agreed there is no additional requirement requirement, then it would be better to indicate that in Suffix F.  NR-DC combination needs general requirements also. |
| Charter Communications Inc. | We are open to further discussions regarding whether suffix F needs further general requirements. We will like companies to discuss if this is the case during round 1. If no additional general comments are needed then we can indicate this in suffix F. A draft revision can be made with the appropriate changes and further discussed in round 2. Once agreement is reached in round 2, a revision of the original CR can be requested to get it finalized and approved.  For the NR-DC combinations, the goal of this draft CR is to have companies made comments regarding the technical content. Once these comments are available, a revision can be made (round 2) to incorporate the changes and get the revised draft CR technically endorsed. We considered the discussion of this draft CR fairly straight forward and it should not take too much time from the other items of higher priority like the items in the exception sheet |
| Skyworks | R4-2015927:Table 7.3B.2.3.4-2 has wrong UL config for LTE band 48  R4-2015803:  Table 5.5B.1-1: n48 configuration n48D/E are not feasible and not specified  Table 6.2B.1.3-1: which NRDC power class for PC3 NR and PC5 NRU: I believe PC3 should apply: same for ENDC.  Some table format issues and void reused |
| Charter Communications , Inc | Thanks Skyworks for the feedback. I will make the changes suggested and request for a revision of the draft. Perhaps offline I can get further feedback on “Some table format issues and void re-used”. It will be greatly appreciated to avoid multiple revisions. |
| CHTTL | In general we support the moderator’s comment.  As NR DC combinations are not in the WID and also the work item exception sheet.,these are related to the part of the NR-U continuation work, such handling are discussed in thread 106 section 4.2.3. |
| Charter Communications, Inc. | To CHTTL, we have discussed with the moderator and the chairman that companies can provide comments with regards to the technical content of the draft CR and once the comments are addressed such draft cr can be technically endorsed. There is no procedural issue with this and furthermore I do not understand the comment regarding thread 106/ |
| Apple | For R4-2015927: LTE specifications do not have 48B and thus the corresponding band combinations should not be added with this CR. Furthermore, since band n48 is 150MHz, it is not necessary to have combinations with n48D and n48E.  For R4-2015803: Since band n48 is 150MHz, it is not necessary to have combinations with n48D and n48E. |

## 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** | Comments were received for both the EN-DC CR and the NR-DC draft CR.  *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:*  Proponents to provide revisions. Suggest the proponents to provide draft revisions first to collect further feedback before the formal revision is presented. |

*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** |
| [**R4-2015927**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015927.zip) | Rel-16 CR 38.101-3 NR-U EN-DC band combinations (Ericsson, Charter Communications, T-Mobile US)  Moderator recommendation: To be revised  Ericsson: https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_97\_e/Inbox/Drafts/%5B97e%5D%5B107%5D%20NR\_unlic\_UE\_RF/2ndRound/draft%20R4-2016801%20Rel-16%20CR%2038.101-3%20to%20add%20NR-U%20EN-DC%20combinations.docx |
| [**R4-2015803**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015803.zip) | Draft CR to add NR-DC\_n48-n46 combinations (Charter Communications, Inc.)  Moderator recommendation: To be revised |

## Discussion on 2nd round (if applicable)

### Open issues

Comments from companies for 2nd round discussion

**Sub-topic 3.1: EN-DC combinations and 38.101-3 CR (revised to** [**R4-2016801**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016801.zip)**)**

**Sub-topic 3.2: NR-DC combinations and 38.101-1 draft CR (revised to** [**R4-2016802**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016802.zip)**)**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
| Charter Communications | Sub-topic 3.2: We will provide a draft revision to incorporate round 1 comments from companies. |
| Skyworks | Beyond our comments may be MCC comments needs to be addressed for [**R4-2016801**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016801.zip) |
| Qualcomm | Sub-topic 3.2: In 5.5B of the revised draft CR, the DC configurations are listed. The bandwidth combination sets refer back to 5.5A.3 CA configurations. However, the DC configurations here do not all have a defined CA configuration counter-part. The uplink DC\_n46A-n48B is included in all DC configurations, but some requirements are missing. For example, max output power is not defined. There are also numerous formatting errors. For example, the caption and table format and font for Table 6.2B.1.3-1 is not following drafting rules. The superscript 1 which is to indicate Note1 is no longer superscripted so the tolerances are now +2/-31. It is unclear what is the purpose of 6.2B.2.1. If the reason is to indicate that the requirements apply for configurations within FR1, the DC operating bands in 5.2B already states “where all operating bands are within FR1.” The added sentence then refers to requirements in 38.101-1, but this is 38.101-1 already so it’s a circular reference. In 6.2B.3, the sentence “For inter-band NR-DC with one uplink assigned per band, the requirements in clause 6.2.3 apply for each uplink component carrier.” was removed without change marks. It’s just gone. Additionally, 6.2B.3.1 was added with the same problems as 6.2B.2.1. There are change marks to delete the text “Text omitted” which is not text that’s in the specification. Many of the same errors are repeated throughout this draft CR, but I don’t have the time to go through each one of them line by line, especially since NR-DC should be treated with lower priority according to moderator’s guidance. |
| Charter Communications | Sub-topic 3-2: Thank you Qualcomm for the thorough review. I have uploaded R4-20xxxxx\_rev4 with the following items addressed   1. We agree that some DC configurations are not defined for the CA configuration counter-part. A future Tp for Tr will request the addition to the remaining configurations 2. Max output power has been updated to include class 3 as it is possible for n48. 3. All formatting errors have been resolved. 4. The subscripted 1 for note 1 has been fixed 5. 6.2B.2.1 and 6.B.3.1 have been removed 6. Added sentence on 6.2B.3 was added 7. All “text omitted” marks have been fixed   We had made a comment to the moderator at the beginning of this meeting that despite the priority of NR-DC configuration, this draft CR warrants the time for discussion. We respectfully ask the moderator and other companies to provide further feedback on R4-20xxxxx\_rev4. |
| CableLabs | Thanks for all the NR-U band combination discussions. NR-U EN-DC and NR-DC between bands n48 and n46 will be key features for many U.S. operators. Given the fact that RAN4 R16 work is already delayed, we highly recommend to continue the discuss on the CR. |
| CHTTL | Sub-topic 3.2: Regarding the content, the proposed changes are not fully aligned with the structure of 38.101-1, as the NR-U related requirements including single band and inter-band CA are placed under the suffix F. And it is condused the changes in section 6.2B.3, since the sentence added is already in the spec. Then section 6.3B.1 is also confusing that the content added is for configured output power. Not sure if the 6.4B.1 is needed cuz in 6.4B it is already mentioned to refer the requirement to the corresponding inter-band CA, some other sections also had similar issues, better to further check. Section 6.5B.1, 6.5B.2, and 6.5B.3 are all using the same title “Inter-band NR-DC within FR1” under the 6.5B Output RF spectrum emissions, which is quite confusing.  As mentioned in the 1st round, the NR DC combinations are not in the current WID and also the work item exception sheet, also given the fact that Rel.16 is already completed, especially the combinations were already switched to Rel.17 in June, we recommend to consider as Rel.17 work and follow the normal procedure, as Rel.17 specifications are planned to be ready after Dec. |
| Charter Communications Inc. | Sub-topic 3.2: To CHTTL, please make comments in latest version R4-20xxxxx\_rev4 as this version already addresses your points above. |
| CHTTL | Sub-topic 3.2: To Charter, yes the comments above are based on the latest version R4-20xxxxx\_rev4, please further check, thanks. |
| Apple | We have not seen revised CR for sub-topic 3.1, so we cannot agree on it. |

## 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*

**Sub-topic 3.1: EN-DC combinations and 38.101-3 CR (revised to** [**R4-2016801**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016801.zip)**)**

The comments received in the first round were that the CR might be missing some general requirements. However, this was only from one company with no other companies raising a concern on missing general requirements. Furthermore, there were no concerns expressed on the technical content of the CR. A revision has been provided late so there has been little opportunity for comments, but since the prior contents did not raise any technical concerns, it is recommended by the moderator that this CR can be agreed. If missing general requirements are later identified, they can be added by correction in future meetings.

**Sub-topic 3.2: NR-DC combinations and 38.101-1 draft CR (revised to** [**R4-2016802**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016802.zip)**)**

A revision of the draft CR was provided in Round 2 for commenting. A number of comments were received and a second revision provided. However, even the second revision did not appear to satisfy the concerns raised by companies. In addition, it has already been guided by the moderator that this topic should receive lowered priority due NR-DC combinations not in the WID and not on the exception sheet. It is the view of the moderator that allowing two rounds of discussion and two revisions to collect comments is enough for the proponent to carry on with this work in future meetings while respecting the work required of other companies to provide comments. As of this meeting, the moderator recommends that the document is Postponed.

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2016801**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016801.zip) | Rel-16 CR 38.101-3 NR-U EN-DC band combinations (Ericsson, Charter Communications, T-Mobile US)  Moderator recommendation: Agreed. |
| [**R4-2016802**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016802.zip) | Draft CR to add NR-DC\_n48-n46 combinations (Charter Communications, Inc.)  Moderator recommendation: Postponed. |