**3GPP TSG-RAN WG4 Meeting # 98-e R4-210xxxx**

**Electronic Meeting, 25th January – 5th February, 2021**

**Agenda item:** 7.1.1, 7.1.2

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [98e][106] NR\_unlic\_Maintenance

**Document for:** Information

# Introduction

This document summarizes the email discussion on topics related to NR-U maintenance in Agenda 7.1.1 and 7.1.2. The list of topics include

Topic #1: Wideband operation and aspects related to intra-cell guard bands and applicability of requirements in the Rel-16 specifications

Topic #2: Specification of channel raster and sync raster numbering.

# Topic #1: Wideband operation

For wideband operation, nominal intra-cell guard bands have been defined in Table 5.3.3-2 of 38.101-1. However, there has also been an understanding that the Rel-16 specifications apply in downlink Mode 1 where LBT passes on all sub-bands of the BWP or carrier and intra-cell guard bands are configured to zero.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2100511**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100511.zip) | Apple Inc. | **NR-U wideband operation and intra-carrier guard bands**  Observation 1a: From the UE perspective, baseline NR-U functionality assumes that a UE can receive data only if LBT succeeds in all the sub-bands.  Observation 1b: There are additional optional UE capabilities that indicate whether a UE can receive data if one or more LBT sub-bands have failed and whether a UE can receive data in intra-carrier guard bands.  Observation 2a: There are NR-U wide-band transmission modes, in which intra-carrier guard band configuration is not needed (or logically speaking, the intra-carrier guard bands are of size zero).  Observation 2b: Logically speaking, the default intra-carrier guard band configuration should correspond to zero width guard bands, while non-zero guard bands can be configured when a UE supports the corresponding wide-band transmission modes. |
| [**R4-2101932**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101932.zip) | Nokia, Nokia Shanghai Bell | **NR-U - On Intra-cell guardbands**  Proposal 1: Resolve the brackets in section 5.3.3 of TS 38.101-1 as given in the TP provided in section 3 of this contribution.  Proposal 2: It is proposed to align the spelling of guard band either in one or two words . |
| [**R4-2101720**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101720.zip) | Ericsson | **Applicability of minimum requirements for shared spectrum access**  The applicability of minimum requirements for the transmitter and receiver characteristics of wideband operation is not specified. For the UL, transmissions in contigous available RB sets where the intra-cell GB posibly scheduled should be assumed for the present release. For the DL, transmissions with no intra-cell GB with all RB sets of a channel scheduled and available should be assumed. |

## Open issues summary

Wideband operation is subject to certain limitations in Rel-16 version of the NR-U specifications. These limitations originate from assumptions taken in the definition of requirements on the success of LBT RB-sets and scheduling of contiguous RB-sets. At the same time, UE capabilities 4-1 and 4-2 have been defined for DL operation but without UE receiver requirements and nominal intra-cell guard bands (or guardbands) are included in the specifications. There are several proposals from companies to clarify the specifications on exactly what is supported in the Rel-16 (and Rel-17) specifications.

### Sub-topic 1-1

Clarification of wideband applicabililty and intra-cell guard bands for UL and DL in Rel-16:

### Sub-topic 1-2

Guard band? Or guardband?

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | Sub topic 1-1: Clarification if wideband applicability is beneficial and perhaps the CR’s in R4-2100512 and R4-2101720 could be revised and merged. It is also noted that there is already indication in the general section under clause 4.3 on restrictions of applicability in this version of the release, though if preferred by companies, this can be broken down and instead placed locally in appropriate sub-clauses  Sub topic 1-2: The fact that we are debating over guardband or guard band is a nice reprieve from some of the more challenging disagreements we’ve encountered in this work item. We are ok with either, but if the dictionary says “guard band”, then that is a strong reason to break it up into two words. On the other hand, what about “wideband” or “narrowband” or “bandwidth”? Should they also be broken up into two words? Maybe for the sake of consistency, despite what the dictionary says, we should treat all of them the same and keep them all as one word.  ….  Others: |
| MTK | Sub topic 1-1:  Clarification to WB operation is needed. We have no strong on where to capture it. (Fine with Ericsson’s approach or Qualcomm’s suggestion).  Regarding the baseline of guard band, 0512 is also fine to us. But we may need to update the feature description of 4-1, which is currently “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”. At least from our understanding, it seems non-zero width intra-cell guard bands is the baseline.  Sub-topic 1-2:  Fine to either one, as long as it is consistent in spec |
| Ericsson | Sub-topic 1-1:  On R4-2100511: Observation 2b contradicts the specification in 38.214 Clause 7, which followed from a long discussion in RAN4.  In our understanding the RAN4 RF receiver requirements apply for zero-width DL intra-cell GB with all RB sets available for transmission following a channel access procedure (read ‘has passed LBT’) and scheduled, a mode supported by all UEs supporting shared spectrum access. This does not mean that the gNB in the field cannot configure intra-cell GB. For LBT not successful in all DL RB sets, the gNB can still transmit subject to the UE capability indication.  It also our understanding that the RAN4 RF transmitter requirements apply for non-zero width UL intra-cell GB between one or >1 contiguous scheduled RB sets all available for transmission and with the intra-cell GB between the contiguous RB sets scheduled.  The 37.213 defines  “A channel access procedure is a procedure based on sensing that evaluates the availability of a channel for performing transmissions.”  The notion “available for transmission” is also used in harmonized standards for a channel that has passed LBT.  Sub-topic 1-2:  On R4-2101932: Proposal 1 is not agreed. The table and the nominal guard bands refer to wideband operation that is only defined for shared spectrum access and with channel bandwidths > 20 MHz. For shared spectrum access with smaller channel bandwidth, the paragraph below the table applies. The square brackets can be removed without changes of the text.  No strong view on used guard band or guardband, the former is used in 38.214. |
| Apple | Sub-topic 1-1: Clarification in R4-2101720 are also useful (see more detailed comments below), so we can consider a merged version from R4-2100512 and R4-2101720 for the 2nd round.  @**Ericsson**: Observation 2b is the outcome of what we agreed last RAN4 meeting. If we need to update other specifications, we shall do it. It seems that last meeting everybody was busy and did not have enough time to check whether we need to update other specs. Referring to another comment, “*This does not mean that the gNB in the field cannot configure intra-cell GB. For LBT not successful in all DL RB sets, the gNB can still transmit subject to the UE capability indication*”, we do agree that the network can configure non-zero guardband subject to the UE capability. However, we could not help but wonder what the network anticipates if a UE does not support data reception on a sub-set of RB-sets, but the network still configures non-zero guardbands. This is what our CR aims at clarifying.  Sub-topic 1-2: No strong view. Our understanding is that since "inter-carrier guardbands" are spelled as one word in legacy TS 38.101-1, we can follow the same principle to avoid confusion. |
| Huawei | Sub topic 1-1: the sentence for CA band combination in R4-2101720 is not needed. The CA definition is clear enough.  “This also applies for wideband operations within a channel part of a CA band combination”  On R4-2100512, the zero width guardband is already clarified in the spec as below, hence the change on zero width guardband part is not needed.  “If the UE is configured with zero width intra-cell guard bands for the uplink and downlink by the IE *intraCellGuardBandsUL-List* and *intraCellGuardBandsDL-List* [7] on a carrier greater than 20 MHz, the maximum transmission bandwidth configuration for the uplink and downlink shall be in accordance with clause 5.3.2 with a minimum inter-cell guard band of the UE channel bandwidth as specified in Table 5.3.3-1.”  Sub-topic 1-2:  Slightly prefer to “guardband” |
| Nokia | Sub-topic: 1-1: We are fine to remove the brackets without any other changes. The, by us proposed, TP was merely an attempt to accommodate concerns expressed last meeting. The current wording is the result of long and extensive RAN4 discussions. If further clarification is needed for wideband operation the approach suggested by Ericsson’s CR could be discussed further.  Sub-topic: 1-2: I am happy that some also find this topic a refreshment related to the NR-U discussion. To honest I do not expect this to be fixed easily as both spellings are used widely as also pointed out by others. Perhaps, more confusion will be added by imposing a change now and we can let this topic go. |
| Charter Communications Inc. | Sub-topic 1-2: I think we need a GTW call to arrive consensus on this. 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.*

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| **CR/TP number** | **Comments collection** |
| **[R4-2100512](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100512.zip" \t "_parent),**  [**R4-2100513**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100513.zip)  Apple | Qualcomm: In the added “with data transmission on a subset of RB-sets”, do you mean both UL and DL? It might be helpful to clarify since it might be misunderstood that data transmission only means UL since the sentence in in the context of UE. I haven’t formed a strong opinion on whether the default guard band should be zero in case the IE’s are not provided, but is there any harm or benefit to zero as opposed to leaving the default values as specified in the table of nominal values? |
|  | Ericsson: not agreed. The nominal guard bands apply for all transmissions, not only on subset of RB sets (assuming ‘subset’ refers to a proper subset not including all RB sets).  The last sentence before the yellow highlight contradicts the 38.214 and a RAN4 agreement reached after considerable debate, from 38.214 sub-clause 7.5,  “When the UE is not configured with *intraCellGuardBandDL-r16*, the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size .”  Sub-clause 5.3.3 specifies these nominal intra-cell guard bands and corresponding RB subsets. |
|  | Apple:  @**Qualcomm**: Thanks for comments on the RB-sets, we will of course clarify the wording to make it crystal clear. As for the default guardband size, it is just awkward that the baseline UE NR-U capability does not need any intra-cell guardband, whereas default network configuration assumes that non-zero guardbands are configured. So we have a slight preference to align it logically.  @**Ericsson**: TS 38.214 was written before RAN4 reached the final agreement on the final NR-U capabilities, so we other specifications can be updated if needed. Echoing what we wrote above, it seems that we need to clarify what the network anticipates by configuring non-zero guardbands if a UE does not support reception on a sub-set of RB-sets, i.e. a UE supports only “all-or-nothing” mode. Please note the highlighted “if any” part in the RAN1 spec. Based on that our view is that there is no discrepancy between RAN1 and RAN4: guardbands can be absent, but of course can be configured by the network if a UE supports the corresponding wideband transmission modes. |
|  | Nokia: We have concerns with the modifications proposed in R4-2100512. As already commented by Ericsson the intra-cell guard band design is referenced in RAN1 specification on the basis on what is currently defined in the RAN4 specification. We do not see any reason to cause changes needed in the RAN1 specification based on the presented justification. |
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| [**R4-2101720**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101720.zip)  Ericsson | Qualcomm: Not clear what “with all RB sets available for transmissions according to…” this means. Does it mean that all RB sets within the configured channel pass LBT? Does it mean all RB sets that have been scheduled for transmission pass LBT? The next statement reads “The requirements also apply”, but is the word “also” necessary? Also means in addition to what? And in the last sentence, what is a “channel part”? |
|  | MTK: Regarding the sentence “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 transmissions.” in 6.1F, our understanding is the intra-cell guard band width should always be zero for UL. Not sure if there is any misunderstanding here. |
|  | Ericsson:  The “available for transmission” refers to a RB set that has passed LBT, from 37.213,  “A channel access procedure is a procedure based on sensing that evaluates the availability of a channel for performing transmissions.”  The word “also” should be removed, the UL intra-cell GB between RB the contiguous RB sets should be scheduled.  The “channel part” should be “This also applies for wideband operations within a channel *that is* part of a CA band combination.” (can be inter-band CA for example).  A revised CR can be provided. |
|  | Apple: We are generally fine with the intention and the wording of the CR.  For DL, the following sentence is not entirely clear, “*This also applies for wideband operations within a channel part of a CA band combination.*”. To avoid misunderstanding, “channel part” should be replaced with e.g. “carrier”.  For UL, MTK raised a good point that in Rel-16 NR-U, UL transmission always takes place over a contiguous set of RB-sets in a “all-or-nothing” way, so intra-cell guardband are indeed absent (or logically speaking set to zero). Thus, the wording should be clarified accordingly. |
|  | Nokia: We are in general fine to introduce these clarifications for wideband operation. We would like to discuss further based on an updated CR with the clarifications mentions above by Ericsson. |
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## Summary for 1st round

### Open issues

Sub-topic 1-1: Clarification of intra-cell guardbands

In the first round discussion, the main point of disagreement was the default value of intra-cell guard band in the case that it is not configured by the gNB. It was proposed that these should be defaulted to zero rather than to the nominal values in the table, however, it was commented by other companies that this would be in conflict with RAN1 specification and with previous discussion in RAN4. Therefore, the proposal is not agreeable. Other edits for clarification and applicability seemed to be agreeable with modification. The moderator recommends that the CR in R4-2101720 is revised for second round discussion and approval.

Sub-topic 1-2: Guardband or guard band

No company had a strong view, although most companies expressed a slight preference to guardband as one word recognizing that both forms are widely used. The proponent has recommended to close this issue with no action. No further discussion needed in the second round.

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|  | **Status summary** |
| **Sub-topic#1-1 Clarification of intra-cell guardbands** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round: Revise the CR in R4-2101720 (Ericsson).* |
| **Sub-topic#1-2 Guard band or guardband** | *Tentative agreements: Both forms are widely used, no action needed.*  *Candidate options:*  *Recommendations for 2nd round: Topic is closed.* |

*Recommendations on WF/LS assignment*

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

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2101720**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101720.zip) | *To be revised. Rel-17 Cat A CR is also needed.* |

## Discussion on 2nd round (if applicable)

Comments on the revision to draft R4-2103135 (revision of R4-2101720) are captured here.

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| **Company** | **Comments** |
| Qualcomm | Why is applicability of nominal guard bands limited to wideband oepration “on a set of non-contiguous RB sets”? What is the definition of a set of non-continuous RB sets? And what are the nominal guard bands for continuous RB sets?  What does “when the zero width UL intra-cell guard bands are configured” mean? Do you mean when the intra-cell guard bands are configured to zero width? |

## 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*

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| **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: Channel raster and sync raster

The specifications 38.101-1 and 38.104 current list the channel and sync raster with a format (First – <Step size> – Last) with downsampled channels enumerated in a note in the table. It is proposed to simply refer to the Note rather than keep the (First – <Step size> – Last).

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2101968**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101968.zip) | ZTE Corporation | **CR to TS 38.104: system parameters maintenance for NR-U**  NR-ARFCN for n46 and n96 is not defined correctly in Table 5.4.2.3-1.  GSCN for n46 and n96 is not defined correctly in Table 5.4.3.3-1. |
| [**R4-2101970**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101970.zip) | ZTE Corporation | **CR to TS 38.101-1: system parameters maintenance for NR-U**  NR-ARFCN for n46 and n96 is not defined correctly in Table 5.4.2.3-1.  GSCN for n46 and n96 is not defined correctly in Table 5.4.3.3-1. |

## Open issues summary

In 38.104 and 38.101-1 specifications, the channel raster and sync raster for Bands n46 and n96 are specified as (First – <Step size> – Last) and then further downsampled by enumeration with notes. It is proposed to remove the (First – <Step size> – Last) values and simply refer to the note. Do companies support this proposal? Are the CR’s agreeable?

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | No strong view. Either way is ok for us.Sub topic 2-2:  ….  Others: |
| Skyworks | OK for us to refer only to the notes but CR may have overlapping part with needed changes to designate the valid rasters for the European sub-band from thread #133, hopefully we may prevent overlapping CRs |
| Ericsson | The channel raster listed in the notes is that matching the European harmonized standard and the Wi-Fi channel raster. If this channel raster is the only possible, then the changes according to the CR apply. |
| Apple | We do not need these CRs. Every 3GPP band has a start and end point, so the fact that we restrict ARFCN points to certain values do not change that principle. |
| Huawei | Ok with the update. |
| CableLabs | There are two 80 MHz Wi-Fi channels 155 from 5735-5815 MHz and 171 from 5815-5895 MHz. NR-U 60 MHz channel raster 787000 (5775-5835 MHz) and 80 MHz channel raster 786332 (5755-5835 MHz) across these two 80 MHz Wi-Fi channels, which conflicts with what we agreed in previous meetings. We would recommend to remove 787000 and 786332. |
| ZTE | To Skyworks, we understand your motivation, however this is treated in different WID, then not sure this applicable from procedure perspective, how to add the WID?  To Apple, only the NOTE for NR-ARFCN and GSCN should be applied, the values proposed in the table is also not aligned with NOTE, this would cause the confusion at the end.  To CableLabs, we could further check it, if that’s agreement reached last meeting,we could accept that. |
| Nokia | We would like to note that exactly the same definition as now in 38.101-1 in E-UTRA specs is used for LAA band 46. Therefor for NR-U the same approach was used (range in table in rows – limited numbers list in the Note). We do not understand why precedence should be changed and the agreed approach should be changed. In short there is no need to make these modifications to the specification as it should already be clear.  The error pointed out by CableLabs seems based on our checking to be correct and the two raster points 787000 (60MHz channel) and 786332 (80MHz channel) should be removed. We can provide CRs to correct this. |
| Charter Communications Inc | We agree with cable Labs and Nokia and support the changes highlighted |

### 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.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2101968**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101968.zip)**,**  [**R4-2101969**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101969.zip)  38.104 CR | Nokia: These CRs is not needed. |
| Company B |
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| [**R4-2101970**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101970.zip)**,**  [**R4-2101971**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101971.zip)  38.101-1 CR | Nokia: These CRs is not needed. |
| Company B |
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## Summary for 1st round

### Open issues

There was no consensus to agree to the CR’s in R4-2101968 and R4-2101969. Several companies were ok with the CR meaning that they were acceptable. On the other hand, several other companies expressed that they were not necessary. However, the proponent of the CR pointed out that there is an error in 38.104 where the GSCN range for Band n96 ends at 9877 but that sync raster points are available well beyond that. This error is not present in 38.101-1 where the GSCN range has already been extended to 10363. Separately, a change to the channel number for two raster points 787000 (60MHz channel) and 786332 (80MHz channel) was suggested and confirmed by two other companies, but this is outside of the scope of the original CR’s and not made available at the beginning of the meeting. It is therefore necessary to give companies time to check. The moderator recommends that the CR’s are revised as follows

* Correct the GSCN values. At least the upper range of GSCN for Band n96 in 38.104 needs to be corrected. Other values can be revised if agreed by all companies.
* The format change to remove (First – <Step size> – Last) is not agreed
* Removing the two raster points is subject to companies checking. If companies do not have an opportunity to check during this meeting, then the two raster points should not be removed and a separate CR to remove them can be presented next meeting.

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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round: Revise the 38.104 CR and 38.101-1 CR. Agree on the correct range of GSCN values and valid ARFCN raster points in case of overlap with multiple WiFi channels.* |

*Suggestion on WF/LS assignment*

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|  | **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*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2101968**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101968.zip)  38.104 CR | *Revised. (Cat A CR in R4-2101969 is not yet submitted so a new tdoc number is not needed)* |
| [**R4-2101970**](http://ftp.3gpp.org/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101970.zip)  38.101-1 CR | *Revised. (Cat A CR in R4-2101971 is not yet submitted so a new tdoc number is not needed)* |

## Discussion on 2nd round (if applicable)

Comments on the revision to draft R4-2103137 (revision of R4-2101968) are captured here.

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| **Company** | **Comments** |
| Charter Communications, Inc | We have confirmed that the NR-U 60 MHz channel raster 787000 (5775-5835 MHz) and 80 MHz channel raster 786332 (5755-5835 MHz) is across these two 80 MHz Wi-Fi channels 155 from 5735-5815 MHz and 171 from 5815-5895 MHz. We agreed with remove these two from the list. We believe there is plenty of time to checking and the revision should be done in this meeting |
| CableLabs | Thanks Charter and Nokia for confirming the two band n46 channel raster points 787000 (60 MHz) and 786332 (80 MHz) are across two 80 MHz Wi-Fi channels. We double checked this issue once again, we recommend to remove 787000 and 786332 from band n46 ARFCN raster list from TS 38.101 and 38.104. |

## 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*

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| **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”* |