**3GPP TSG-RAN WG4 Meeting # 96-e draft R4-2001184**

**Electronic Meeting, 17 – 21 Aug., 2020**

**Agenda item:** 4.2.1

**Source:** Hisashi Onozawa (Nokia)

**Title:** Email discussion summary for [96e][102] NR\_NewRAT\_UE\_RF\_Part\_1

**Document for:** Information

# Introduction

This email discussion thread is for Release 15 NR maintenance on FR1 UE RF issues.

Note that the following documents are assigned to other agendas.

R4-2010340, R4-2010341, R4-2010342, R4-2010343 are moved to 4.1 (thread #101).

R4-2010628, R4-2011480, R4-2011481, R4-2011491 are moved 4.2.2 (thread 103)

# Topic #1: Transmitter requirement maintenance

## Companies’ contributions summary

Here’s the summary of the contributions to the transmitter requirements.

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2010626**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010626.zip)  CR to TS 38.101-1: Correction on the Aggregated Channel Bandwidth | ZTE Corporation | 1. Apply largest u for SCSlow, SCShigh, NRB,low, NRB,high and BWGB,Channel(k), aligned with Rel-16 spec. 2. On top of 1, apply μ=1 for SCSlow, SCShigh, NRB,low, NRB,high and BWGB,Channel(k) in the case of no common μ value for both of the channel bandwidths. |
| [**R4-2010810**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010810.zip)  On UL MIMO Tx EVM requirement | Huawei, HiSilicon | ***Observation 1: Not all crosstalk noise can be eliminated by gNB***  ***Observation 2: Antenna crosstalk does not exist for the conductive measurement***  ***Observation 3: PCB isolation should be guaranteed by UE design and the non-linear coupling noise cannot be eliminated***  ***Observation 4: MMSE has a better performance than ZF MIMO receiver, and no obvious performance degradation for non-MIMO receiver if the conductive crosstalk isolation is good enough.***  ***Proposal: It is proposed that TE vendors to further evaluate the feasibility of UL MIMO EVM measurement with MIMO receiver.*** |
| [**R4-2011520**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011520.zip)  On the Transmit EVM Requirement for UL MIMO Transmission | Lenovo, Motorola Mobility | **Proposal 1:** Use the linear zero-forcing MIMO equalizer to define and measure the transmit EVM for multi-layer MIMO transmission,  or  **Proposal 2:** Use the unbiased linear MMSE MIMO equalizer to define and measure the transmit EVM for the multi-layer MIMO transmission. |
| [**R4-2009655**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009655.zip)  Clarification of assumption on EVM measurement for UL-MIMO | Anritsu Corporation | ***Observation 1: There is a concern that companies are not aligned with assumptions of the words “per layer/ each layer/ each connector” with regards to a reference point for EVM calculation, variety of codebook to be applied, number of layers to be measured simultaneously, and mapping of logical antenna port and physical antenna connector.***  ***Proposal 1: Align an assumption of EVM measurement for UL-MIMO in a group***  ***Proposal 2: Clarify assumptions in TS38.101-x from viewpoints of a reference point of EVM calculation, number of configured layers for test, numbers of layers to be measured simultaneously and mapping between logical antenna port and physical antenna connector once the consensus has been created in the group.***  ***Observation 2: We assume that the mapping of logical antenna port and physical antenna connector in a UE is fixed 1:1 during the MIMO operation***  ***Observation 3: Calculated EVM at the UE antenna as a reference point includes at least 5.6% impairments of measurement antenna caused by XPD in FR2 OTA test system.***  ***Observation 4: As a final goal of EVM measurement for 2-layer UL-MIMO, reference point of EVM calculation should be at UE antenna port when measuring 2 layers simultaneously.*** |
| [**R4-2010114**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010114.zip)  Corrections of Japan-related CA co-ex tables for REL-15 combo | SoftBank Corp., NTT docomo INC., KDDI Corporation | 1) Protection to n74 is added to n3-n78 and n8-n78.  2) For n8-n78, Note 5 was removed since the protection is supported with A-MPR(NS\_43) in NR. |
| [**R4-2010126**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010126.zip)  Handling of additional requirements for UE co-ex in CA/DC | SoftBank Corp. | **[Proposal-1] We draw conclusions for the two questions below in this meeting and take necessary actions by the next meeting.**   1. **Whether we should add the info. or the table above?** 2. **Whether we should add/improve description (esp. if the table is not added)?** |
| [**R4-2010800**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010800.zip)  Correction to uplink antenna connectors | Rohde & Schwarz | Update the wording in section 6.1 |
| **[R4-2010804](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010804.zip)**  Discussion on the number of Tx connectors | Rohde & Schwarz | **Proposal:** RAN4 agrees on the accompanying CR R4-2010800. |
| [**R4-2011341**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011341.zip)  Applicability of DTRxSRS to SRS carrier switching and power class 2 | Qualcomm Incorporated | This contribution describes two shortcomings of the ∆TRxSRS allowance for PCMAX\_L when SRS carrier switching is required with a DL-only carrier and when the transmission on the primary antenna is PC2 but only PC3 on the diversity antennas. The proposed modification is described in this contribution and included in [2]. |
| [**R4-2011342**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011342.zip)  Correction to configured power with allowance for SRS switching | Qualcomm Incorporated | SRS carrier switching to DL-only carriers is added to applicability of DeltaT\_RxSRS and DeltaT\_RxSRS value is increased by 3 dB for the case when primary Tx is PC2. |
| [**R4-2011495**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011495.zip)  CR for 38.101-1 on minimum output power-Rel-15 | Huawei, HiSilicon | Adding one table for minimum output power for 256QAM which is aligned with EVM requirement. |
| [**R4-2011497**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011497.zip)  CR for 38.101-1 on corrections for AMPR-Rel-15 | Huawei, HiSilicon | Adding one table for minimum output power for 256QAM which is aligned with EVM requirement. |

## Open issues summary

### Sub-topic 1-1 UL MIMO EVM

R4-2010810, R4-2011520, and R4-2009655 discuss the issues on EVM measurement in UL MIMO. Some clarifications are needed to establish a common understanding how EVM is measured in UL MIMO. Huawei proposes to study the feasibility of MIMO receiver, Lenovo/Motorola proposes a specific MIMO receiver(s), and Anritsu summarizes the current understanding from TE vendor point of view including FR2. Anritsu summarize the test methods and reference point for EVM measurement in the following.

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| --- | --- | --- | --- | --- | --- |
| **Method** | **Type of EVM measurement** | **Reference point for EVM calculation** | **Num. of configured layers for test** | **Other measurement conditions / remarks** | **Related paper/ Specs** |
| 1 | Definition of current FR1 EVM spec for MIMO. | UE antenna connector | 2 | EVM of two layers are measured simultaneously. UE RF front end impairments are included in the calculated EVM. | TS38.101-1 [10] |
| 2 | New proposal of EVM test for each layer | Layer / UE antenna port | 2 | EVM of two layers are measured simultaneously by MIMO receiver in the TE. UE RF front end impairments are cancelled by estimating unbiased symbols which are derived utilizing DM-RS. | [4][6][8]  Not clear if [3] applies. |
| 3 | Similar definition with current FR2 EVM spec. for MIMO | UE antenna connector | 1 | Test is carried out in series by configuring each layer separately.  UE RF front end impairments are included in the calculated EVM. | TS38.101-2 [11]  [5] with a compromise.  Not clear if [3] applies. |



Sub-topic 1-1 Please present your company view in 1.3.1 about the FR1 EVM reference point, EVM test method and reference receiver.

### Sub-topic 1-2 Handling of UE coexistence in CA/DC

R4-2010126 proposes clarifications in UE coexistence requirement in CA/DC as they are incomplete and unclear.

Sub-topic 1-2 Please present your company view in 1.3.1 whether we should add a new table or info (somehow), or how to clarify or fix the presented issues.

## Companies views’ collection for 1st round

### Open issues

Here’s to collect comments about two discussion topics

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| --- | --- |
| **Company** | **Comments** |
| Rohde & Schwarz | Sub topic 1-1: We share a similar view to Anritsu. It is necessary to align the assumptions before defining the EVM measurement.  For Motorola, currently we would rather prefer Option 1, but before making this agreement, we should align the assumptions and then come back to this discussion. |
| Motorola | Sub topic 1-1: For Rohde & Schwarz, by Option 1, do you mean Proposal 1? If so, this is fine for us. However, we are also ok with an unbiased MMSE receiver as in Proposal 2. Our point is that if an MMSE receiver is used, it should be scaled to an unbiased receiver, as otherwise the error will be measured incorrectly. In any case, an unbiased receiver should be used to measure EVM. |
| Rohde & Schwarz | To Motorola: Yes, sorry, I meant Proposal 1. |
| Nokia | Sub topic 1-2: UE coexistence in CA/DC: No new UE to UE co-ex table is preferred option. A text proposed in paper “union of single band UE co-ex requirements, including additional requirements, are applied for CA/EN-DC” sounds good way. |
| Ericsson | Sub-topic 1-1:  We support Method 1, the existing measurement per antenna connector. We agree with Observation 1 and Observation 3 in R4-2010810.  We appreciate the comprehensive results and the clear assumptions presented in R4-2011520, but still doubt that the non-linear crosstalk in the UE can be eliminated by a linear receiver. Indeed, non-linear effects in MIMO systems can be modelled by modifying the channel matrix and adding correlated noise: e.g. would Observation 3 in R4.2011520 be met for uncorrelated noise due to non-linearities?  Notwithstanding, agreeing a reference receiver for the TE (gNB emulator) may not be trivial.  Internal crosstalk within the UE should be eliminated by UE design (Observation 3 in R4-2010820) and duly tested according to the existing specification. |
| Huawei, HiSilicon | Sub topic 1-1:  As noticed in Anritsu’s observation 4, i.e. “***As a final goal of EVM measurement for 2-layer UL-MIMO, reference point of EVM calculation should be at UE antenna port when measuring 2 layers simultaneously.***” , before we make a decision, we’d like to know what’s the TE implementation status so far? Any issues to implement MIMO receiver at TE side? |
| Intel | Sub topic 1-1: For UL-MIMO EVM testing, unbiased MMSE receiver is preferred. It is also our understanding that MMSE MIMO receiver is assumed in Demod performance evaluations. So TE should adopt the same method. |
| Qualcomm | Sub topic 1-1: UL MIMO EVM  We agree with the need to introduce MIMO receivers in TE for UL MIMO EVM test. Note that there is NO mandate in the standard that forces an SRS port to directly connect to a physical Tx chain. Unfortunately testing procedure with single Rx chain (one connector at a time) makes this mandate, rather than the standard.  ANR observation 4 is precise enough to be an agreement: **As a final goal of EVM measurement for 2-layer UL-MIMO, reference point of EVM calculation should be at UE antenna port when measuring 2 layers simultaneously.**  As we understand it, ‘antenna port’ in the ANR observation is distinct from ‘antenna connector’. This wording may be more acceptable to the group than ‘per layer’  We are less sensitive to MIMO receiver type for high SNR conditions. |
| vivo | Sub topic 1-1: UL MIMO EVM  Agree with Anritsu and R&S, we need to align the understanding of basic terminology for EVM calculation and testing.  Same view as proposal 1 and proposal 2 in R4-2009655. |

### CRs/TPs comments collection

Here’s to collect comments to CRs (and companion discussion papers) to transmitter requirements.

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| **CR/TP number** | **Comments collection** |
| [**R4-2010626**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010626.zip) | Nokia: Ok. This matches with what has been agreed for Rel-16.  Skyworks: Ok.  Qualcomm: The sentence "In case there is no common μ value for both of the channel bandwidths, SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use *μ*=1 according to Table 5.3.3-1 and BWGB,Channel(k) is the minimum guard band for carrier k according to Table 5.3.3-1 for the *μ*=1 value.." is not required because you are already using the largest common u. Perhaps we can change the 1st sentence to largest common u instead of largest u. |
| [**R4-2010114**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010114.zip) |  |
| [**R4-2010800**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010800.zip)  [**R4-2010804**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010804.zip) | Qualcomm: SRS when sounding on all 4 RX antennas is still transmitting on multiple antennas. If only 2 antennas are specified, then an exception must be placed for SRS in the general section. Also, why was this not a concern for LTE?  Rohde & Schwarz: To Qualcomm, I checked for LTE conformance test spec 36.521-1 and there is no TC defined for this, so the issue does not exist there. Also using 4 different antennas for UL in our understanding violates the agreement from R4-2008462, stating that the max number of UL antenna connectors is 2.  Huawei: During the discussion of UL CA, it is possible that 2 PA are utilized to support a certain CA bandwidth class. Considering also UL MIMO capability, it may end up with 4 PA and 4 antennas.  Qualcomm: The CR in R4-2010800 limits the UE to two transmit antennas. This limitation is written on the UE, but maybe the intention is a limit of two antennas per band? The UE could and most likely does have separate antenna system for different frequency ranges.  Skyworks: same observation as Huawei. For intra-band non contiguous uplink CA, we are considering supporting 2x2 MIMO, which calls for 4 PAs and 4 antenna connectors. Also for the case of SRS antenna switching, in case of 1T4R, 1 PA is routed to 4 different antenna connectors. We note that both of these instances, perhaps there are ways of verifying core requirements with only 2 Rx ports: for UL NC CA, 2x2 MIMO could perhaps be verified CC per CC, and for 1T4R there are perhaps ways of testing all antenna ports with only 2 cables by adding extra external hardware between UE and TE? |
| [**R4-2011341**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011341.zip)  [**R4-2011342**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011342.zip) | OPPO: For clarification, does this increased IL only apply to 1T4R or both 1T4R and 2T4R?  Huawei: why SRS carrier switching needs to consider the increased delta SRS? In which scenario we need to consider the switching to a different antenna for a different carrier? Also we see no reason to remove the SRS resource information.  Qualcomm: For OPPO, I think the increased IL would apply for both 1T4R and 2T4R. It applies whenever you switch a PC3 PA to one of the antennas in the PC2 band for sounding. With multi-band PA’s, that PC3 PA may not be the one that is used for PUSCH/PUCCH transmission on the PC2 primary Tx but “borrowed” for transmitting SRS on the diversity Rx antenna.  For Huawei one scenario is that you have CA between Band A and Band B, each on a separate antenna. However, Band B is a DL only band so there is no dedicated PA for that band. In order to transmit SRS on carrier on Band B, then I need to switch a PA in to the antenna for Band B. We removed the SRS resource because we thought it didn’t add any new information and thought there might be an error. For example, if a 1T4R UE is configured with 2 SRS resources, then the DT\_RxSRS should apply since switching would be needed. However, the current clause states that the relaxation applies only when configured with 4 SRS resources.  Skyworks: Could you confirm if it is correct understanding that the rationale for an increasing DT\_RxSRS by 3dB is to account for an SRS transmission that would be made in a PC2 band with a PC3 PA ?  For information, we have contribution R4-2011527 that proposes to introduce DeltaTsrs for 36.101 in thread [105]. |
| [**R4-2011495**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011495.zip) | DISH: We can’t agree this CR. The same minimum output power shall apply for all movulations, like in LTE.  Nokia: Minimum output power requirement is needed to control interference in NW, should not be changed for 256-QAM.  Huawei: It is specifed in the spec that for EVM requirement, the applied minimum output power for 256QAM is 10dB higher than other modulation order. The change is to align the requriements in different clauses.  Qualcomm: Change not required. Carrier leakage and IBE still needs to be met at -40dBm. |
| [**R4-2011497**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011497.zip) | [SoftBank] CR needs further modifications.  While I understand the concern, proposed description of "lower than or equal to 15dBm" seems to permit to test any value <= 15dBm, for example at -10dBm and would make the description meaningless. A better description should be sought for. Alternatively, we have not mentioned MPR or A-MPR when we talk about 23dBm or 26dBm so we could live with the current description, i.e. without proposed changes.  Qualcomm: In Gothenburg, we provided simulations that show otherwise. Only MPR is required for 5MHz BW. Perhaps Huawei needs to bring simulations to justify excess back-off. Please note that a 3MHz guard band was used in the analysis. |

## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic#1-1** | There are still diverse views on UL MIMO EVM, however, the bottom line is to align the EVM measurement assumption and reference point.   * WF is assigned to summarize the current status and to agree how EVM is measured for UL MIMO. |
| **Sub-topic#1-2** | Only one comment received not to add any new table but clarify by text.   * WF is assigned to further discuss how to clarify/clean-up the CA/DC UE coex requirement. |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on EVM measurement for UL-MIMO | Anritsu |
| #2 | WF on Handling of additional requirements for UE co-ex in CA/DC | Softbank |

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2010626**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010626.zip) | Supported by two companies. Not supported by one company.  Continue the second round. |
| [**R4-2010114**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010114.zip) | Recommend agreed.  (Cat A CR R4-2010115) |
| [**R4-2010800**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010800.zip)  [**R4-2010804**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010804.zip) | There are different views.  Continue the second round. |
| [**R4-2011341**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011341.zip)  [**R4-2011342**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011342.zip) | More clarifications needed.  Continue the second round. |
| [**R4-2011495**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011495.zip) | Not supported by three companies.  Continue the second round. |
| [**R4-2011497**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011497.zip) | Continue the second round. |

## Discussion on 2nd round (if applicable)

Here’s to collect the 2nd round comments

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| **tdoc** | **Comments** |
| R4-2011747 WF on EVM measurement for UL-MIMO | R&S: on Point 3, in our understanding when discussing UL MIMO EVM measurement, we consider 2 Tx antennas. From the comments on R4-2010800, we understand that there may be UE implementations with more antennas (e.g. CA + UL MIMO) on a given band, but for testing UL MIMO EVM, 2 Tx antennas shall be considered and EVM measurements shall be defined based on this assumption. |
| R4-2011748 WF on Handling of additional requirements for UE co-ex in CA/DC | SoftBank: Thanks for allocating a WF. But it seems that, without a concrete WF in this meeting, we can prepare a CR for the next meeting (and the content can be fixed within 3 weeks...). Then the WF can be withdrawn. |
| R4-2010626 | ZTE: Just response the Qualcomm’s comments in 1st round:  Different with FR2 band, for some FR1 bands such as band n40, some 'corner cases' are exised, where no common mu for the constituent channel bandwidth when band n40 operating in intra-band contiguous CA operation. For example band n40 supporting 5MHz+60MHz CA, where only15kHz SCS is supported for 5MHz while 30kHz/60kHz SCS are supported for 60MHz, which means no common mu are found for 5MHz and 60MHz. In this case, RAN4 have discussed this issue and achieved agreements in last meeting that mu=1 is selected. Therefore it is required this sentence "in case there is no common μ.................."  For the largest common mu or largest mu, i think it is the same with FR2 and i have explained it under R4-2010628, which is just align with the description of “section 5.4A.1 channel spacing for CA” in TS38.101-1: “... μ0 is the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1....”, actually it implies that the μ is common μ among the SCS of the CCs.  Qualcomm:  For FR2, I have no problem with the largest mu.  For FR1, I was just suggesting more optimized wording. So, just change 1 word instead of adding a new sentence.  Example: For FR1, 5MHz+60MHz, 5MHz supports 15K, 30K SCS and 60MHz supports 30K, 60K SCS. The largest common mu = 1. So, why not just say “use the largest common mu”.  In summary,  For FR2, use “largest mu”  For FR1, use “largest common mu”  Is this acceptable? Or am I over simplifying?  ZTE：  As i said in my previous email, for some FR1 band, such as band n40, only 15kHz SCS is supported in 5MHz(30k scs is not supported), we cannot find the common mu for 5+60MHz CA.We have discussed such 'corner cases' last meeting, and have reached agreements that mu=1.  we need a separate sentence to describe the 'corner case' where no common mu is found.  And also such sentence have been agreed in CA channel spacing in last meeting. For CA aggregated bandwidth, it needs the same sentence since the parameters in aggregated channel bandwidth calculation are aligned with CA channel spacing.  QC：  Okay I see that you were referring to Table 5.3.5.1 to find out if there is common mu between BWs. Then in case of no common mu, you refer to Table 5.3.3-1.  So this was causing some confusion to me, and perhaps we should clear up this confusion. Sorry, as it was not so obvious to me.    What do you think?  ZTE：  Happy to see the motivation is clear now.  For the sentence i added:  SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidthsaccording to Table 5.3.5-1and BWGB,Channel(k) is the minimum guard band for carrier k according to Table 5.3.3-1 for the saidμ value.In case there is nocommonμ valuefor both of the channel bandwidths,SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) useμ=1 according to Table 5.3.3-1 and BWGB,Channel(k) is the minimum guard band for carrier kaccording to Table 5.3.3-1for theμ=1 value.  The logic for this sentence is first we need to check the SCS supported in each channel bandwidth operating in intra-band contiguous CA for a certain bandaccording to table 5.3.5-1, and then  1:If largest mu values is found, the using this largest mu to calculate the BWChannel\_CA ,  where the minimun guard bands for the largest mu are used according to table 5.3.3-1  2: If no common mu value is found, then mu=1 is selected to calculate the BWChannel\_CA ,  where the minimun guard bands for the mu=1 are used according to table 5.3.3-1    I suppose it is clear since the tables referred are mentioned in the sentence, and the precondition is we need to check table 5.3.5-1 first. what do you think??  QC：  Great! I am ok with the CR if you had the highlighted part below.  ZTE：  Thanks.  Then i suppose you are ok with the CR, since the highlighted part below is already existed in the CR. which means no need to revised the CR, correct?  QC：  Yes Wubin, The original CR is fine.  Huawei: 1. The wording in this sentence is so confused. *“SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidthsaccording to Table 5.3.5-1”* . At a first glance, there may be two meanings in this sentence.   * + - 1. *SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k) use the largest μ value. It means the largest μ value is the largest value in SCSlow, SCShigh, NRB,low, NRB,high, and BWGB,Channel(k).*       2. *largest μ value is the largest common μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidthsaccording to Table 5.3.5-1*   Can you further clarify this sentence? The original can’t be acceptable.  2. QC’s suggestion is correct. We support use the *largest common μ instead of largest μ value. It will be much clear in the specifications.*  ZTE:  To Huawei.  RAN4 have discussed the sentence for several meetings and have achieved the agreement in last meeting, actually this sentence was proposed by Huawei when RAN4 discussed R16 intra-band contiguous CA RF requirements and was agreed in the end.  I have explained it to Qualcomm, you can refer to it. Actually this sentence is based on NR channel spacing. We don’t think there are confusion existed since the the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths according to Table 5.3.5-1 is used.  For the “common u”, Qualcomm have already agreed with the original one. If you have further comments, you can bring CR next meeting to correct all the impacted clauses as package.  Qualcomm: I am ok with the CR, but maybe for further clarification in the future, you could say, “In case there is no supported common mu …in Table 5.3.5-1……then choose mu = 1 in Table 5.3.3-1”. |
| R4-2010800  R4-2010804 | R&S: Thanks for all the valuable inputs.  It seems that we may need to solve this problem during test case definition in RAN5. There are some obvious limitations to TE implementations and it is not possible to connect unlimited amounts of Tx antennas. So some features may need to be tested separately, e.g. RAN5 currently defines UL MIMO only for single CC. |
| R4-2011341  R4-2011342 | *Skyworks: The proposal to increase* ∆TRxSRS *by 3dB for power class 2 operation seems difficult to accept since the justification does not necessarily reflect all PC2 capable UE architecture/configuration. There are bands for which there are no PC3 PA available on top of PC2, and UE is able to route PC2 PA output port to the DRX antenna port.*  Qualcomm: The∆TRxSRS is only an allowance, not a mandatory reduction in power. Therefore, for a UE that cannot route the PC2 PA to the DRx, a recourse is made available but is not forced upon every UE. The UE with available PC2 and with enough output power to handle the potential additional switch loss in front of the PC2 PA is not required to take it. The ∆TRxSRS is only applied to the lower bound of Pcmax.  OPPO: Maybe it is better to change wording “when the device is capable of power class 2 in the band” to “when the device is capable of power class 2 in the band and transmit SRS from the diversity antennas with power class 3 PA”  Skyworks: To Qualcomm: Thank you for the clarification. We understand this is an allowance, ie. a UE that would support PC2 using PC2 PA(s) would not have to necessarily make use of the proposed allowance.  OPPO: Although it might be better to modify the wording further, we are ok with original version. |
| R4-2011495 |  |
| R4-2011497 |  |

## 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: Receiver requirement maintenance

Here’s the summary of the contributions to the receiver requirements.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2010814**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010814.zip)  CR for 38.101-1 FRC corrections (R15) | Huawei, HiSilicon | Correct the RFC parameter errors in Table A.3.2.2-1, Table A.3.2.2-2, Table A.3.2.2-3, Table A.3.2.3-1, Table A.3.2.3-2, Table A.3.2.3-3, Table A.3.2.4-1, Table A.3.2.4-2, Table A.3.2.4-3, Table A.3.3.2-1, Table A.3.3.2-2, Table A.3.3.2-3, Table A.3.3.3-1, Table A.3.3.3-2, Table A.3.3.3-3, Table A.3.3.4-1, Table A.3.3.4-2, and Table A.3.3.4-3. |
| [**R4-2009616**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009616.zip)  OOB blocking for Inter-band CA | Qualcomm Incorporated | Add statement to add in gap OOB blocking requirements to cover overlapping OOB ranges and exclusion zones.  Endorsed draft CR R4-2004399 in RAN4#94-bis-e |
| [**R4-2010022**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010022.zip)  CR to TS 38.101-1 R15: corrections on narrow band blocking for intra-band contiguous CA | Xiaomi | Add the interferer offset value for 30 kHz SCS case for narrow band blocking for CA bandwidth class C |
| [**R4-2010796**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010796.zip)  Correction to RMC for 256QAM | Rohde & Schwarz | Change MCS table from 64QAM to 256QAM |
| [**R4-2010926**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010926.zip)  CR for 38.101-1 to add the missing MSD for CA\_n41A-n78A (Rel-15) | Huawei, HiSilicon | 1. The exception due to cross band isolation is added for DL band n78 with UL band n41. 2. The exception values for 60MHz, 80MHz, 90MHz and 100MHz for CA\_n41-n78 are added. 3. Some editorial errors are corrected in Table 7.3A.6-1 and Table 7.3A.6-2. |

## Open issues summary

N/A

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

Here’s to collect comments to CRs to receiver maintenance.

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2010814**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010814.zip) | Anritsu:The idea to correct the allocated slots per frame is agreeable.  There are missing corrections and a typo.The values for 100MHz CBW in Table A.3.2.2-3/Table A.3.2.3-3 should also be 36 same as the other CBW.  There is a typo with the value for 10 MHz CBW in Table A.3.3.4-3. 246 should be 24. (6 was missed to be deleted.)  Huawei: we can make further revision based on the comments. |
| [**R4-2009616**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009616.zip) |  |
| [**R4-2010022**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010022.zip) | Qualcomm: why add the extra row in the table? Just change the note. Maybe ∆F should change to SCS as well.  Table 7.6A.4.1-1: Narrow-band blocking for intra-band contiguous CA   |  |  |  |  | | --- | --- | --- | --- | | NR band | Parameter | Unit | NR CA bandwidth class | | C | | n41 | Pw in Transmission Bandwidth Configuration, per CC | dBm | REFSENS + NA CA Bandwidth Class specific value below | | 16 | | Puw (CW) | dBm | -55 | | Fuw (offset for SCS = 15 kHz, 30KHz) | MHz | - Foffset – 0.2  /  + Foffset + 0.2 | | NOTE 1: The transmitter shall be set a 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in Table 7.3.2-3 with PCMAX\_L,f,c defined in clause 6.2.4.  NOTE 2: Reference measurement channel is specified in Annexes A.3.2 and A3.2 with one sided dynamic OCNG Pattern OP.1 FDD/TDD as described in Annex A.5.1.1/A.5.2.1.  NOTE 3: The PREFSENS power level is specified in Table 7.3.2-1 and Table 7.3.2-2 for two and four antenna ports, respectively.  NOTE 4: The Fuw (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer and shall be further adjusted to MHz to be offset from the sub-carrier raster. | | | |   Xiaomi: For feedback to Qualcomm, actually we didn’t add extra row to the table, that row is already in the original table just no Fuw values. With this clarification, is that OK for you? |
| [**R4-2010796**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010796.zip) | Huawei: the CR can be merged in R4-2010814, which already captures the correction. |
| [**R4-2010926**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010926.zip) | ZTE: It seems Rel-16 spec is correct, so it is no need to draft Rel-16 CR. In this case the question is the normal procedure is Rel-16 spec align with Rel-15 spec. Surprising to see inverting alignment CR. CR is not agreeable.  Huawei: If Rel-16 spec is correct and Rel-15 is wrong, we need to correct the Rel-15 spec. I can revise it if there is no any technical comments. |

## Summary for 1st round

### Open issues

### CRs/TPs

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2010814**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010814.zip) | To be revised including R4-2010796. |
| [**R4-2009616**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009616.zip) | Recommend approved.  (Cat A CR R4-2009617) |
| [**R4-2010022**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010022.zip) | Continue the 2nd round. |
| [**R4-2010796**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010796.zip) | Noted. Contents agreeable. To be merged into R4-2010814. |
| [**R4-2010926**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010926.zip) | To be revised. |

## Discussion on 2nd round (if applicable)

Here’s to collect the 2nd round comments

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| --- | --- |
| **tdoc** | **comments** |
| R4-2011749  (revision of R4-2010814) | Company name: Comments |
| R4-2010022 | Qualcomm: I am fine with the revision suggested below from Xiaomi.    Xiaomi: With offline discussion with Qualcomm, the revision is attached at the following link  [draft R4-201xxxx CR for 38.101-1 Rel15 corrections on narrow band blocking requirements for intra-band contiguous CA](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_96_e/Inbox/Drafts/%5B102%5D%20NR_NewRAT_UE_RF_Part_1/2nd%20round%20drafts/draft%20R4-201xxxx%20CR%20for%2038.101-1%20Rel15%20corrections%20on%20narrow%20band%20blocking%20requirements%20for%20intra-band%20contiguous%20CA.docx)  Qualcomm: We are ok with the revision of the CR. |
| R4-2010796 |  |
| R4-2011750  (revision of  R4-2010926 | *ZTE：* It seems the revision is the same with original one.  As i commented in the 1st round, Rel-16 spec is correct and no need to submit a Cat A CR for Rel-16 spec. The question is only Rel-15 Cat F without Cat A CR may cause procedure issue. Since in my understanding, all of the Cat F CR for Rel-15 should be mirrored to Rel-16 spec by Cat A CR. Similar situation have been happened before.  Huawei: To ZTE, you are totally wrong. As I said in the reasons of change, there are some editorial errors in both Rel-15 and Rel-16 just like below. We can’t use the red words in the specifications. If no technical comments, the revision can be agreed.  C:\Users\z00471447\AppData\Roaming\eSpace_Desktop\UserData\z00471447\imagefiles\originalImgfiles\3F909F86-A6A1-4F35-9A87-700D1AF31F81.png  ZTE: To Huawei.  We don’t think just only change the color for wording can be a formal CR, i.e. we think Cat A CR for Rel-16 is not needed. As stated by Chairman, purely editorial CR is not allowed in this meeting. |

## 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: LS reply

## Companies’ contributions summary

Here’s the summary of the contributions to the receiver requirements.

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2010827**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010827.zip)  Reply LS on RF testing of 4Rx capable UE | Huawei, HiSilicon | **1. Overall Description:**  RAN4 would like to thank RAN5 for the LS on questions on RF testing related to 4Rx, RAN4 would like to provide feedback as below.  1. Confirm RAN5 view that for requirements other than single carrier REFSENS, testing the UE with 4Rx antenna ports with corresponding requirements, would be sufficient to verify the Rx performance.  RAN4 answer: RAN4 shares the same view with RAN5 that for the requirements other than singel carrier REFSENS, 4Rx testing would be sufficient to verify the Rx performance. In order to simplify the measurement, no need to do duplicated tests for both 4Rx and 2Rx.  2. Confirm whether connecting UE declared 2Rx antenna ports suffices to test 2Rx requirements on 4Rx bands  RAN4 answer: In order to keep consistent receiving performance and UE behaviour, 2Rx antenna would not be selected randomly by UE implementation. Measurement based on OEM declaration can better reflect the UE implementation in real application.  **2. Actions:**  **To RAN5:**  **ACTION:** RAN4 respectfully asks RAN5 to take the above information into account. |
| [**R4-2011235**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2011235.zip)  Views and reply LS on RF testing of 4Rx UEs | vivo | 1 Overall description  RAN4 would like to thank RAN5 for their LS R4-2009530 on RF testing of 4Rx capable UE.  RAN4 has discussed the receiver requirements testing for 4Rx capable UEs, and has made the following agreement:   * **For single carrier REFSENS requirement in 4Rx bands, both 2Rx and 4Rx requirements shall be tested. The 2Rx testing of REFSENS shall be performed with the connection of 2Rx antenna ports declared by UE.** * **For other Rx requirements, testing the UE with 4Rx antenna ports with corresponding requirements is sufficient to verify the Rx performance in 4Rx bands.**   2 Actions  **To** **RAN5:**  **ACTION:** RAN4 respectfully asks RAN5 to take the above decision into consideration in their future work.  draft CR is also attached. |
| [**R4-2010928**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2010928.zip)  Discussion and reply draft LS on structure of NR CA reference sensitivity requirements in 38.101-1 | Huawei, HiSilicon | **Proposal 1: It’s proposed to inform RAN5 that the requirement structure in both clause 7.3A.4 and 7.3A.6 listing only aggressor and victim will be retained in future.**  **Proposal 2: It’s proposed to inform RAN5 that band combination specific manner will be used to specify IMD exception requirements in clause 7.3A.5.**  **Proposal 3: It’s proposed to move the SDL requirements in 7.3A.2.4 to 7.3. The exceptions for SDL band combinations can be specified in clause 7.3A.4, 7.3A.5 and 7.3A.6.**  1 Overall description  RAN4 thanks RAN5 LS on structure of NR CA reference sensitivity requirements in 38.101-1. RAN4 has discussed the structure of NR CA reference sensitivity requirements and achieved the following agreement:   1. **The requirement structure in both clause 7.3A.4 and 7.3A.6 listing only aggressor and victim will be retained in future.** 2. **Band combination specific manner will be used to specify IMD exception requirements in clause 7.3A.5 instead of NR CA configurations.** 3. **RAN4 accept RAN5’s suggestion that the SDL band REFSENS requirements will be moved to 7.3.**   2 Actions  **To TSG RAN WG5**  **ACTION:** RAN4 respectfully asks RAN5 to take account the above RAN4 agreements in the future. |

## Open issues summary

### Sub-topic 2-1 LS reply on 4 Rx UE

Both Huawei and vivo papers proposes to confirm RAN5 understanding.

Sub-topic 3-1: Please comments if you have a different view to confirm RAN5. Draft CR is attached in vivo’s paper. Please present your view if the CR should be recommended or not.

### Sub-topic 2-2 LS reply on CA REFSENS

Sub-topic 3-2: Please comments if you have a different view from the reply draft by Huawei.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| ZTE | Sub topic 3-2: we agree with proposal 1.  For proposal 2, there were no agreements in RAN4 so far, it should be discussed in RAN4 first. In our view, if the configurations are removed, then companies may not know whether their configurations are completed or not, and it is hard to trace the configurations. In addition, we think in RAN4 discussion, inter-band NR CA and inter-band ENDC are the same approach and should be discussed together.  For proposal 3. SDL band cannot work alone, it should work together with other normal band. In our view, SDL band +normal band is inter-band scenario, not single band scenario, so it cannot be treated as single carrier requirement. |
| OPPO | Sub-topic 3-1 LS reply on 4 Rx UE  Same view as HW/vivo. |
| DISH | Sub-topic 3-2, P3 is not ok. SDL REFSENS should not be defined alone |
| Huawei | Sub-topic 3-2:  To ZTE:  For IMD exception, we can use the band combination just like UE coexistence table. If possible, we are ok to use this method for both NR CA and ENDC.  To ZTE and Dish:  It doesn’t mean SDL band will be tested in single band scenario. SDL band combination will still be tested under the NR CA scenario. I suppose RAN5 has the same understanding. For SDL, as we said in this contribution, RAN4 doesn’t need to list SDL band REFSENS again and again such as band n75A for CA\_n8A-n75A, CA\_n20A-n75A, CA\_n28A-n75A and CA\_n75A-n78A. We just change the architecture of spec instead of the requirements.  To QC:  You can refer to R4-2001072 which we provided in RAN4#94. Seems we didn’t receive any comments from QC in that meeting. |
| Qualcomm | Sub topic 3-1: UE should declare the specific 2RX of the 4RX ports to be tested, not any 2RX. Where is the draft CR from VIVO? [Moderator: It is attached after the LS text in R4-2011235.]  Sub topic 3-2: Can you provide an examples of how this is simplified. The only simplification that I can see is consolidate DC\_1A\_n77A, DC\_1A\_n77(2A) into DC\_1\_n77. UL configuration list in 3 band scenarios is critical. You still need to list the bands of the configuration in a separate column, so all it does is save the number of rows in the table. So again, maybe provide example tables of the simplification in the next meeting. |
| vivo | Sub-topic 3-1 LS reply on 4 Rx UE  Considering REFSENS is the exception, separated statement of REFSENS and other Rx requirements is beneficial to reflect the status clearly, which is also easily linked to the requirements applicability. Draft reply LS in R4-2011235 is suggested as the basis for next step.  In addition, the draft CR in R4-2011235 is essential to reflect the 4Rx applicability. |

### CRs/TPs comments collection

## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic#3-1** | Recommendations for 2nd round:  LS draft by vivo is revised considering the comment by Qualcomm.  CR draft (attached in R4-2011235) is further reviewed. |
| **Sub-topic#3-2** | Recommendations for 2nd round:  There are different views how REFSENS requirement can be structured.  Moderator encourage the proponent to address the concerns by Qualcomm and Dish.   * WF is assigned. * LS can be assigned if WF is agreeable. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | Reply LS on RF testing of 4Rx capable UE | vivo |
| #2 | CR to 38.101-1: Correction of applicability of 2Rx requirements | vivo |
| #3 | WF on structure of NR CA reference sensitivity requirements in 38.101-1 | Huawei |
| #4 (only if WF is agreeable) | Reply LS on structure of NR CA reference sensitivity requirements in 38.101-1 | Huawei |

### CRs/TPs

## Discussion on 2nd round (if applicable)

Here’s to collect the second-round comments.

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| **tdoc** | **Comments** |
| R4-2011751 Reply LS on RF testing of 4Rx capable UE | Qualcomm: I am ok with the latest revision of the LS. |
| R4-2011752 CR to 38.101-1: Correction of applicability of 2Rx requirements | Qualcomm: Wording of CR is a bit confusing. The way I understand it is as follows:   * + - 1. If UE is equipped is not equipped with 4RX ports, then all RX requirements are measured with 2RX ports.       2. If the UE is equipped with 4RX ports then for REFSENS, requirements are measured with 2RX (declared by UE) and 4RX, and all other requirements are measured with 4RX.   I noticed the declared part is not in the CR. I spent an hour trying to understand the CR, but I’m ok if others have no objections. |
|  | Qualcomm: I am ok with the WF.  Perhaps for IMD, we can clean up the tables in a notation such as consolidating DC\_1A\_n77A, DC\_1A\_n77(2A) into DC\_1\_n77, like the coexistence tables. |
| R4-2011755 Reply LS on structure of NR CA reference sensitivity requirements in 38.101-1 |  |

## 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”* |