**3GPP TSG-RAN WG4 Meeting #94-e R4-200xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item: 6.5**

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for RAN4#94e\_#4\_NR\_NewRAT\_UE\_RF

**Document for:** Information

# Introduction

Agenda 6.5 is Rel-15 NR maintenance agenda. Most of the papers are alone with their topic and so being they are CRs. The treatment of the paper is to collect technical concerns on the proposed changes. Two topics seem to have more papers: FR1 UL MIMO PC2 where there are numerous open items in section 3.1.1 and in FR2 new requirements coming from World Radio Conference 2019 and open items are discussed in section 4.1.1.

This paper contains in addition to the 1st round comments and summary, also 2nd round comments and summary.

# Topic #1: Editorial Corrections in to 38.101-1/-2/-3

## Editorial corrections on 38.101-1 Agenda 6.5.1.1

### Sub-topic #1.1.1: UL MIMO PC2 MPR reference

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000119](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000119.zip) | CR to 38.101-1 UL MIMO MPR reference table | vivo | 38.101-1 | Refer to clause 6.2.2 instead of Table 6.2.2-1 to cover MPR for all power classes |

### Sub-topic #1.1.2: Moving notes about 90 % spectral utilization

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000594](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000594.zip) | CR for TS38.101-1, Remove notes for UE channel bandwidth | CATT | 38.101-1 | Moves notes “90% spectrum utilization may not be achieved” from one table to an other |

### Sub-topic #1.1.3: maxUplinkDutyCycle

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000596](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000596.zip) | CR for TS38.101-1, Correction of IE RF-Parameters name of maxUplinkDutyCycle | CATT | 38.101-1 | Changes maxUplinkDutyCycle  to  maxUplinkDutyCycle-PC2-FR1  + some editorial corrections |

### Sub-topic #1.1.4: CBW Channel Bandwidth, which approach to choose?

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000743](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000743.zip) | CR for TS 38.101-1: Editorial addition of CBW definition in Abbreviations section | MediaTek Inc. | 38.101-1 | Adds CBW Channel Bandwidth into definitions |
| [R4-2000491](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000491.zip) | CR to TS 38.101-1: Replace CBW with symbols defined in the specification. | ZTE Corporation | 38.101-1 | Replaces CBW with BW\_Channel  From Agenda 6.5.3 |

### Sub-topic #1.1.5: offsetmax,IMD3

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2002148](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002148.zip) | Removal of unnecessary definition of offsetmax,IMD3 from Table 6.2.3.2-1 | Motorola Mobility España SA | 38.101-1 | Removes offsetmax,IMD3 and defines offsetmax,IMD3 as BWChannel – 6 MHz. |

## Summary of Editorial corrections on 38.101-1 Agenda 6.5.1.1

### Companies views and open issues for Editorial corrections on 38.101-1

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| **Sub-topic** | **Company views** |
| 1.1.1: UL MIMO PC2 MPR reference | [ZTE].CR cover version is wrong. It should be v12.0, not v11.2. In addition, for ‘ other specs affected, the affected specs shall be added in the blank.  Huawei: It seems that the proposed change is not based on the latest spec and the referred clause is not correct.  Ericsson: not editorial, the applicability of MPR for different power classes needs to be explicitly specified for 23 + 23 dBm UEs, CR not agreed (see e.g. R4-2001316)  Qualcomm: Instead of referencing the sub-clause, it would be more accurate to reference the actual table. There are only two of them so it’s not too verbose.  vivo:  to ZTE: thank you, I will revise cover sheet of my CR  to Huawei: the comment has been solved by offline discussion.  to Ericsson: in R4-2001316 “*Table 6.2.2-1 and Table 6.2.2-2 for the respective power class for both single-layer and dual layer transmission.*” , as we all can see, there is ambiguity about “***respective power class***” of UL MIMO in R15. We need more discussion under MIMO power class clarification agenda about “UE is supposed to meet the requirements of which PC when configured with single port or dual port transmission?” And should it be single/dual port instead of layer?  I used to consider this CR as extreme simple. The intension was that original text only includes table 6.2.2-1 which is PC3, and table 6.2.2-2 for PC2 is missing. So we can either change it to “*Table 6.2.2-1 and Table 6.2.2-2”* or just simply refer to the whole section 6.2.2 i.e. “clause 6.2.2” as proposed in the CR.  And I agree with your suggestion that “*the applicability of MPR for different power classes needs to be explicitly specified for 23 + 23 dBm UEs*”. Once we finish the discussion on the MIMO power class clarification, we will have a clear common understanding. Can we leave the ambiguity discussion to MIMO power class clarification agenda?  To Qualcomm: we are fine to revise as “*Table 6.2.2-1 and Table 6.2.2-2*”. But as you can see, there is already proposal to add a new “table 6.2.2-3 MPR for PC2 2Tx” in [R4-2002037](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002037.zip). My point is that we may have more tables in the future. It is a bit ugly to be “*Table 6.2.2-1 and Table 6.2.2-2 and Table 6.2.2-3…*” Certainly, we don’t have third table yet, and I don’t have strong view on this. We are fine with either way. |
| 1.1.2: Moving notes about 90 % spectral utilization | Ericsson: are these (informative) notes needed?  NTT DOCOMO, INC.: For Table 5.3.2-1, it is better to have less number of NOTEs, as far as we put them into each of the relevant cells. Thus, better to have one SCS agnostic NOTE such as ”90% spectrum utilization may not be achieved”.  **R&S:** In principle we are ok to move the note to table 5.3.2-1. Regarding the wording we have similar view as NTT DOCOMO......+.  Qualcomm: These notes about spectrum utilization do not serve any testable requirement hence they are not needed. We would prefer to remove those and that would end this this debate too. |
| 1.1.3: maxUplinkDutyCycle |  |
| 1.1.4: CBW Channel Bandwidth, which approach to choose? | [ZTE]. Our CR([R4-2000491](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000491.zip)) is re-submission of the CR of R4-1915486, which have already been agreed in #93 meeting. The reason for the re-submission is that both R4-1915486 (Cat F for Rel-15) and [R4-1913604](D:/Program%20Files%20(x86)/zMail/app/zMail/WebContent/pcWeb/Scripts/MailControls/ReadPanelIframe/javascript:void(0);) (Cat A for rel-16) were missed to be reflected in the latest spec. According to the RAN4 secretary’s instruction, it shall be re-submitted based on the latest spec.  Since ZTE’s CR have been agreed in the last meeting, where the ‘CBW’ in the text were all replaced with symbols defined in the specification such as BWchannel or . So it is no need for MTK’s CR([R4-2000743](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000743.zip)).  [MTK] Since ZTE’s CR has been agreed. Our CR can be noted. And the CAT CR can be withdrawn. |
| 1.1.5: offsetmax,IMD3 |  |

### Summary of discussion in the first round on editorial corrections on 38.101-1 Agenda 6.5.1.1

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| **Sub-topic** | **Summary** |
| 1.1.1: UL MIMO PC2 MPR reference | CR needs editorial revision for the cover page at least spec version to me seems correct. For the content, it seems Ericsson wants to see broader correction once UL MIMO issues are settled, ref new tables proposed.  Proposed WF is to postpone this CR [R4-2000119](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000119.zip) and wait until other UL MIMO issues are settled. Maybe this change can be included in the bigger CR if consensus is reached. |
| 1.1.2: Moving notes about 90 % spectral utilization | Concerns and alternative approaches proposed: remove or merge notes. Proposal for 2nd round is to revise this CR[R4-2000594](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000594.zip). |
| 1.1.3: maxUplinkDutyCycle | No concerns expressed.  Proposed WF is to agree the CR [R4-2000596](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000596.zip). |
| 1.1.4: CBW Channel Bandwidth, which approach to choose? | Proposed WF is to agree ZTE CR [R4-2000491](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000491.zip) |
| 1.1.5: offsetmax,IMD3 | Proposed WF is to agree this CR [R4-2002148](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002148.zip). |

### Companies views on 2nd round for Editorial corrections on 38.101-1

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| **Sub-topic** | **Companies views** |
| 1.1.2: Moving notes about 90 % spectral utilization, CR revision R4-2002719 from CATT |  |

## Editorial corrections 38.101-2 Agenda 6.5.1.2

### Sub topic #1.3.1: all UL CCs in MPR

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000397](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000397.zip) | CR to 38.101-2 (Rel-15) MPR for CA | Intel Corporation | 38.101-2 | “and all UL CCs use the same SCS” moved from single CC allocation clause to more general section for determining inner outer allocation.  CAT F CR! Should be treated 6.5.7 |

### Sub topic #1.3.2: Section modification for intra-contiguous and non-contiguous

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000695](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000695.zip) | CR to 38.101-2: Align Rx CA requirements structure with TS38.101-1 | Qualcomm Incorporated | 38.101-2 | Creating sections structure to accommodate intra-contiguous and non-contiguous RX requirements in separate sections |

### Sub topic #1.3.3: CABW and CBW, Align with sub-topic #1.1.4?

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000745](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000745.zip) | CR for TS 38.101-2: Editorial addition of CBW and CABW definitions in Abbreviations section | MediaTek Inc. | 38.101-2 | CABW =Cumulative Aggregated Channel Bandwidth  CBW=Channel Bandwidth  Added to definitions  Align with sub-topic #1.1.4 for FR1 treatment |

### Sub topic #1.3.4: TDD Slot in mod(i, 10) from 10 to 5

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000912](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000912.zip) | CR to TS 38.101-2 Correction on FRC table for FR2 DL 64QAM(R15) | China Telecom | 38.101-2 | Change the number of TDD Slot in mod(i, 10) from 10 to 5 in A.3.3.4 FRC for receiver requirements for 64QAM  cat F, should be treated in 6.5.8 |

## Summary of editorial corrections on 38.101-2 Agenda 6.5.1.2

### Company views and open issues for 38.101-2

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| **Sub-topic** | **Company views** |
| 1.3.1: all UL CCs in MPR | Qualcomm: “Propose” should be “purpose”. Ok to agree with a correction. |
| 1.3.2: Section modification for intra-contiguous and non-contiguous |  |
| 1.3.3: CABW and CBW. Align with sub-topic #1.1.4? | [ZTE]. it shall be aligned with topic #1.1.4. we can replace the CBW in the text with symbols in 101-2 in next meeting, like 101-1 did.  [MTK] We are fine with ZTE’s proposal. Can ZTE take care of CABW as well in next meeting? If so, our CR can be noted and the CAT A CR can be withdrawn in this meeting. Thanks. |
| 1.3.4: TDD Slot in mod(i, 10) from 10 to 5 | Ericsson: OK (this is not an editorial correction). |

### Summary of open issues for 38.101-2 editorial corrections

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| **Sub-topic** | **Summary** |
| 1.3.1: all UL CCs in MPR | Proposed 2nd round is to revise the CR [R4-2000397](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000397.zip) to correct the typo and agree on 2nd round. |
| 1.3.2: Section modification for intra-contiguous and non-contiguous | Proposed 2nd round is to agree the CR [R4-2000695](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000695.zip). |
| 1.3.3: CABW and CBW. Align with sub-topic #1.1.4? | Proposed 2nd round is to revise the CR [R4-2000745](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000745.zip) to align with 38101-1 change in [R4-2000491](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000491.zip) and agree in 2nd round |
| 1.3.4: TDD Slot in mod(i, 10) from 10 to 5 | Proposal for 2nd round is to agree [R4-2000912](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000912.zip) |

### Company views and open issues on 2nd round for 38.101-2 editorial corrections

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| **Sub-topic** | **Companies views** |
| 1.3.1: all UL CCs in MPR, CR R4-2002720 revision from Intel |  |
| 1.3.3: CABW and CBW. CR R4-2002721 revision from Mediatek |  |

## Editorial corrections 38.101-3 Agenda 6.5.1.3

### Sub-topic #1.5.1: PCMAX\_L,f,c,NR

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000453](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000453.zip) | CR to TS 38.101-3: editorial corrections on Rx requirements for intra-band contiguous EN-DC | Xiaomi | 38.101-3 | PCMAX\_L,f,c is replaced by PCMAX\_L,f,c,NR  PCMAX\_L is replaced by PCMAX\_L\_E-TURA,c |

### Sub topic #1.5.2: maxUplinkDutyCycle

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000598](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000598.zip) | CR for TS38.101-3, Correction of IE RF-Parameters name of maxUplinkDutyCycle | CATT | 38.101-3 | Changes maxUplinkDutyCycle to maxUplinkDutyCycle-PC2-FR1  And numerous combinations are reorganised in Table 6.2B.1.3-1 |

### Sub topic #1.5.3: Output power dynamics with/without dual PA

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000892](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000892.zip) | CR to TS 38.101-3: editorial correction for output power dynamics for intra-band EN-DC | CHTTL | 38.101-3 | Clarification on sentence for Output power dynamics for intra-band EN-DC with/without dual PA capability |

### Sub topic #1.5.4: EN-DC table corrections

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2002098](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002098.zip) | EN-DC configuration table corrections | Nokia | 38.101-3 | EN-DC configuration grouping is further fixed for DC\_19-42\_n77, DC\_19-42\_n78, DC\_19-42\_n79 and DC\_66\_n257.  The empty rows are removed. |

## Summary of Editorial corrections 38.101-3 Agenda 6.5.1.3

### Company views and Open issues for Editorial corrections 38.101-3 Agenda 6.5.1.3

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| **Sub-topic** | **Company views** |
| 1.5.1: PCMAX\_L,f,c,NR | Sprint: If we are going to fix this, should we fix all of the inconsistencies with variants of PCMAX\_L,f,c,NR while we’re at it.  From 6.2B.4.1.2  pCMAX L,f,c,,NR c(q)  pCMAX L \_ NR,c(q)  PCMAX\_L,f,c,,NR (q)  pCMAX L,f,c,,NR c(q)  pCMAX L \_ NR,c(q) |
| 1.5.2: maxUplinkDutyCycle | CMCC: For the IE RF-Parameters name of maxUplinkDutyCycle in TS38.101-3, Capability name of maxUplinkDutyCycle-PC2-FR1 is not aligned with TS38.331/306. RAN2 is deciding how to define the name, we need to wait for RAN2 conclusion. We suggest to postpone this CR([R4-2000598](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000598.zip)), otherwise RAN4 need to change it again as RAN2 has its conclusion. |
| 1.5.3: Output power dynamics with/without dual PA |  |
| 1.5.4: EN-DC table corrections | Huawei: there are also some configuration error in the 2 band combination table, could you revise it together with 3bands?   |  |  |  | | --- | --- | --- | | DC\_38A\_n78A7 | N/A | No |   Where UL configuration shall not be “N/A”  NOKIA: The revision of R4-2002098 is provided in the draft folder. The same error for DC\_40A\_n77A is also fixed. |

### Summary for Editorial corrections 38.101-3 Agenda 6.5.1.3

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| **Sub-topic** | **Summary** |
| 1.5.1: PCMAX\_L,f,c,NR | Proposed WF is to revise the CR [R4-2000453](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000453.zip) according to the comments |
| 1.5.2: maxUplinkDutyCycle | Proposed WF is to agree the CR [R4-2000598](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000598.zip) |
| 1.5.3: Output power dynamics with/without dual PA | Proposed WF is to agree the CR [R4-2000892](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000892.zip) |
| 1.5.4: EN-DC table corrections | Proposed WF is to revise the CR [R4-2002098](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002098.zip) and agree the CR in the 2nd round. Revision is in  <ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/revision%20of%20R4-2002098%20Table%20simplification%20and%20correction%20CR%2038101-3-f80.docx> |

### Company views and Open issues for 2nd round for Editorial corrections 38.101-3 Agenda 6.5.1.3

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| **Sub-topic** | **Companies views** |
| 1.5.1: PCMAX\_L,f,c,NR, revised CR **R4-2002722** from Xiaomi | Xiaomi: we have shared the revision by FTP (Revision of R4-2000453), and Sprint is ok for the version during offline discussion. The following version is only to add Tdoc number on top of previous revision.  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/draft%202002722%20CR%20for%2038.101-3%20Rel15%20corrections%20on%20Rx%20requirements%20for%20intra-band%20contiguous%20EN-DC%20.docx> |
| 1.5.4: EN-DC table corrections, revised CR **R4-2002723** from Nokia |  |
| 1.5.2: maxUplinkDutyCycle | CMCC: For the IE RF-Parameters name of maxUplinkDutyCycle in TS38.101-3, Capability name of maxUplinkDutyCycle-PC2-FR1 is not aligned with TS38.331/306. RAN2 is deciding how to define the name, we need to wait for RAN2 conclusion. We suggest to postpone this CR([R4-2000598](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000598.zip)), otherwise RAN4 need to change it again as RAN2 has its conclusion. |

# Topic #2: Band combination maintenance

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

## Maintenance for bands and band combinations for 38.101-1 Agenda 6.5.2.1

### Sub topic #2.1.1: A-MPR and spurious emission changes for NS\_04

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000413](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000413.zip) | CR for 38.101-1: n41 and n25 corrections | Sprint Corporation | 38.101-1 | Note “The A-MPR' values in this table apply for both A-MPR relative to 23 dBm for power class 3 and A-MPR relative to 26 dBm for power class 2”  Removed and  “NOTE 4:   Does not apply for Band n41, CA configurations including Band n41, and EN-DC configurations that include n41 specified in subclause 5.2B of TS 38.101-3 [3] when NS\_04 is signalled.”  added (Different tables) |

### Sub topic #2.1.2: NR CA bandwidth class B and F changes

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000525](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000525.zip) | Correction of NR CA bandwidth classe B and F | Nokia, Nokia Shanghai Bell | 38.101-1 | Class F removed and applicability for B lower limit changed from 220 to 20 MHz |

### Sub topic #2.1.3: CA fallback group 1

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001069](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001069.zip) | CR for 38.101-1: removing the fallback group for NR CA configuration (Rel-15) | Huawei, HiSilicon | 38.101-1 | “for fallback group 1” was removed in table 5.5A.1-1. |

### Sub topic #2.1.4: Modified MPR behavior

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001308](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001308.zip) | Introduction of the Annex modifiedMPR-Behaviour into the NR SA specification | Ericsson | 38.101-1 | Introduces modified MPR behaviour in to 38.101-1 as annex G |

## Summary of Maintenance for bands and band combinations for 38.101-1 Agenda 6.5.2.1

### Discussions issues for 38.101-1 maintenance

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| **Sub-topic** | **Company views** |
| 2.1.1: A-MPR and spurious emission changes for NS\_04 |  |
| 2.1.2: NR CA bandwidth class B and F changes | Huawei: Removing CA bandwidth class F has backward compatibility issue, the agreed changes in last meeting needs to be revisited. |
| 2.1.3: CA fallback group 1 |  |
| 2.1.4: Modified MPR behaviour | Huawei: there shall be a CR  NTT DOCOMO, INC.: We propose for each of 38.101-1/2/3 to have this Annex and broaden the meaning of this modifiedMPR.  [Reasons] Although we understand that the modifiedMPRbehavior is a field of the NR band capability in the supported NR band list that is part of the UE-NR-Capability IE, the MPR or A-MPR listed in the current 38.101-3 is captured in 38.101-3. Thus, in reality it is easier for readers to have this Annex in 38.101-3. On the other hand, we would have MPR or A-MPR change in the future purely related with 38.101-1 and 38.101-2 so that each of the 38.101 series should have this Annex. Finally, we also propose to broaden the meaning of this feature as proposed in R4-2000220, R4-2000221, R4-2000223 and R4-2000225  Qualcomm: Should be Annex H, not G. At the time when this was discussed, the modifiedMPR was decided to be included in -3 or SA spec. |

### Summary of discussions in 1st round for 38.101-1 maintenance

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| **Sub-topic** | **Summary** |
| 2.1.1: A-MPR and spurious emission changes for NS\_04 | Proposal to the 2nd round is agree CR [R4-2000413](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000413.zip) |
| 2.1.2: NR CA bandwidth class B and F changes | Huawei has concerns on agreement from previous meeting but no proposals how to correct them. Proposal is to continue discussions in 2nd round and if no more details on issues are provide, agreed CR [R4-2000525](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000525.zip) after 2nd round. |
| 2.1.3: CA fallback group 1 | Proposal to the 2nd round is to agree CR [R4-2001069](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001069.zip) |
| 2.1.4: Modified MPR behaviour | There are alternate proposals and CR in topic #5. Proposed WF is to merge this CR [R4-2001308](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001308.zip). |

### Companies views for 2nd round for 38.101-1 maintenance

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| **Sub-topic** | **Companies views** |
| 2.1.2: NR CA bandwidth class B and F changes, CR R4-2000525 | Sprint: We see no backward compatibility issue with eliminating Bandwidth Class F since no UEs with class F exist, and changing the max BW for B from 50 to 100 MHz is covered by the BCS as was discussed via e-mail. However, as Ericsson pointe out the correct to class B and the elimination of class F are covered in R4-2002575 so this CR is not needed and can be merged with R4-2002575. |
| 2.1.4: Modified MPR behaviour, CR R4-2001308 and R4-2001314 still in discussion, (38.101-3 CR from sub topic #2.5.4 still in discussion) |  |

### Summary of discussions in 2nd round for 38.101-1 maintenance

## Maintenance for bands and band combinations for 38.101-2 Agenda 6.5.2.2

### Sub topic #2.3.1: Intra-contig and non-contig CA Table re-arrangement and correction

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| --- | --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000521](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000521.zip) | CR FR2 CA tables REL15 | Nokia, Nokia Shanghai Bell | 38.101-2 | Table 5.5A.2-1 and -2 changed format from listing individual CH BWs to refer to configuration |
| [R4-2000559](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000559.zip) | CR to TS 38.101-2 on corrections to intra-band contiguous CA for FR2 bands (Rel-15) | ZTE Corporation |  | Adds 50 MHz CH BWs to many configurations |

### Sub topic #2.3.2: removal of fallback clause for CA and DC

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001310](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001310.zip) | Removal of contradicting fall-back specification for intra-band non-contigous CA/DC | Ericsson | 38.101-2 | Removes:” A terminal which supports CA or DC configurations, which include FR2 intra-band CA combinations with multiple subblocks, where at least one of the subblocks consists of a contiguous CA combination, is not required to support all possible fallback combinations but can directly fall back to a single FR2 carrier. Deactivating carriers within the CA or DC combination is still possible.”  Cover pages talks about adding this to 38.306. |

## Summary for Maintenance for bands and band combinations for 38.101-2 Agenda 6.5.2.2

### Company views and open issues for 38.101-2 band and combo maintenance

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| **Sub-topic** | **Company views** |
| 2.3.1: Intra-contig and non-contig CA Table re-arrangement and correction | Xiaomi: Thanks Nokia for the paper R4-2000521. We support this new good table format, but why so many sub blocks (14) are list in the table? Can we use 8 sub blocks in the table? In addition, one editorial correction "class A" is missing in the second revised table.  Huawei: For [R4-2000559](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000559.zip), there is no need to add 50MHz CBW to the band combination if there is no 50MHz component in the current version.  NTT DOCOMO, INC.: For R4-2000521, the proposal itself is understandable but do we need to capture columns for sub-blocks?  [ZTE]. There is note saying ‘Unless otherwise stated, BCS0 is referred in each constituent CA configuration’. How about different BCS for each sub-block in each constituent CA configuration in future?  In addition, can we use ‘sub-block configuration’ name in the table, because bandwidth class is added after the band for each sub-block. |
| 2.3.2: removal of fallback clause for CA and DC | [ZTE]. Some CA and DC configurations were added in the spec based on the approach of this sentence. If this sentention removed and add to TS38.306, then people may confuse with 101 spec if they don’t check the 38.306 spec.  Huawei: this topic is under discussion in RAN2, we would like to wait for RAN2’s decision before RAN4 make any revision.  Apple: We expect RAN2 to act on the RAN4 LS which was sent in August [R4-1910239]. |

### Summary of 1st round of discussions 38.101-2 band and combo maintenance

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| **Sub-topic** | **Summary** |
| 2.3.1: Intra-contig and non-contig CA Table re-arrangement and correction | Seems to need more discussions.  Proposal for 2nd round is to continue discussion and see if issues can be clarified. Important for 2nr round is to identify if CR is acceptable way since R4-2000521 proposes new table format and CR R4-2000559 corrects the old one.  Revision proposal for R4-2000521.  [REV R4-2000521 FR2 CA table corrections REL15.docx](ftp://ftp.3gpp.com/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/REV%20R4-2000521%20FR2%20CA%20table%20corrections%20REL15.docx) |
| 2.3.2: removal of fallback clause for CA and DC | Companies seem to want to wait RAN2.  Proposed WF is to postpone this CR R4-2001310. |

### Company views 2nd round of discussions 38.101-2 band and combo maintenance

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| **Sub-topic** | **Companies views** |
| 2.3.1: Intra-contig and non-contig CA Table re-arrangement and correction, CR’s R4-2000521 and R4-2000559 still in discussion | [ZTE] For R4-2000559, to Huawei. The uniform table format should be used for intra-band contiguous CA configurations. The requirements of 50MHz CBW to the band combination have been discussed in last Reno meeting. For some band combination, such as band n257G, the maximum aggregated BW is 200MHz but only 100MHz is included in current spec. However, the aggregated BW is 100MHz<BWChannel\_CA≤200MHz for class G, and 150MHz BWChannel\_CA will be excluded if only 100MHz channel bandwidth is listed. Some operators think it is a bug in the current spec and need to be corrected. Therefore, companies agreed that 50MHz BW should also be added for some CA configurations in last Reno meeting.  To Qualcomm, for the issue of re-arrangement of configurations for contiguous and non-contiguous CA using the uniform format, we don’t think it is necessary. As stated in R4-2000521, the concept of sub-block is introduced for non-contiguous CA. However, it doesn’t apply to contiguous CA. The contiguous CA is different from non-contiguous CA. For contiguous CA, the CBW for each carrier shall be used, and no concept of sub-block is required. |

## Maintenance for bands and band combinations for 38.101-3 Agenda 6.5.2.3

### Sub topic #2.5.1: Intra-EN-DC (n)41 power tolerance

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000410](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000410.zip) | CR for 38.101-3: Correction of MOP tolerance for B41/n41 EN-DC | Sprint Corporation | 38.101-3 | Intra EN-DC n41 power tolerance relaxed from +2/-2 to +2/-3. |

### Sub topic #2.5.2: Adding new BCS’s for intra EN-DC

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000854](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000854.zip) | CR to introduce new BCS of intra-band continuous EN-DC for TS 38.101-3(Rel-15) | KDDI Corporation | 38.101-3 | Adds new BCS’s DC\_(n)41AA and (n)41CA. |

### Sub topic #2.5.3: removal of fallback clause for CA and DC

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001312](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001312.zip) | Removal of contradicting fall-back specification for intra-band non-contigous CA/DC | Ericsson | 38.101-3 | Removes:” A terminal which supports CA or DC configurations, which include FR2 intra-band CA combinations with multiple subblocks, where at least one of the subblocks consists of a contiguous CA combination, is not required to support all possible fallback combinations but can directly fall back to a single FR2 carrier. Deactivating carriers within the CA or DC combination is still possible.”  Cover page mentions conflict with 38.306 |

### Sub topic #2.5.4: removal of annex H

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001314](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001314.zip) | Removal of the Annex modifiedMPR-Behaviour from the NSA specification | Ericsson | 38.101-3 | Removal of the Annex modifiedMPR-Behaviour Annex H |

### Sub topic #2.5.5: CA\_n78-n79 with simultaneous TX/RX

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2002118](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002118.zip) | CR for [agreed] asynchronous operation for NR CA n78-n79 | NTT DOCOMO INC. | 38.101-3 | Adds delta TA and MSD for CA 78+79  Adds also a note:  NOTE 2: The requirements only apply for UEs supporting inter-band carrier aggregation with simultaneous Rx/Tx capability. The requirement does not apply for UEs supporting band n77 with a combined n77 and n78 filter.  CR has two sets on change marks |

### Sub topic #2.5.6: Missing n78 and updates on MSD testpoints

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [**R4-2001518**](ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001518.zip) | Editorial corrections |  | 38.101-3 | Add missing "n78" reference in DC\_20A\_n78A in Table 7.3B.2.3.5.1-1  Correct CA -> DC for 28A\_n77A and 28A\_n78A in Table 7.3B.2.3.5.1-1  Remove DC\_12\_n5 from DC\_12\_n66 entry in spurious emission table  Correcting test frequencies for DC\_7A-28A\_n78A Table 7.3B.2.3.5.2-1 |

## Summary of Maintenance for bands and band combinations for 38.101-3 Agenda 6.5.2.3

### Company views and Open issues for 38.101-3

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| **Sub-topic** | **Company views** |
| 2.5.1: Intra-EN-DC (n)41 power tolerance |  |
| 2.5.2: Adding new BCS’s for intra EN-DC | KDDI: One subset is missed in current CR which is pointed out by another company. The following BCS2 of DC\_41A\_n41A need to be added to complete this feature. And we have a Cat. A CR (R4-2000857) of Rel-16 for this feature need to be moved to this agenda which has been checked with Chairman.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **DL EN-DC configuration** | **Uplink EN-DC Configuration** | **Channel bandwidth for E-UTRA carrier(MHz)** | **Channel bandwidth for NR carrier(MHz)** | **Channel bandwidth for E-UTRA carrier(MHz)** | **Maximum aggregated bandwidth(MHz)** | **Bandwidth combination set** | | DC\_41A\_n41A | DC\_41A\_n41A | 20 | 10, 20, 30, 40, 50, 60, 80,100 |  | 120 | 2 | |  | 10, 20, 30, 40, 50, 60, 80,100 | 20 | | 10 | 20, 30, 40, 50, 60, 80,100 |  | |  | 20, 30, 40, 50, 60, 80,100 | 10 |   Qualcomm: My understanding is that addition of new BCS’s requires a work item approved at RAN, rather than just adding by CR.  KDDI: We bring this CR directly because there has no basket WI for Rel-15. We have added this requirement in Rel-16 basket WI. Is it correct to bring this CR again in release independent manner after Rel-16 WI approval? |
| 2.5.3: removal of fallback clause for CA and DC | Huawei: this topic is under discussion in RAN2, we would like to wait for RAN2’s decision before RAN4 make any revision.  Apple: We expect RAN2 to act on the RAN4 LS which was sent in August [R4-1910239]. |
| 2.5.4: removal of annex H | Huawei: shall be discussed together with the CR for TS 38.101-1. We think it is correct to define modified MPR in 38.101-1.  NTT DOCOMO, INC.: We have the same comments for this t-doc as those for R4-2001308. |
| 2.5.5: CA\_n78-n79 with simultaneous TX/RX |  |
| 2.5.6: Missing n78 and updates on MSD test points | Apple: Not editorial CR, changing IMD test frequencies in a wrong way: wrongly changing test frequencies for DC\_7A-28A\_n78A Table 7.3B.2.3.5.2-1: Changing band 7 DL Fc to band edge because UL is already on band edge. The IMD locations need to be recalculated for correct values.  Ericsson: Correction of test points have been made in revision which has been agreed with Apple. Agreed version have been uploaded in R4-2002724 to inbox. |

### Summary of 1st round of discussions for bands and band combinations for 38.101-3 Agenda 6.5.2.3

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| --- | --- |
| **Sub-topic** | **Summary** |
| 2.5.1: Intra-EN-DC (n)41 power tolerance | Proposals for 2nd round is agree the CR [R4-2000410](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000410.zip) |
| 2.5.2: Adding new BCS’s for intra EN-DC | New combinations and BCS’s are added only to latest version of the specs.  Proposal for 2nd round is to not pursue the CR [R4-2000854](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000854.zip) |
| 2.5.3: removal of fallback clause for CA and DC | Propose to postpone [R4-2001312](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001312.zip) until RAN2 has settled |
| 2.5.4: removal of annex H | Postpone CR [R4-2001314](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001314.zip) |
| 2.5.5: CA\_n78-n79 with simultaneous TX/RX | Propose to agreed CR [R4-2002118](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002118.zip) |
| 2.5.6: Missing n78 and updates on MSD test points | Proposal for 2nd round is that CR R4-2001518 can be revised to remove test points and then change only the corrections to the configurations or alternatively correct test points.   Ericsson: Correction of test points have been made in revision which has been agreed with Apple. Agreed version have been uploaded in R4-2002724 to inbox. |

### Summary of 2nd round of discussions for bands and band combinations for 38.101-3 Agenda 6.5.2.3

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| **Sub-topic** | **Company views** |
| 2.5.4: removal of annex H | Merged with subtopic #2.1.4, please insert your comments in to sub topic #2.1.4 |
| 2.5.6: Missing n78 and updates on MSD test points, CR R4-2002724 revision |  |

### Summary of 2nd round of discussions for bands and band combinations for 38.101-3 Agenda 6.5.2.3

# Topic #3: FR1 general requirements

## FR1 Transmitter Agenda 6.5.4 and 6.5.3

### Sub-topic #3.1.1: UL MIMO PC2 (Agenda 6.5.4.5 and 6.5.4.1)

#### Discussion papers submitted for Sub-topic #3.1.1: UL MIMO PC2

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000063](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000063.zip) | Clarification of Power Class related features | NTT DOCOMO, INC. |  | Observation 1: Supported power class information is not clear if a UE supports UL MIMO for a certain band.  Observation 2: In LTE, RAN4 does not have Tx diversity related requirements but RAN1/2 have. In NR, RAN1/2 does not have Tx diversity related requirements but RAN4 tries to have.  Observation 3: Due to lack of Tx diversity capability, even more challenging to identify supported features and relevant power classes among normal NR single, Tx diversity and UL MIMO. (e.g., A UE supporting PC2 UL MIMO may achieve normal NR single as PC2 with one single Tx chain or two Tx chains (Tx diversity) and applicable requirements are different based on which implementation is used.  Observation 4: Tx diversity may provide a better system performance while there are no specific capability signalling and requirements for NW to make maximum use of the feature.  Observation 5: Supported power class information of each of the features comprising a certain band combination is not explicitly signalled with the current RAN2 spec.  Proposal:  For Rel15, not to set a power class bundling rules such as if a UE supporting UL MIMO transmits PC2 capability, consider the UE capable of PC2 for that band in normal NR single, UL MIMO as well as Tx diversity mode etc, but rather live with the current ambiguous power class definition.  For Rel16, create a signalling mechanism to explicitly indicate supported power class when power class related features are simultaneously used as shown in Figure 2.2-1if RAN2 is possible to accommodate the request in Rel16 time-frame. |
| [R4-2001229](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001229.zip) | Further on UL MIMO PC2 fallback | OPPO |  | 23+23 and Tx diversity  Observation 1: UEs with 23+23 PA configurations to support 26dBm HPUE is 3GPP compliant.  Observation 2: Allow UE to declare whether PC2 or PC3 can be supported in basic transmission mode decouples the discussion of 23+23 UL MIMO and Tx diversity.  Observation 3: With this change, UE can use 23+23 to support 26dBm in UL MIMO and use 1 PA transmission in basic transmission mode with PC3 in Rel-15.  Observation 4: With this change, Tx diversity is not supported in Rel-15 RAN4 specification.  Proposal 1: It is proposed to agree on “*A UE supporting power class 2 and UL-MIMO configured as specified in clause 6.2D.1 in any NR band, shall meet the requirements 6.2.1 for either power class 2 or power class 3.*”  Proposal 2: Inform RAN5 that UE Tx diversity is not supported in RAN4 Rel-15 specification.  Tx emissions and SEM requirements  Observation 5: Evaluating UE with one antenna is 3dB less than regulatory.  Observation 6: MPR need to be revisited if SEM and Tx emission requirements are changed from one antenna to two antennas.  Proposal 3: MPR, SEM and Tx emissions are revisited together due to change requirements from one antenna to two antennas.  Observation 7: It has never been guaranteed that the 3GPP requirements are always consistent with regulatory requirements all over the world.  Observation 8: UE passes 3GPP tests does not necessarily mean it will pass the regulatory tests.  Observation 9: Regulation requirements can be guaranteed by regulatory certification themselves.  Observation 10: The impact to UE development and certification caused by changing Rel-15 requirements can be eased by “specification effective transient period”, i.e. new requirements will not be tested in RAN5 conformance spec for several months.  Observation 11: Re-visiting MPR, SEM and Tx emission may need several meetings which makes Rel-15 specs unstable.  Proposal 4: Change MPR, SEM and Tx emissions in Rel-16 and keep Rel-15 unchanged considering the time limitations. |
| [R4-2002037](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002037.zip) | On UL MIMO requirements | Huawei, HiSilicon |  | Proposal: It is proposed to define the MPR requirements for PC2 UE supporting 2Tx transmission in Table 4*.* |
| [R4-2002038](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002038.zip) | On EN-DC power class | Huawei, HiSilicon |  | Proposal: It is proposed to introduce an explicit signaling for the power class for NR side in MR-DC mode in Rel-16. |
| [R4-2000356](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000356.zip) | Correction on UL MIMO Emission requirements and alignment with RAN1 terminology | Qualcomm Incorporated |  | Observation 1: If UE supports UL MIMO, it still has to meet general requirements.  Observation 2: Usage of language “UE supporting UL MIMO” or “UE with two transmit connectors” to refer UE requirements is confusing  And to clarify the text, we made one proposal  Proposal 1: Change language in Ran4 requirement specifications from “UE supporting UL MIMO” and “UE with two transmit connectors” when referring to UL MIMO requirements to “UE configured for UL MIMO”  To understand better UL MIMO requirements, we made the following observations  Observation 3: UE output power is summed for UL MIMO  Observation 4: UE emission requirements are defined per connector  Then we looked back and found out what assumptions were made when the discrepancy between observation 3 and 4 was initially agreed and made the following observation:  Observation 5: The current specification for UL MIMO was assuming that each PA power is backed off by 3 dB from their maximum power  Observation 6: Assumptions for implementation have changed since the LTE specification for UL MIMO was created and therefore NR specification should be written in a different way  To correct the specification to reflect new assumptions, we made one proposal:  Proposal 2: Update the UL MIMO emission requirements to support implementation where PA’s operate at declared UE power class power level when configured for UL MIMO. |
| [R4-2000795](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000795.zip) | On the condition of antenna configuration for UL-MIMO in FR1 | SoftBank Corp. |  | Observation 1: In LTE, the total amount of unwanted emissions of UE supporting UL-MIMO is the same as that of UE not supporting UL-MMO considering the regulatory recommendation in ITU-R.  Observation 2: The approach of "each transmit antenna connector" can be adopted only when the average transmission power per antenna connector in UL-MIMO transmission is reduced by 3 dB comparing with that of single antenna connector transmission.  Proposal 1: In NR, the total amount of unwanted emissions of UE supporting UL-MIMO shall also be the same as that of UE not supporting UL-MMO like LTE.  Proposal 2: RAN4 confirm whether "each transmit antenna connector" approach can be adopted or not in the current UL-MIMO spec and ongoing functions for UL-MIMO. |

#### CRs submitted

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| **T-doc number** | **Title** | **Company** | **Spec** | **Changes** |
| [R4-2000117](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000117.zip) | CR to 38.101-1 clarification of MIMO power class in R15 | vivo | 38.101-1 |  |
| [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip) | Correction of transmitter characteristics for UL-MIMO: powerclass 2 and fallback | Ericsson | 38.101-1 |  |
| [R4-2000354](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000354.zip) | Correction on UL MIMO Emission requirements and alignment with RAN1 terminology | Qualcomm Incorporated | 38.101-1 |  |

#### LS’s submitted

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| **T-doc number** | **Title** | **Company** | **To** | **Actions** |
| [R4-2000118](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000118.zip) | draft LS on clarification of EN-DC power class in R15 | vivo |  |  |
| [R4-2002141](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002141.zip) | Draft LS on EN-DC power class | Huawei, HiSilicon |  |  |

#### Open issues for Sub-topic #3.1.1: UL MIMO PC2

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| **Issue #** | **Issue** | **Notes** |
| #3.1.1.1 | Power class ambiguity needs change or not | Change is prosed in [R4-2000117](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000117.zip), [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip), [R4-2001229](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001229.zip), [R4-2000118](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000118.zip)  No Change is proposed: [R4-2000063](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000063.zip) |
| #3.1.1.2 | Which mode is the baseline for power class declaration, general (DCI 0\_0) or UL MIMO | Either text from [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip):  For UEs indicating power class 3 in the *ue-PowerClass* field of the *UE-NR-Capability* IE, the UE shall meet the requirements 6.2D.1-1 for either power class 2 or power class 3.  or Text from R4-2000117  If above power class 2 UE is configured for transmission on single-antenna port, it shall meet the requirements for either power class 2 or power class 3 in subclause 6.2.1 |
| #3.1.1.3 | Spec language: “UE supporting UL MIMO” or “UE configured for UL MIMO” | Removal of language “UE supporting UL MIMO” proposed in [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip) and [R4-2000356](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000356.zip). |
| #3.1.1.4 | Emission requirement correction for UL MIMO | Emissions summed: [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip), [R4-2000063](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000063.zip), [R4-2000795](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000795.zip), [R4-2002037](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002037.zip) (Proposal is really for new MPR table but that assumes new emission reqs).  Emissions changed in Rel-16: [R4-2001229](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001229.zip) |
| #3.1.1.5 | Power class signalling for Rel-16 | Proposed to add NR PC signalling when UE is in EN-DC [R4-2002038](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002038.zip). |
| #3.1.1.6 | Need for new MPR requirements | If decision is to do a change in emission requirements, need for new MPR needs to be discussed. Proposed to add 2Tx MPR in: [R4-2002037](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2002037.zip), [R4-2001229](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001229.zip) |

#### Company views for Sub-topic #3.1.1: UL MIMO PC2

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| **Issue #** | **Issue** | **Companies views** |
| #3.1.1.1 | Power class ambiguity needs change or not | vivo: yes, change is needed for R15. Because current specs says “*If UE is configured for transmission on single-antenna port, the requirements in subclause 6.2.1 apply.*” (last sentence of 38.101-1 6.2D.1). And RAN4 has agreed that there will be no TxD in R15. So we need to change this sentence to implement “*not to set a power class bundling rules such as if a UE supporting UL MIMO transmits PC2 capability, consider the UE capable of PC2 for that band in normal NR single…*” which is also proposed in R4-2000063.  vivo: yes, change is needed for R15.  OPPO: Yes, actually the changes proposed in this meeting are keeping the ambiguity, e.g. UE report PC2 in UL MIMO will apply either PC2 or PC3 based on UE declaration in single antenna port.  Huawei: OK with the proposed changes for single antenna port by vivo or OPPO and fine to send an LS to RAN5. In our understanding, what proposed by DOCOMO is to live with the status without explicit power class capability in Rel-15 but to introduce new signalling in Rel-16, that is ok for us.  Ericsson: the power-class ambiguity should be addressed. A UE indicating PC2 shall meet PC2 requirements for all types of transmissions (e.g. also single-port transmissions like PUCCH). Exceptions can be allowed for 23 + 23 dBm when this is configured with UL-MIMO. Allowing a declaration of capability can remove ambiguity in conformance testing but not in network signaling (the main problem).  Nokia, Nokia Shanghai Bell: The specification is not broken and therefore it is not critical to change the specification. The reason for requesting to specification change has been to allow relaxation to some UE implementations, which may support 26 dBn only in some cases but not in all cases like specified by the PC2 requirements. As a compromise we can accept that some relaxations for the power class definition is allowed in Rel-15 but Rel-15 relaxation should not cause further uncertainty or relaxations in the Rel-16 specifications. If change is desired by the group, in our view the Ericsson CR in [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip) should be used as basis as it also aims to correct the UE emission requirement for UL MIMO.  CMCC：RAN4 previously had a consensus that PC2 UL-MIMO only supported 23+23dBm in Rel-15 (WF R4-1803259), but considering issues such as PC2 UL-MIMO UE implementation and PC2 UL-MIMO fallback (The transmission power class should keep constant by 2T diversity or single PA implementation), we suggested that PC2 UL-MIMO could support 23+23dBm or 23+26dBm depending on the UE implementation.  Qualcomm: It is not very clearly documented that there is an agreement of PC2 UL MIMO to be realised with two PA’s that are only capable for up to 23 dBm and that this UE is allowed to be declared as PC2 also when configured for single port. There are WF with unclear language. We do not see a necessity of any change. If infra is saying it is necessary for network to know exactly, we will not be against the change but the change should be motivated by need to clarify UE behaviour, not by OEM allowing to implement PC2 device with 23 dBm PA. |
| #3.1.1.2 | Which mode is the baseline for power class declaration, general (DCI 0\_0) or UL MIMO | vivo: UL MIMO power class as in R4-2000117.  There is contradiction in CR [R4-2001316](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001316.zip) as below   * In the first paragraph of section 6.2D.1, a sentence was added as “*For UEs indicating power class 3 in the ue-PowerClass field of the UE-NR-Capability IE, the UE shall meet the requirements 6.2D.1-1 for either power class 2 or power class 3.*” * In the last paragraph of section 6.2D.1, the original sentence was changed to “*For each power class as indicated by the ue-PowerClass field of the UE-NR-Capability IE, the UE shall meet the requirements in 6.2.1 when PUSCH is scheduled for single antenna-port transmission by DCI 0\_0 or by DCI 0\_1 when the UE is configured for single port operation.*”   These two sentences are contradictory to each other i.e. the first one says that PC3 UE shall meet either PC3 or PC2. The second one says that PC3 UE shall meet PC3.  And neither of these two sentences can solve the problem of UL MIMO PC2 UE with 23+23 PAs which can only meet PC3 when configured with one port transmission without TxD as we previously agreed that no TxD requirements in R15. We have a CR in R4-2000117 to solve this problem.  OPPO: The reported UE power class capability fundamentally can either under single antenna port mode or under UL MIMO mode, but we prefer UL MIMO mode. Usually UE has higher power capabilities under UL MIMO comparing to single antenna port mode, it is much straight forward to let UE declare the fall back power capability according to the PAs implemented. This is where this issue coming from.  Huawei: It’s not clear of the proposed changes by Ericsson especially when the requirement is defined for UL MIMO mode.  Ericsson: the text from R4-2001316, we propose changing the baseline for UE power-class indication (the field *ue-PowerClass* per NR band in *UE-NR-Capability*) discussed last meeting such that a UE now only indicates PC2 capability in case it supports PC2 for all transmissions, single port/connector or UL-MIMO. However, for a 23 + 23 dBm UE implementation we allow the first “mode” above when this UE is configured for two-layer transmissions: it indicates PC3 but can comply with PC2 requirements for two-layer transmissions. In fallback (single port) it shall comply with PC3 requirements according to its capability indication. Moreover, this UE that meets PC2 requirements with two-layer transmissions shall also modify the Pcmax for two-layer transmissions such that the PHR becomes correct (thus alleviating the power class ambiguity in the field). The problem with capability indication for EN-DC is eliminated for the 23 + 23 dBm UE since its capability indication is still PC3 (can always be met for all transmissions). In this way the specification accommodates the 23 + 23 dBm implementation without changing the intention of the power-class capability indication.  Nokia, Nokia Shanghai Bell: In our view the text in R4-2001316 should be used as baseline.  CMCC:We prefer to use UL-MIMO as baseline for UE power class declaration, My understanding is that 23+23dBm=PC2 UL-MIMO which has been clearly written in WF (R4-1803259). PC2 UL-MIMO (23+23dBm) UEs will also be important applications in 5G deployment, and such PC2 UL-MIMO UEs could be widely deployed in 5G networks.  Qualcomm: Our view is that DCI 0\_0 is baseline and if UE meets PC2 requirements for when tested from single antenna connector, then power class declaration should be PC2. If UE meets PC3, then it should declare PC3 and for UL MIMO i.e. rank-2 transmissions, it may be able to transmit with sum 26 dBm. |
| #3.1.1.3 | Spec language: “UE supporting UL MIMO” or “UE configured for UL MIMO” | OPPO: It is correct UE need to meet the UL MIMO requirements when UL MIMO is configured, however, RAN4 only defines requirements based on feature itself. And if UE declares it supports certain feature, the requirements will be tested no matter it is configured by NW or not. Therefore, no objecting to “UE configured for UL MIMO” but it would be better to align the wording with other features like CA, etc.  Huawei: As the requirements are defined with corresponding MIMO configuration, the proposed changes may not be necessary. For each requirements, whether a change is needed should be checked case by case.  Nokia, Nokia Shanghai Bell: OK to improve the specification text as proposed |
| #3.1.1.4 | Emission requirement correction for UL MIMO | [SoftBank] As shown in our contribution (R4-2000795), there are conditions for applying “each antenna connector” approach. Considering the conditions, there is the risk to violate the regulation. It should be changed the related requirements to "sum of antenna connectors" instead of "each antenna connector" from Rel-15.  OPPO: Our understanding is MPR, SEM and Tx emissions should be revisited together if from one antenna to two antennas. And if it is difficult to achieve consensus on the MPR table within this meeting, our preference is to keep Rel-15 unchanged and discuss this issue in Rel-16, considering the time limitations and also the impacts to large number of Rel-15 UEs already on the market or under development.  Huawei: the emission requirements shall be changed together with MPR  Ericsson: the emission requirements should align with regulatory requirements for multi-antenna transmissions. Comment to R4-2001229: 3GPP specifications are voluntary but should reflect the binding regulatory requirements, the functionality specified should enable compliance with these.  NTT DOCOMO, INC.: Emission requirements should apply to the sum of emission from all antenna connecter from Rel-15. And a description of Minimum output power requirement should be also changed from “each” to “sum” in R4-2000354 from Qualcomm, and description of Minimum output power, Transmit OFF power, and Transmit intermodulation should be changed from “each” to “sum” in R4-2001316 from Ericsson.  Nokia, Nokia Shanghai Bell: Emission requirements should be corrected as the sum of the powers from all UE antenna connectors. In our view no further MPR relaxations should be added when correcting the emission requirements.  Qualcomm: Specification should be aligned with regulatory requirements hence emissions should be as sum. The previous assumptions from LTE are not valid. Also comment to R4-2001229, if there are missing regulatory requirements, companies should bring them to 3GPP attention and 3GPP should take corrective actions. It seems now this is used as a motivation to degrade the 3GPP specifications even further. |
| #3.1.1.5 | Power class signalling for Rel-16 | OPPO: ok with new power class introduced, but this should take #3.1.1.2 into consideration, i.e. which mode is baseline in Rel-15.  Huawei: LS should be sent to RAN2 for the new signalling design  Ericsson: (draft LS in R4-2002038) unclear what RAN2 is going to do with the proposed LS, what is the expected action? An NR CA power class for an EN-DC band combination? This draft LS is not agreed.  NTT DOCOMO, INC.: The principle is OK. But we should discuss which power class for a feature should be distinguish from what. The issue may not be limited to MR-DC only. For instance, even now, Power class for UL MIMO for standalone operation is not clear even if UEs report PC2 for a certain NR band, this does not always mean the corresponding PC for UL MIMO for that band is PC2 as well.  Nokia, Nokia Shanghai Bell: No new UE capability signalling should be introduced until Rel-15 and Rel-16 requirements are agreed. The details for potential new signalling should be clear and agreed before agreeing new signalling. Otherwise, further uncertainty and increased complexity is added to the specification and system.  Qualcomm: Difficult to know what exactly is needed in rel-16 since discussion in rel-16 is still open. Also, this agreement should be made as part of one of the agreed WID. The LS has Rel-15 WI code but release is Rel-16, this will create confusion in ran2. |
| #3.1.1.6 | Need for new MPR requirements | OPPO: Our understanding is MPR, SEM and Tx emissions should be revisited together if from one antenna to two antennas.  Huawei: Agree with OPPO to Change MPR, SEM and Tx emissions in Rel-16 and keep Rel-15 unchanged considering the time limitations. To comments of DCM, 2dB for BPSK inner RB is a typo, which should be 0dB.  Ericsson: is the increased tolerance for UL-MIMO MOP accounted for, the tolerance is +2/-3 dB for UL-MIMO with its two connectors? Hence a 1 dB relaxation compared to a single-connector requirement. Do the results in R4-2002037 assume a 23 dBm MOP for each connector with unwanted emissions tightened by 3 dB, i.e. "measure each port and then add"? Compliance with the requirements for any requirement per connector should be clearly specified (e.g. 3 dB tighter requirement per connector subject to compliance with the total MOP for UL-MIMO).  NTT DOCOMO, INC.: For clarification, PC3 MPR and 1Tx PC2 MPR should be kept. For R4-2002037 from Huawei, we have a question why MPR of Pi/2 BPSK for inner allocation is 2 dB though that of QPSK is 0dB?  Nokia, Nokia Shanghai Bell: Emission requirements should be corrected as the sum of the powers from all UE antenna connectors. In our view no further MPR relaxations should be added when correcting the emission requirements.   * CMCC: From the perspective of operators, some countries have carried out 5G network deployment based on the UE Tx requirements in Rel-15. We have concerns that changing the UE MPR would relax UE output power and degrade network performance. We recommend not to introduce MRP relaxations.   Qualcomm: If 2Tx i.e. transparent tx diversity needs different MPR’s, it is not transparent anymore and may need a capability if specification has two requirements for same feature. This also concerns UL MIMO. New MPR’s should be discussed only if emission requirement change is agreed. |

#### Summary of 1st round of discussions for Sub-topic #3.1.1: UL MIMO PC2

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| **Issue #** | **Issue** | **Summary** |
| #3.1.1.1 | Power class ambiguity needs change or not | It seems opinions on the need for change are diverged so that some are saying change is needed but some are saying change is not needed but tone implies they can accommodate a change if the change is suitable. WF R4-1803259 is referred but language seems unclear to some what it really means since UL MIMO device needs to support 1Tx too.  Proposal for 2nd round is to continue discussion to clarify what is the motivation of the change. |
| #3.1.1.2 | Which mode is the baseline for power class declaration, general (DCI 0\_0) or UL MIMO | Opinions seem diverged which one is the baseline. Both options would solve the spec ambiguity but using UL MIMO as baseline would change the intent of the power class capability and for network to know how UE behaves in DCI 0\_0, it would need to check if UE support UL MIMO or not. WF R4-1803259 is also referred here: <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_86/Docs/R4-1803259.zip> but understanding of the WF is not unified.  Proposal is to continue discussions in the 2nd round. |
| #3.1.1.3 | Spec language: “UE supporting UL MIMO” or “UE configured for UL MIMO” | Companies seems to agree the change can be made. Huawei as only company said case by case check is needed but that is done by proposing companies and conclusion is in the submitted CRs.  Proposal for 2nd round is to comment and justify which cases do not need the change, use CR’s R4-2001316 or R4-2000354 baseline. |
| #3.1.1.4 | Emission requirement correction for UL MIMO | No agreement on emission requirements. Serios problem for 3GPP since many companies are saying 3GPP requirements are not aligned with regulatory requirements. Emission update is seen important when 23+23 dBm=26 dBm UL MIMO configuration is implemented which is not allowed by capability framework but a change is being discussed in #3.1.1.1. Possible WF is to align the emission change with the capability modification. Agreement seems to be that emission requirements should be changed but disagreement which release.  Proposal for agreements:  Change emission requirements for UL MIMO in Rel-16.  Continue discussions for Rel-15 in the 2nd round in conjunction with #3.1.1.1. |
| #3.1.1.5 | Power class signalling for Rel-16 | In principle new signalling seems to be agreeable but it seems companies want to clarify Rel-15 first and then Rel-16 situation.  Proposal is to merge this discussion with eMIMO Rel-16 discussion to avoid possible overlap. |
| #3.1.1.6 | Need for new MPR requirements | There seems to be some trend to change MPR’s with changed emission requirements. Revisiting MPR’s would allow the analysis of the R\_IMD to be included.  Discussion topics for 2nd round:  3.1.1.6.1: Which release MPR change will be impacting?  3.1.1.6.2: Which features MPR change will concerns: tx div, UL MIMO, CA  3.1.1.6.3: Which power classes change will be made, PC5, PC3, PC2, PC1.5?  3.1.1.6.4: Will the existing MPR requirements be kept in the spec or will new requirements cover all e.g. for tx div? |

#### Summary of 2nd round of discussions for Sub-topic #3.1.1: UL MIMO PC2

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| **Issue #** | **Issue** | **Company views** |
| **#3.1.1.0** | R4-2002738 WF on UL MIMO PC2 from Huawei | Ericsson: -- p.3 power-class ambiguity:  A UE advertising PC2 shall meet this for all type of transmissions, also for single port (e.g. PUCCH. Option 3 is the ideal given the current power-class indication per NR band. However, to allow the 23 0 + 23 dBm implementation of 26 dBm, we propose to use Option 2 (the 23 + 23 dBm declare PC3 that it can always meet, but allowed to do PC2 with two antenna ports).  -- p.6 power-class signaling for Rel-16  Using Option 2 there is no need for any new indication for MR-DC/NSA. The 23 + 23 dBm UE would advertise PC3. No need for any MIMO parameters for the NW to figure out the power capability. We consider additional power-class indication for SA (but in conjunction with the FP discussion in Rel-16, this could possibly apply to 23 + 23 dBm in UL-MIMO).  **OPPO:** p.3 power-class ambiguity: we support option 1.  **vivo:** p.3 power-class ambiguity:  we proposed option1 in our CR R4-2000117 i.e. “*Either PC2 or PC3 MOP requirements could apply for a PC2 UE supporting UL MIMO*”  compare PC2 UEs with 23+23 and 23+26 PA configurations in R15   * When configured with 2 port&2 layer transmission ( ), both can meet PC2 requirements * When configured with 2 port&1 layer transmission (), both apply 3dB power reduction because non-full power transmission in R15. (also proposed in R4-2001316) * When configured with 1 port transmission, 23+23 PA UE can only meet PC3 requirements due to lack of TxD testability in 3GPP R15 (previous LS between RAN4 and RAN5). But! In the field, UE with 23+23 PAs may still achieve one port 26dBm by TxD).   So: non-full power transmission is already a reality in R15, and it is not fair to restrict UE implementation due to lack of testability in 3GPP R15.  Qualcomm: See our comments on sub topics.  CMCC：-- p.3 power-class ambiguity：  In RAN4#89 meeting, WF on PC2 UL MIMO (R4-1816615 ) was approved, RAN4 reach a consensus on clarify in the Rel-15 specification on ambiguous requirements for UE supporting UL MIMO.   * “Clarity in the spec that if PC2 UE is configured for transmission on single-antenna port, the requirements of the same power class in subclause 6.2.1 apply for the UE * How to configure for transmission on single-antenna port is up to UE implementation”.   Based on the existing conclusions, we support option 3 Power class should be the same for both UL MIMO or single antenna port mode.23+23=26 transmission on single-antenna port is up to UE implementation. Some UEs may not support TxD, but RAN4 cannot assume that all UEs do not support TxD. We recommend that the power class remain constant by allowing UE implementations to be met.  Given the current situation, it seems that opton3 is also somewhat ideal, and we propose a potential option that does not modify the definition of the UL-MIMO in rel-15, but instead tries to do some testing relaxation with RAN5.  Huawei: As agreed in RAN4#89, the power class should be the same for UL MIMO and UE configured to single antenna port mode. Option 3 is aligned with the current specification for both RAN4 and RAN2. However, we understand that Tx div is not implemented for some vendors, thus exception for some implementation should be allowed for the current situation. However we think that definition manner of power class should not be changed and how to reflect this kind of exception can be further discussed. Preference is exception is allowed in RAN5 test rather than changes in the RAN4 spec. As a compromise, option 1 is acceptable.  Ericsson;  It is unfortunate that we cannot agree a specification that will not cause power-class ambiguity in signaling in live operation, and that allows devices that are not conformance tested according to regulations for unwanted emissions. Failure!  The added Option 4 means failure.  Option 3 discussed below, “the ideal”, is actually the intended behavior form the start: a UE shall meet the single-port/connector and UL-MIMO requirements according to its advertised power class. However, this option would not allow the UL-MIMO PC2 since the power capability for single port is not necessarily PC2.  Below we asked the rhetorical question: is a Rel-15 UL-MIMO PC2 that is not capable of producing 26 dBm for single-port transmissions like PUSCH with DCI 0\_0 and PUCCH still a PC2 for all transmissions? The answer is obvious – or it should be. The root cause of our problem is Option 1, this is the ambiguity we are trying to remove.  A proposed package deal resolves  a. Power class ambiguity: Option 2, we allow the 23 + 23 dBm UL-MIMO implementation, but it advertises PC3 and modified the Pcmax for two-port transmissions (26 dBm) such that the PHR becomes correct. This removes the ambiguity. But it is not Option 3 that would make the UL-MIMO PC2 non-compliant. Option 1 proponents not happy. Neither are Option 3 proponents. A compromise, and the ambiguity problem resolved.  b. Emission requirement changes for UL-MIMO: this must be modified in Rel-15. No compromising here. However, we propose to allow measurements either as the sum of connectors or per connector with 3 dB tighter requirements per connector, additional MPR can be allowed for the 23 + 23 dBm as requested by Option 1 proponents. The latter another compromise.  c. New capability signaling: this should be discussed in the Rel-16 eMIMO FP work item, a solution that could also allow UL-MIMO PC2 to advertise its power capability for two-layer transmissions. Using Option 2 for Rel-15 there is no longer any ambiguity for MR-DC, we can remove the UL-MIMO conditions from 38.101-3.  Transparent TxD is Rel-16. The UE will indicate its FP capability, the gNB configures an appropriate mode for this UE. If no mode configured by the gNB, the UE follows Rel-15 behaviour. Then there should be no ambiguity!  Finally, the WF in 2018 is referred to below. In all fairness it should be noted that there was considerable debate about this, and that the implications on signaling were unknown or not considered. Moreover, in was recognized that requirements do not preclude any other implementation, in yellow highlight:  The RAN4 reply LS to RAN1 R4-1902497 (March 2019): In Rel-15, for power class 2 UE PA configurations for UL-MIMO, RAN4 had the following two approved WFs [R4-1803259] and [R4-1816615], and the key relating parts are listed below respectively:  *“Only PA configurations of 23+23dBm for UL MIMO and 26dBm for 1Tx are supported by specification for NR TDD bands for PC2 UE in Rel-15”*  *“Clarify in the Rel-15 specification on ambiguous requirements for UE supporting UL MIMO*  •        *Maximum output power*  •        *Clarity in the spec that if PC2 UE is configured for transmission on single-antenna port, the requirements of the same power class in subclause 6.2.1 apply for the UE.*  •        *How to configure for transmission on single-antenna port is up to UE implementation”*  However, current RAN4 requirements does not preclude any UE implementation.  Qualcomm: Sentence |
| #3.1.1.1 | Power class ambiguity needs change or not | Ericsson:  for a UE implementing PC2 support for UL-MIMO only (23 + 23 dBm architecture), the power capability will be ambiguous in the network if this UE does not meet PC2 requirements for single-port transmissions. Moreover, the maximum power used for the PHR would be unknown (based on either PC3 or PC2).  The above 23 + 23 dBm implementation should advertise PC3 (minimum power capability) but modify its PHR for two-port configuration if it meets PC2 with two-layer transmissions (and then meet PC3 with single layer according to the scaling rules).  This above also solves the problem for EN-DC power capability for UEs implemented with a 23 + 23 dBm architecture: PC3 is indicated and no need to include any MIMO capabilities, the NW should be able to use the power-class indication.  Ambiguity in conformance testing can be solved by declaration (but does not help the BS).  The above is proposed in R4-2001316.  **OPPO:** There is ambiguity for UEs with different implementations, and the ambiguity is caused due to only one power class reported. In our understanding, it is better to explicitly allowing UE to declare different power class once the power capability is different under different operating modes. For example, UE with 23+23 PAs could achieve PC2 in UL MIMO mode can declare PC3 in single port mode.  vivo: See our comments in above #3.1.1.0. The solution is proposed in R4-2000117.  Qualcomm: Our view this change is not necessary since within the agreements made during rel-15, there is no ambiguity. But we can compromise the and agree achange as long as it is made respecting former agreements.  CMCC:  As stated in WF(R4-1803259) which was approved two years ago, the intention is to explain that there are two PC2 configurations in REL-15 at that time, PC2 configuration one is UL-MIMO( 2Tx 23+23dBm)=26dBm, and the other is 1Tx 26dBm. Both UL-MIMO (23+23) and 1Tx (26dBm) configurations can be defined as PC2 UE. It was not stated that 23+26 or 26+26 UEs were not supported, but the WF clearly stated that UL-MIMO (23+23) was a PC2 UE. So I understand that RAN4 does not limit the architecture of the PC2 UE.  Huawei: Power class should be unique for a NR band, no matter it is in MIMO mode or single antenna port mode according to the current signalling design. The ambiguity clarification is just an exception considering the implementation situation, which should be treated as a special case. We do not see the necessity to introduce new power class for SA MIMO mode. However, the power class for NSA is still ambiguity in Rel-16 specification. We all know the reason to cause the ambiguity, and we already see that additional power class for E-UTRA band is indicated in the NSA mode, which can be considered as an example to introduce similar NR power class in NSA mode additionally. |
| #3.1.1.2 | Which mode is the baseline for power class declaration, general (DCI 0\_0) or UL MIMO | Ericsson:  a UE should not advertise PC2 in the *ue-PowerClass* capability unless it can meet PC2 requirements for all transmissions including single-port antenna transmissions (e.g. PUCCH).  On any contradiction in R4-2001316, clause 6.2D.1:  In the first paragraph we allow a UE indicating PC3 to meet the requirements for either PC3 or PC2 or two-port transmission (the 23 + 23 dBm then meets PC2):  “The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1-2 with PUSCH scheduled by DCI format 0\_1 and the transmission precoder selected from the codebooks for two antenna ports. For UEs indicating power class 3 in the *ue-PowerClass* field of the *UE-NR-Capability* IE, the UE shall meet the requirements 6.2D.1-1 for either power class 2 or power class 3.”  Regardless what the PC3 UE does, the power should be reduced by 3 dB for single-layer transmissions (still two ports), after the table:  “When PUSCH is scheduled [for single-layer transmission] using TPMI 0 or 1 according to Table 6.2D.1-2, the output power shall be 3 dB less than the maximum output power given by Table 6.2D.1-1, as is specified in [8] subclause 7.1.”  However, if it is configured for single antenna port transmissions, it must meet the requirements according to its advertised power class, hence the PC3 (also the 23 + 23 dBm) must meet PC3 requirements:  “For each power class as indicated by the *ue-PowerClass* field of the *UE-NR-Capability* IE, the UE shall meet the requirements in 6.2.1 when PUSCH is scheduled for single antenna-port transmission by DCI 0\_0 or by DCI 0\_1 when the UE is configured for single port operation.”  The last overrides the first statement (that is only for two-port transmission)  OPPO: UL MIMO.  vivo: UL MIMO. See our comments in above #3.1.1.0.  Qualcomm: Our preference is option 2 in WF i.e. general requirements are baseline since not all UE’s support UL MIMO. Using UL MIMO as baseline also creates far bigger ambiguity for single port operation than what it creates for UL MIMO if single port configuration (DCI 0\_0) is used.  Huawei: Baseline mode itself is an ambiguity concept. But we can compromised to option 1 to allow some exception for applied MOP requirements for single antenna port mode.  Qualcomm: Baseline should be general requirements and UE configured for single port or not configured at all such as RACH. Option 2. |
| #3.1.1.3 | Spec language: “UE supporting UL MIMO” or “UE configured for UL MIMO” | Qualcomm: We prefer the change according to [R4-2000354](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000354.zip) and waiting for other companies to check as they commented they need to check. The [WF](ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/draft%20R4-2002738%20WF%20on%20UL%20MIMO%20PC2.pptx) has an ambiguous sentence: “Requirments for single antenna port mode with different implementation should also be checked for applying the changes” and the source and motivation needs to be clarified or then removed.  Huawei: As we commented that the change should be checked case by case, the thinking is that UE supporting UL MIMO could also include the implementation of Tx div, even though we agree that Tx div is spec transparent and is up to UE implementation, but the verification of UL MIMO essentially could also verify the Tx div in some kind of aspects. Since the change is also related to other possible revision of the unwanted emissions and MPR requirements, we think we need to consider the all related changes as a package.  Qualcomm: This change and the discussion has nothing to do with tx diversity or general requirements. It was clearly agreed there is no tx diversity in rel-15 in ran4. We have proposed to include it but it was not agreeable. This sentence should be removed. |
| #3.1.1.4 | Emission requirement correction for UL MIMO | Ericsson:  one way is to allow an alternative measurement per connector but with 3 dB added to each measurement before comparison with the emission limit (standard procedure for unwanted emissions for multi-antennas). Updated MPR could be allowed for the 23 + 23 dBm UE, but are these MPR w r t the power per connector (23 dBm nominal maximum) or the total power (26 dBm nominal maximum)? What is the tolerance assumed? Note that +2/-3 dB gives some headroom.  The R4-2001316 can be amended with this measurement procedure.  SoftBank: The emission requirement should be changed from Rel-15. As described in the summary, it is related to the regulatory requirement. Alignment from Rel-16 means Rel-15 UEs violate the regulation.  OPPO: Emissions with UL MIMO need to be changed together with MPR from RAN4 spec definition point of view.  Qualcomm: We do think it is mandatory that emission requirements are changes and WF should reflect that, either for rel-15 or rel-16. We do not see the need for MPR changes but are open for a simulation campaign to check those after a clear agreement on emission changes is made.  Huawei: Even the unwanted emission is defined as a sum manner, we don't think that the test could be performed by a combiner. Thus the requirement is still tested at each antenna connector, and we agree with E// that the alternative way is to test with 3dB tightened requirement. It is worth noting that even for current PC2 MPR requirement, the MPR for edge RB allocation was not derived based on the simulation results, it is a revised value based on further evaluation by Qualcomm with relaxation 1.5~2.5dB for 16QAM and QPSK compared to simulation result in Rel-15, so we don't think that simulation campaign is any useful, and our proposal is to relax the edge RB MPR for PC2 by 0.5dB. |
| #3.1.1.5 | Power class signalling for Rel-16 | Ericsson: any additional signalling for Rel-16 FP transmission should preferably also resolve the remaining power-class ambiguity for UL-MIMO PC2 (modifying the PHR indication and using PC3 as the power class indication for Rel-15 solve most of the ambiguity as described under #3.1.1.1).  Qualcomm: FP eMIMO work should lead new capability work. Making the agreement separately will lead to confusion and likely to an overlap.  Huawei: The objective of eMIMO is to verify the full power transmission capability with corresponding mode. No need to introduce the new power class for UL MIMO. |
| #3.1.1.6 | Need for new MPR requirements | Ericsson:  we could accept additional MPR for the 23 + 23 dBm for UEs measured per antenna connector (see also #3.1.1.4), the comments below mainly for Rel-15:  3.1.1.6.1: Rel-15 for UL-MIMO PC2  3.1.1.6.2: only UL-MIMO PC2 (23 + 23 dBm) for Rel-15  3.1.1.6.3: for UEs indicating PC3 but complaint with PC2 with two-layer transmission (Rel-15)  3.1.1.6.4: in the FP Rel-16 discussion, good if any changes proposed for Rel-15 could be reused for e.g. Mode 0 (pending discussion on the power capability of this mode for FP). There is no support for TxD in Rel-15.  Qualcomm: We are open for new MPR work but that work need to be agreed clearly by starting with simulation assumptions and emission requirements and applicable features, tx div, UL MIMO etc.. Coordination with FP eMIMO is needed.  CMCC: MPR requirements rexlation should only be on the edge RB allocations if it is needed.  Huawei: Additional MPR for PC2 UL-MIMO is defined together with changes of unwanted emissions. Which release depends on the group view when to change the unwanted emission requirements.  Qualcomm: We are not ok to use the initial proposal as any stating point. Please remove sentence :” along the lines of the initial proposal” from p7 |

### Sub-topic #3.1.2: Tx modulation quality

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2001767](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001767.zip) | CR for inter-band CA Tx requirement\_Rel-15 | Huawei, HiSilicon | 38.101-1 | Adds a limitation to tx mod quality: ”PCC with PRB allocation and SCC without PRB allocation and without CSI reporting and SRS configured.” |
| [R4-2001769](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001769.zip) | CR for inter-band ENDC Tx requirement\_Rel-15 | Huawei, HiSilicon | 38.101-3 | Adds a limitation:” applies with PRB allocation in one of the CG and the other CG unallocated” |

### Sub-topic #3.1.3: Tx EVM for UL MIMO

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000204](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000204.zip) | FR1 TX EVM test condition correction for ULMIMO | Qualcomm Incorporated |  | **Observation 1: A UE’s antenna mutual coupling dominates over conducted domain mechanisms in degrading channel quality in UL MIMO**  **Observation 2: An MMSE MIMO receiver’s throughput is much less sensitive to crosstalk than it is to uncorrelated noise**  **Observation 3: RAN4 EVM test for UL MIMO per v15.8 treats crosstalk as uncorrelated noise**  **Proposal 1: Transmit signal quality testing for UL MIMO shall employ TE with MIMO demodulation capability**  **Proposal 2: Until MIMO demod capability is available in TE, transmit signal quality testing for FR1 shall draw from v15.8 FR2 practice of configuring the UE for single layer operation with two ports.** |
| [R4-2000205](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000205.zip) | CR to 38.101-1: Revision to ULMIMO EVM spec | Qualcomm Incorporated | 38.101-1 | “The requirements apply when the UE is configured for 2-layer UL MIMO transmission as specified in Table 6.2D.1-2. The requirement may alternatively be verified in each of the single layer UL MIMO configurations as specified in Table 6.4D.2.0-1.” And table for Added for single layer TPMI’s |

### Sub-topic #3.1.4: Correction on UE co-ex tables

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000959](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000959.zip) | On correction of UE co-ex tables for Japan | SoftBank Corp., NTT docomo INC., KDDI Corporation |  | Adds notes  NOTE 43: Applicable for 5, 10 or 15MHz channel bandwidth confined between 824 - 845MHz.  NOTE 44: Applicable for 5 MHz and 15 MHz channel bandwidth confined between 900 MHz and 915 MHz and for 10 MHz channel BW confined between 905 MHz and 915 MHz.  NOTE 45: Applicable for 5, 10, 15 and 20MHz channel bandwidth.  To certain bands |

### Sub-topic #3.1.5: Avoidance of redundant power reduction for HPUE

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000227](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000227.zip) | Avoidance of redundant power reduction for HPUE | NTT DOCOMO, INC. | 38.101-1 | ***Proposal 1: ΔPPowerClass for a power class 2 capable UE shall be defined as follows for Rel15 and beyond***  ***if MAX(MAX(MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc) is less than 3 dB, ΔPPowerClass shall be 3- MAX(MAX(MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc) dB***  ***Else if ΔPPowerClass shall be 3 dB.***  ***Proposal 2: ΔPPowerClass shall be 0 dB when P-max is lower than 23 dBm for Rel15 and beyond.*** |

### Sub-topic #3.1.6: Correct the NS\_xx abbreviation to ‘network signalling’

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| [R4-2000326](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000326.zip) | CR to TS 38.101-1 on corrections to network signalling value (Rel-15) | ZTE Corporation | 38.101-1 | ***(1) Correct the NS\_xx abbreviation to ‘network signalling’ in the titles of sub-clause 6.5.2.3 and 6.5.3.3.***  ***(2) Modify the header of tables in sub-clause 6.5.2.3 for the additional requirement of network signalling values.***  ***(3) Editorial correction in Table 6.5.3.3.2-1.*** |

### Sub-topic #3.1.7: power class fallback enhancement

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| R4-2002158 | CR for power class fallback enhancement | Huawei, HiSilicon | 38.101-1 | Changes in this CR:  Define the linear relation between ΔPPowerClass and uplink duty cycle. |

### Sub-topic #3.1.8: NS 45->50 correction

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| **T-doc number** | **Title** | **Company** | **Spec** | **Proposals / Observations** |
| R4-2000400 | CR for 38.101- n39 NS flag change due to conflict | Qualcomm Incorporated | 38.101-1 | Changes in this CR:  Changes NS\_45 to NS\_50 due to conflict with NS numbering between 38.101-1 and 36.101. |

## Summary FR1 Transmitter Agenda 6.5.4 and 6.5.3

### Discussions for 1st round for FR1 transmitter

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| **Sub-topic** | **Company views** |
| 3.1.2: Tx modulation quality | Ericsson: this is not a clarification (“spec is not clear” used in the consequences if not approved), but the change aligned with the LTE requirements so could be considered. The same for EN-DC. |
| 3.1.3: Tx EVM for UL MIMO | OPPO: For clarification, in Observation 1 it says “A UE’s antenna mutual coupling dominates over conducted domain mechanisms in degrading channel quality in UL MIMO” does it mean conducted domain mutual coupling is not severe, then why this change is needed? If this can be justified, then we support the proposals.  Huawei: The UE implementation for FR1 and FR2 are quite different. We do not see the necessity to make changes for FR1 EVM test with the alternative MIMO configuration as it does not reflect the real field scenario and could degrade the system performance with a relaxed measurement result.  Ericsson: (R4-2000204) it is asserted that the test equipment (and BS in the field) can cancel the crosstalk in the device for dual-port transmissions, EVM can therefore be tested with the per-antenna precoders (one TX active at a time) or with a test equipment equipped with a MIMO receiver. However, EVM degradation is also caused by non-linear cross talk (e.g. crosstalk by coupling before the PAs and between PA outputs and inputs) that a linear MIMO receiver cannot cancel. The PAs are the main culprits of EVM degradation. The simulations make an a priori assumption of an EVM (2.5% that corresponds to 32 dB SNR) with a linear cross talk introduced after this, e.g. that occurring between the antenna ports after the PAs. This linear cross talk a MIMO receiver can cancel. EVM should be tested per connector/port with both TX chains active. The proposed test is not meaningful, the effect of non-linear cross talk on would not be verified. We do not agree the CR in R4-2000205.  **R&S:**  **For Proposal 1:** There have been similar discussions in the past with regards to EVM testing in FR2. As stated before, this is a complicated task, which requires further alignment among all interested companies, since otherwise different companies may have different understandings and implementations. Once this alignment has happened it can be further discussed how and if this goal can be achieved.  **For Proposal 2:** We are ok with this proposal.  Qualcomm: (in response to Oppo). Yes, it does mean conducted domain mutual coupling is not severe in the real world. The change is needed because unlike in the real world, in the current EVM test methodology it matters, because conducted domain crosstalk is seen as noise. We have here a case of test method forcing a tougher requirement on a UE than a real system.  (In response to Ericsson) the current EVM methodology already bypasses the antennae, and so, circumvents the PA coupling mechanism you point out. The proposed change does not change that aspect of the test. The only way to capture the mechanism you point out is an OTA test for FR1, because the antennae (the predominant coupling mechanism) need to be reintroduced into the testing chain.  (In response to Huawei). We are ok with retaining current EVM test requirements if the TE is capable of MIMO demod, like real field scenario |
| 3.1.4: Correction on UE co-ex tables |  |
| 3.1.5: Avoidance of redundant power reduction for HPUE | Xiaomi: Thanks Docomo for the contribution R4-2000227. For clarification question, these proposals are only applied to the case that scheduling UL dutycycle excessed the signaled maxUPlinkDutycycle or whatever the UL dutycycle is?  vivo: Thank DoCoMo for the contribution in R4-2000227, we support both proposal 1 and 2. I have two questions for clarification:   1. Is it appropriate to apply the changes to both R15 and R16? (R4-2000228 and R4-2000229) Should it be R16 only?   If the proposed changes are agreed by the meeting for R16, can we conclude the R16 TEI on power class fallback? I.e. no more discussion on other solutions e.g. linear technique etc. in R16.  Huawei: we agree with proposal 2. For Proposal 1, it depends on the relation between power class and MPR adoption. Assume MPR for PC2 is 2dB, then this PC2 use MPR=2dB, the PCMAX,L=24dBm. When the uplinkdutycycle exceeds UE capability, UE fallback to PC3, then the UE may use MPR=0dB which is defined for PC3, PCMAX,L=23dBm with ∆Ppowerclass=3dB. We are not sure which MPR it means in the equation of P1.  Ericsson: (comments to R4-2000227) Proposal 1, the DPpowerclass should only take fixed values, i.e. the difference between (signaled) power class values, since Ppowerclass is mapped to an IE (the original intention). Notwithstanding, using the MPR or A-MPR can be misleading since these are the maximum values that can be used (set the lower limit of the configured power), not necessarily the actual values applied by the UE. In general: a "graceful" fall back from PC2 to PC3 should be specified using another parameter. Proposal 2: if P-Max is less than 23 dBm, the power class parameter does not matter (PC3 the lowest power class). Not agreed  NTT DOCOMO, INC:  For Xiaomi, if PEMAX,c (P-Max) is larger than or equal to 23 dBm, the answer is YES. If PEMAX,c (P-Max) is lower than 23 dBm, maxUplinkDutyCycle does not matter.  For vivo, we propose to change from Rel-15 since this is unnecessary power reduction and critically important for PC2 specification. We think that the R16 TEI on power class fallback is a different issue from this.  For Huawei, MPR in the equation is MPR allowed for PC2 utnil the UE fallbacks to PC3. Then, MPR for PC3 may be used. Point is that without fixing this issue, additional ∆Ppowerclass=3dB power back off is allowed, then, UE’s PCMAX,L=21dBm regardless of the number of RBs etc. That is unnecessary.  For Ericsson and Qualcomm, if we keep ∆Ppowerclass 3dB, our compromised alternative is as follow. Given that a new parameter of “a”(tentative name) introduced,  if MAX(MAX(MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc) is less than 3 dB, “a” shall be “3 - MAX(MAX(MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc)”. Note that each of the parameters in the equation shall be based on PC2 requirements.  Else if MAX(MAX(MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc) shall be based on PC3 requirements.  Qualcomm: Disagree with the proposal. The intention is that de;ta\_PPowerClass is to align the specification for the PC2 UE that falls back to PC3 to be identical to a native PC3 UE. |
| 3.1.6: Correct the NS\_xx abbreviation to ‘network signalling’ | Huawei: most changes are unnecessary. The last change on FOOB is acceptable. |
| 3.1.7: power class fallback enhancement | [SoftBank] The first/3rd corrections need divisions by maxUplinkDutyCycle (in logarithm) but it seems impossible since the sentences are conditioned as "UE capability of maxUplinkDutyCycle is absent". It seems that further clarification is required to avoid contradictions.  Ericsson: (comments to R4-2002158) the DPpowerclass parameter should not be used for the purpose of "graceful" fallback to PC3; the intent of this parameter is to compensate for differences between the indicated power class and the applicable power-class requirement (should only be difference between power class values if any). Use another (new) notion instead. The CR is confusing: the RRC parameter used does not exist, probably referring to the maxUplinkdutCycle-PC2-FR1 that can take values 60% and greater. Hence, 3 dB can never be reached in the fallback condition in 6.2.1 (only for the default 50%). 6.2.4: aside from the use of DPpowerclass, the compensation can be negative (results in >26 dBm) and undefined if the RRC parameter is absent. CR not agreed.  NTT DOCOMO, INC.:  Basic idea is OK but we have different ideas on how to incorporate this feature. Firstly, we need a capability for network to distinguish UEs with or without this feature. Otherwise, network cannot adjust UL scheduling for the respective UEs. Secondly, we have discussed that we cannot reuse delta Power class so that we need a new parameter. We’ve submitted an alternative CR whose file name is “[draft] Alternative CR from docomo PC enhancement for sub topic 3.1.7.docx”.  Qualcomm: The changes are not clear. Firstly, as pointed out by Softbank, you complete (% UL symbols/maxUplinkDutyCycle) but this is for a case where maxUplinkDutyCYcle is absent. Also, in the condition that 10log(% UL symbols / maxULDutyCycle) < 3dB, then UE should apply requirements of supported power class. Does this mean that if uplink symbols exceeds max UL Duty Cycle, the PC2 should still apply?  vivo: In our view, this belongs to TEI16 which is out of scope of this meeting according to chairman’s Agenda.  Intel: Out of scope. There was no agreement or progress on this approach in RAN#93. We would like to understand better the idea. |
| #3.1.8: NS 45->50 correction |  |

### Summary after 1st round for FR1 transmitter

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| **Sub-topic** | **Summary** |
| 3.1.2: Tx modulation quality | Propose to agree CR’s R4-2001767 and R4-2001769 |
| 3.1.3: Tx EVM for UL MIMO | It seems Huawei is not agreeing proposal 2 and R&S not with proposal 1 and Ericsson not ok with CR [R4-2000205](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000205.zip).  Proposal is to continue discussions in 2nd round with Qualcomm lead WF. |
| 3.1.4: Correction on UE co-ex tables | Proposal is to note discussion paper [R4-2000959](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000959.zip) |
| 3.1.5: Avoidance of redundant power reduction for HPUE | Seems many companies disagree with the change but proponent wishes to continue discussions in 2nd round. . Proposal is to reviseCR [R4-2000227](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000227.zip) |
| 3.1.6: Correct the NS\_xx abbreviation to ‘network signalling’ | Only comment is that some of the changes are unnecessary but some companies see this important hence they can be allowed.  Proposals is to agree CR [R4-2000326](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000326.zip) |
| 3.1.7: power class fallback enhancement | It seems more discussions are needed. Since a new revision is provided  <ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/%5Bdraft%5D%20Alternative%20CR%20from%20docomo%20PC%20enhancement%20for%20sub%20topic%203.1.7.docx>  Proposal is to continue discussion and allocate a WF to NTT Docomo. |

### Discussions for 2nd round for FR1 transmitter

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| **Sub-topic** | **Company views** |
| #3.1.3: Tx EVM for UL MIMO, WF from Qualcomm | Huawei: The NR UL MIMO EVM requirement was introduced in the similar way as that of LTE, which was defined in Rel-10, and even for NR, the requirement was defined for a long time. We didn’t see the reason why TE cannot test the EVM requirement based on existing code book and MIMO configuration. We understand the difficulty for OTA test for FR2, but that is not the case for FR1. The test is done at the antenna connector, no space coupling would affect the measurement, and the PCB isolation is only an implementation design issue which should not be an excuse to relax the requirement. We cannot accept this WF in R4-2002726.  Ericsson: feasibility of UL-MIMO reception in the test instruments should be considered. |
| #3.1.5: Avoidance of redundant power reduction for HPUE, revised **R4-2002725** discussion paper and its proposals and CRs as submitted originally |  |
| #3.1.8: NS 45->50 correction |  |

### Summary after 2nd round for FR1 transmitter

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| **Sub-topic** | **Company views** |
| #3.1.3: Tx EVM for UL MIMO (WF) |  |
| #3.1.8: NS 45->50 correction |  |
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## FR1 Receiver Agenda 6.5.5

### Sub-topic #3.3.1: OOB TX level change due to testability issue in EN-DC

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| Tdoc number | Title | Source | Spec | Proposals/ Observations |
| [R4-2000439](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000439.zip) | Testability issue with OoBB for FR1 EN-DC UE | Anritsu Corporation |  | ***Observation 1: Based on the current definition of the OoBB uplink signal levels, if an antenna (connector) is common between E-UTRA and NR in a UE, too much power imbalance will cause a testability issue with the FR1 EN-DC UE.***  ***Observation 2: UL level difference between E-UTRA and NR is approximately 60 dB with the current requirement.***  ***Observation 3: SS is in short of the dynamic range approximately 30 dB against the requirement and it is not possible to measure the throughput of UL signals***  ***Observation 4: Filter performance may not be provided appropriately in a case bands are aligned nearby.***  ***Proposal1: Change UL signal level settings of out-of-band blocking requirement for FR1 EN-DC UE. Choice of option and UL level are TBD.***  **Option 1: PCMAX\_L – 4 dB for both E-UTRA and NR UL**  **Option 2: PCMAX\_L – 7 dB for both E-UTRA and NR UL**  **Option 3: PCMAX\_L – 4 dB (UL for the source of IMD) and PCMAX\_L – [14] dB (UL whose DL is being tested)** |
| [R4-2000440](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000440.zip) | CR to out-of-band blocking for DC in FR1 | Anritsu Corporation | 38.101-3 | Has changes for all three candidates in the discussion paper. |

### Sub-topic #3.3.2: ACS TX level change

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| Tdoc number | Title | Source | Spec | Proposals/ Observations |
| [R4-2000449](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000449.zip) | CR to TS 38.101-1: corrections on ACS for intra-band contiguous CA | Xiaomi | 38.101-1 | Change TX from Pcmax 4 dB below max to 24 dB below max |
| [R4-2000451](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000451.zip) | CR to TS 38.101-3: corrections on ACS for intra-band contiguous EN-DC | Xiaomi | 38.101-3 | Change TX from Pcmax 4 dB below max to 24 dB below max |

### Sub-topic #3.3.3: ACS RMC change FR1 and FR2

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| Tdoc number | Title | Source | Spec | Proposals/ Observations |
| [R4-2000747](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000747.zip) | NR UE receiver ACS test requirements | MediaTek Inc. |  | ***Proposal 1***: *Modify NR ACS test configuration by aligning the PDCCH/DCI power level to the same as PDSCH in DL reference measurement channel for both FR1 and FR2.*  ***Proposal 2****: Send an LS to inform RAN5 for RAN4’s concern on current ACS test requirements and RAN4’s agreement to modify the ACS test configuration to align the PDCCH/DCI power level to the same as PDSCH in DL reference measurement channel for both FR1 and FR2.*  ***Proposal 3****: Whether the same modification should be applied to other UE RF receiver test requirements or not is up to RAN5’s decision.* |
| [R4-2000748](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000748.zip) | LS on NR UE receiver ACS test requirements | MediaTek Inc. | 38.101-3 | ” , RAN4 has agreed to modify the NR UE ACS test configuration by aligning the PDCCH/DCI power level to the same as PDSCH in DL reference measurement channel for both FR1 and FR2” |

## Summary FR1 Receiver Agenda 6.5.5

### Discussions for 1st round for FR1 receiver

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| **Sub-topic** | **Company views** |
| 3.3.1: OOB TX level change due to testability issue in EN-DC | Qualcomm: If this change is truly needed, then setting other Tx to Pcmax-14 might be the best alternative. But we should study if that impacts the requirements and whether any adjustment is needed  Apple: We do not agree the proposed changes, since the change puts both transmitters at maximum output power, resulting in large IMD.  Anritsu: Considering the comments from Qualcomm and Docomo, we are fine to limit the solution to option 1 or 3 as a 1st stage. Also for option 3, if it is necessary to lower the power level from Pcmax-14, there is still room to decrease it.  NTT DOCOMO, INC.:We prefer option 1. We have concern about option 2. The motivation of OBB in EN-DC is to test the impact of IM caused by blocker and uplink whose down link is not being tested. If the uplink transmission power is decreased, the impact of IM is also decreased and the OBB requirement is relaxed. |
| 3.3.2: ACS TX level change | Huawei: PCMAX,L-24dB is coming from LTE spec, we would like to know whether UE is allowed to lower down 24dB output power under large interference condition?  Ericsson: OK, consistent with non-CA requirements.  Xiaomi: For Huawei, as you said, our intention is to align with LTE spec and Non-CA case. Though the large interference is specified for ACS case 2, the wanted signal level is also high (about 20dB higher than that in case 1). In our view, Case 2 is to verify the receiver ACS ability when path loss is lower than that in case1, so it is natural that the transmitter power in case 2 is lower than in case 1. If we don’t change and leave it as it is, I think the test may have a problem. |
| 3.3.3: ACS RMC change FR1 and FR2 | [MTK] Thanks to Huawei, Ericsson, and Anritsu’s comments. The reason we raise this issue is that we have seen the NR Rx test setup from multiple test equipment vendors that the PDCCH/DCI did not occupy the full BW and it did become a bottleneck in ACS tests. Maybe Anritsu or other test equipment vendors can help confirm how PDCCH/DCI has been configured in Rx tests. Do they occupy the full BW or what is the aggregation level for all channel BWs? Is there a power difference between PDCCH/DCI and PDSCH?  Huawei: we agree that PDCCH demodulation shall not configured as the bottleneck on ACS test for PDSCH. To be more specific, there are two conditions need be clarified:   1. PSD of PDCCH and PDSCH shall be aligned. 2. The aggregation level of PDCCH can be configured as at least 8 or higher   We think the same conditions are also work for other receiver requirements.  Ericsson: the CORESET is configured such that it occupies the full BW (A.3.1-1), there should be no power change between PDCCH/DCI and PUSCH. Then, presumably, the PDCCH CCE to REG for the DL transmission of the DUT interleaved (i.e. the nonInterleaved option is not used).  Anritsu: Comment to R4-2000747.  We have a concern with proposals.  Aligning the output level between PDCCH and PDSCH by changing only the output power for PDCCH will make another discrepancy with the requirements described in TS38.101-1 Table C.3.1-1. (EPRE ratio between physical channels which are supposed to be aligned among them except for DMRS.)  Extract from TS38.101-1 Annex C.3.1 |

### Summary for 1st round

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| **Sub-topic** | **Summary** |
| 3.3.1: OOB TX level change due to testability issue in EN-DC | Propose to narrow down options and continue discussion in 2nd round with WF lead by Anritsu. |
| 3.3.2: ACS TX level change | Only one company had a question and it seems to be answered.  Proposal is to continue discussion in 2nd round as see if change is approvable after explanation. |
| 3.3.3: ACS RMC change FR1 and FR2 | Seems better to continue discussion on 2nd round or in next meeting. Proposed WF: LS should be postponed and WF assigned and lead by Mediatek |

### Discussion on 2nd round (if applicable)

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| **Sub-topic** | **Company views** |
| #3.3.1: OOB TX level change due to testability issue in EN-DC | **Anritsu**  Please refer to the draft WF uploaded below.  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/draft_R4-2002727_WF_on_FR1_OoBB_Testability_rev0%20.pptx>  **Apple**  This proposal is changing a two carrier intermodulation problem to a three carrier intermodulation problem. This will result in a much tighter requirement for the UE as there will be many more intermodulation products. Also 3GPP would need to allow more exceptions due to the higher number of IMD products. This has been extensively discussed in RAN4 during the definition of NR with the outcome we have in the spec now.  Such a fundamental change should only be done if there is really a problem. This proposal is based on an analysis in R4-2000439, however, there seem to be some inconsistencies in this analysis. For example a 14 bit ADC is assumed to have 60dB dynamic range, but a 14 bit ADC has approximately 14 \* 6 = 84 dB dynamic range. Additionally the noise floor is calculated across the whole 1GHz bandwidth. But the LTE/NR signals are much narrower, this will result in an additional dynamic range increase. Also the required SNR to receive the signaling is much lower than 15dB. So the analysis seems to be much too pessimistic and most likely there is no issue at all. The proponents are encouraged to prove in the next meeting that there is really an issue.  We cannot agree to the WF as presented by Anritsu and propose to withdraw it. Otherwise we propose to change it according to the uploaded file below:  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/draft_R4-2002727_WF_on_FR1_OoBB_Testability_rev0_Apple.pptx>  **Anritsu (Mar 5)**  I think our logic is already clear enough and I can say our estimation is not such a massively underestimated one.  >For example a 14 bit ADC is assumed to have 60dB dynamic range, but a 14 bit ADC has approximately 14 \* 6 = 84 dB dynamic range.  [Anritsu] To calculate the dynamic range based on the ideal equation (in this case 14\*6) is not realistic and not aligned with the actual situation.  If you check the datasheet of commercially available ADC, you can find the specification called “Effective number of bits (ENOB)”.  We have to use this parameter when we calculate the actual SNR, and the average ENOB in a case of 14 bit ADC is around 10.  So 10bit \* 6 = 60 dB is already the same range which is defined as the current test condition even if we do not take account of the noise floor level and the crest factor margin.  Thus we think we already have the enough reason to say we have the testability issue.  You might say to use 16bit ADC, but I believe we cannot find a product which has enough dynamic range like 80 or 90dB..  >Additionally the noise floor is calculated across the whole 1GHz bandwidth. But the LTE/NR signals are much narrower, this will result in an additional dynamic range increase.  [Anritsu] As we showed in my paper, we are assuming the NR case whose channel bandwidth is up to 800MHz.  Compared to the 1GHz bandwidth, we do not have so big effect by oversampling.  Let’s say to limit the channel bandwidth upto 400 MHz. But still we have only 4 dB gain or so, which is not enough to compensate crest factor margin and noise floor level.  >Also the required SNR to receive the signaling is much lower than 15dB.  [Anritsu] This might be true with other TE vendors. I appreciate if we can hear views from other TE vendors.  But again, even though we can reduce this part to 10dB, the situation is same and we still lack of the dynamic range.  With all explanations above, I would propose to use the original WF and we should proceed to a phase to check the actual impact to the requirements by changing the test condition.  As I also wrote in my paper, this issue occurs only when the EN-DC UE is sharing the Tx antenna commonly with LTE and FR1 NR.  So separating the requirements depending on the implementation can also be one of the solution.  **Anritsu (Mar 5 -2nd)**  How about the slightly modified WF as below?  Companies are encouraged to study following two aspects on Option 3 as a starting point and bring views at RAN4 #94bis.  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/draft_R4-2002727_WF_on_FR1_OoBB_Testability_rev1%20.pptx>  **Apple:**  Many thanks to Anritsu for the additional explanations. However, it still seems to be a very pessimistic calculation. We would like to see also opinions from other TE companies, if they have the same issue or not.  Any of the proposed options are a massive change to the UE RF requirements. This is not just a small fix for a measurement issue. Therefore before we change the UE spec we need from multiple TE vendors the info if they also see the issue and how much power difference they can handle. The WF should reflect this request to TE vendors, it should not be a request to the UE companies just asking if UE companies are ok to change the spec. We cannot agree to the modified WF from Anritsu therefore.  We would propose we do not have a WF this meeting, unless Anritsu agrees to the previously proposed modification by Apple, and the TE vendors come up with this issue and more info on the possible power difference in the next meeting. |
| 3.3.2: ACS TX level change | **Xiaomi: With the clarification and offline discussion, Huawei is OK for the original CR.** |
| #3.3.3: ACS RMC change FR1 and FR2 | Ericsson: using OCNG the CORSET/PDCCH can be allocated up to n\*6 PRB, i.e. almost the full BW. There would only a small symbol-power change if the TX PSD is kept constant.  **Anritsu’s comments to Huawei, Ericsson and Mediatek.**  [To Huawei]  1. PSD of PDCCH and PDSCH shall be aligned.  -> As explained in the 1st round, we disagree with this idea under the condition that we ignore EPRE definition in TS 38.101-1.   1. The aggregation level of PDCCH can be configured as at least 8 or higher  * It is acceptable to increase aggregation level to 8 or 16 (Now AG level = 4 in our implementation.). By this change we expect we will be able to increase the power level of the wanted signal (PDCCH).   Open issue with the solution 2 above   * It is possible to increase the power level. But there is still a gap between PDCCH and PDSCH. So not sure the bottleneck will be improved. * We need also to revisit the definition of nrofcandidates for AG level 8 and 16 in TS 38.508-1. (Table 4.6.3-162: SearchSpace). Refer to the table outlined below this table. * There is a concern with the case for narrow CBW (5MHz or 10MHz) since we may not be able to ensure enough PDCCH region. There is a need to study using existing AG level for narrow CBW.   [To Ericsson]  > the CORESET is configured such that it occupies the full BW (A.3.1-1), there should be no power change between PDCCH/DCI and PUSCH.  -> It is not possible to transmit PDCCH with full BW from the current spec. Full BW means that the resource position is activated with full BW under RRC configuration, and actual allocation depends on the aggregation level. Since unallocated resources are filled with OCNG, total level at the UE RF block should be (PDCCH (+OCNG) = PDSCH.  [To Mediatek] Answer to questions below.  ***Do they occupy the full BW or what is the aggregation level for all channel BWs?***  -> Number of RB with CORESET (frequencyDomainResources) is full BW (strictly speaking, multiple of 6 which is closest to the BW size).  Aggregation level is currently used 4 for the wanted signal schedule. (PDCCH=approx 12RB).  We chose this number taking into account of the possibility of scheduling UL/DL simultaneously. (Num of candidates are two with AG level 4. So we can transmit two PDCCH(DCI) in 1 slot.)  ***Is there a power difference between PDCCH/DCI and PDSCH?***  Out understandings and implementations are as follows.  Power level at RF output from UE.  Total PDCCH/DCI+OCNG= Total PDSCH  Note that since number of PDCCH/PDSCH symbols is not exactly equal, strictly speaking it is not completely equal. But the image is almost aligned with the following figure. (<- Compliant to the DL level for test.)  cid:image006.png@01D5F0A5.509156F0  If we focus on only to the wanted signal.  PDCCH/DCI(without OCNG) ≠ PDSCH  Image is as follows. <- We assume this is valid from NR spec PoV.  cid:image007.png@01D5F0A5.509156F0  If we focus on symbol level power:  EPRE PDCCH/DCI = EPRE PDSCH \* Compliant to Annex C.3.1-1 in TS38.101-1.  For information, if we follow the original CR, the implementation will change as follows.  Power level at RF output from UE  Total PDCCH/DCI+OCNG ≠ Total PDSCH  By adding OCNG, total power only at PDCCH will be higher. (Total power is not flat.)  Only wanted signal  PDCCH/DCI(without OCNG) = PDSCH  Symbol level  EPRE PDCCH/DCI ≠ EPRE PDSCH \* Not compliant to Annex C.3.1-1. |

Additional information from Anritsu for sub-topic 3.3.3. Candidate of change with TS 38.508-1.

Table 4.6.3-162: *SearchSpace*

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| Derivation Path: TS 38.331 [6], clause 6.3.2 | | | |
| Information Element | Value/remark | Comment | Condition |
| SearchSpace ::= SEQUENCE { |  |  |  |
| nrofCandidates SEQUENCE { |  |  |  |
| aggregationLevel1 | n0 |  |  |
| aggregationLevel2 | n4 |  |  |
|  | n2 |  | FR1\_5MHz OR FR1\_10MHz |
| aggregationLevel4 | n2 |  |  |
|  | n1 |  | FR1\_5MHz OR FR1\_10MHz |
| aggregationLevel8 | n1⇒n2? |  |  |
|  | n0 |  | FR1\_5MHz OR FR1\_10MHz |
| aggregationLevel16 | n0⇒n2? |  |  |
| } |  |  |  |

The reason to define n2 is that we need two candidates to schedule UL/DL simultaneously in the same slot.

### Summary on 2nd round (if applicable)

# Topic #4: FR2 General requirements

## FR2 Transmitter

### Sub topic #4.1.1: WRC-19 resolutions (Agenda 6.5.6.1)

#### Papers submitted for Sub-topic #4.1.1 WRC-19

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000091**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000091.zip) | On 3GPP band n258 and WRC-19 EESS unwanted emission limits | T-Mobile USA, AT&T | The proponents believe that RAN4 should revise current band n258 specifications to implement WRC-19 agreed phase-1 EESS limits only for now, and leave phase-2 limits for a future revision, when applicable. |
| [**R4-2000216**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000216.zip) | Impact of WRC19 resolutions on FR2 | Qualcomm Incorporated | None. WRC19 resolutions analyzed, 3GPP standards impact projected |
| [**R4-2000230**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000230.zip) | EESS protection from n257 (from 6.5.7.3) | NTT DOCOMO, INC. | Proposal 1: n257 UEs shall meet the unwanted emission limits to protect the EESS (passive) only when any portion of the UL transmission bandwidth is inside 26.5 - 27.5GHz.  Proposal 2: Specify -5 dBm/200MHz for Band n257 UEs from the beginning(No spec change from 1 to -5 dBm/200MHz in the future). |
| [**R4-2000409**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000409.zip) | On 3GPP band n258 and WRC-19 EESS unwanted emission limits | T-Mobile USA, AT&T, U.S. Cellular | Duplicate?  The proponents believe that RAN4 should revise current band n258 specifications to implement WRC-19 agreed phase-1 EESS limits only for now, and leave phase-2 limits for a future revision, when applicable. |
| [**R4-2001775**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001775.zip) | On FR2 EESS protection emission requirement | Huawei, HiSilicon | Observation 1: The current NS\_201 spurious emission can work well for the new ITU emission requirement.  Proposal 1: RAN4 do not change or add AMPR and spurious requirement for EESS protection in Rel-15 and Rel-16, and pay close attention on the EESS protection requirement adoption.  Proposal 2: slightly revise NS\_201 AMPR requirement as in Table 3. (*Moderator note:* *this proposal is identical to QC proposed change in* [*R4-2000212*](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000212.zip)) |

#### Open Issues Summary, Sub topic #4.1.1: WRC-19 resolutions

##### Additional Requirements or General Requirements?

* 4.1.1.2.1-1: Any new emissions requirements would go into general requirements
* 4.1.1.2.1-2: Any new emissions requirements would go into ‘Additional’ requirements

##### Timing of Introduction of new emissions requierments into 3GPP standard

* 4.1.1.2.2-1: Immediately
* 4.1.1.2.2-2: Wait for regulators to declare intent to change emissions limits

##### Emissions Limit for 3GPP

* 4.1.1.2.3-1: Adopt more stringent EESS protection limit (-5 dBm//200MHz)
* 4.1.1.2.3-2: Adopt emission limit that tracks regulatory requirement, not WRC-19 resolution
* 4.1.1.2.3-3: Retain emission limit from NS\_201 (-8 dBm/200MHz) as long as WRC-19 resolutions are more relaxed

#### Company Views on Open Issues Sub topic #4.1.1: WRC-19 resolutions

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| Open Issue | Proposal | Description | Company Views |
| 4.1.1.2.1 Additional Requirements or General Requirements? | -1 | Any new emissions requirements would go into general requirements | Huawei: currently, we don’t see ECC will change the EESS -8dBm/200MHz limit, while maybe other regulation will adopt ITU requirement in the future. Then different EESS requirement may exist in different regions. We are not sure before indication from regulators. We prefer to decide on this when the EESS protection requirement is clear.  Ericsson: (2) additional requirement to reflect local regulation.  NTT DOCOMO, INC. : For n257 case, strictly speaking, neither option 1 nor 2. -8dBm/200MHz was introduced without NS because this had been expected to be a benchmark which would be close to the value WRC19 selected. Now we know -5dBm/200MHz must be met in the end. This is what we have. Thus, -5dBm/200MHz must be treated as general. The other proposals such as relaxed one until Sep 1st 2027 and a value to be determined in EU would be treated as addtitional.  With respect to additing new NS, we really need a mechamism to make UEs to report which NS they can deal with to network. R4-2000214 (Qualcomm) says ”Deployed n257 UEs in the EU will remain emissions compliant because they will self-detach from the network if they receive unexpected NS\_201 and NS\_202” It is true only for Standalone operation. NSA has other issues which is elaborated in R4-2000220 (DCM).  Qualcomm: Favor -2 option  T-Mobile USA:  For n258, we support -2 option. I.e., treating WRC-19 resolution emission limits as additional requirements. Meanwhile, the problem identified in DOCOMO’s paper R4-2000220 that a network not being able to distingush two types of UEs, which are subject to different emission limits and may not understand some new NS\_numbers, will result in a RRCReconfiguration failure in certain situations must be resolved. RAN4 should revise current band n258 specifications to implement WRC-19 EESS limits but not to create a new band for new emission requirements.  Samsung: We prefer Option 2  Intel: Proposal-2 conditioned on that new emission requirements are tigher than general requirements |
| -2 | Any new emissions requirements would go into ‘Additional’ requirements |
| 4.1.1.2.2 Timing of Introduction of new emissions requierments into 3GPP standard | -1 | Introduce requirements immediately | Huawei:Option 2  Ericsson: (1) the requirements for the phase 1 and phase 2 WRC19 requirements for EESS protection should be introduced at the same time from Rel-15. There is precedence in the 3GPP specifications (Band 23/25 co-existence in 3GPP Rel-10)  NTT DCOOMO, INC.: For both n257 and n259, Favor -1 option. There are no reasons not to introduce the requirements. For EU, if they derive differnt one from that from WRC19, we newly introduce it into n257 and n259, respectively.  Qualcomm: Favor -2 option  T-Mobile USA:  For n258, we prefer to implement WRC-19 agreed phase-1 EESS limits immediately.  [SoftBank-2] We’ve got a feedback from ITU-R guys that, in general, such ITU-R resolution takes precedence over a domentic rule (because this is an international agreement made among regulators) then application of the rule should be promptly. We’d recommend that interesting parties should check with internal ITU-R relevant persons.  Samsung: We prefer Option 1  Intel: Proposal-1. But if CEPT still keep - 8dBm/200MHz limit, proposal 1 looks useless  [Verizon] This contribution has concluded the A-MPR proposal associated with a new NS\_205, and the possible A-MPRs will be extremely high for perfection of EESS bands. In our view, this new A-MPR could create big impacts to mmWave developments, such as the band n260, or delay deployment plan.  Hence, we strongly suggest a new proposal for the protection of the EESS band should consider all of regional regulation requirements, instead of a generic requirement.  At this time, we could not agree any A-MPR proposal in 3GPP. |
| -2 | (Wait for regulators to declare intent to change emissions limits) |
| 4.1.1.2.3 Emissions Limit for 3GPP | -1 | -5 dBm/200 MHz | Huawei:Option 2  Ericsson: (3) retain the existing (e.g. for use in EU) while introducing the phased additional requirements according to WRC19.  NTT DOCOMO, INC: For n257, Favor -1 option.  Qualcomm: Favor -2 option.  T-Mobile USA:  For n258, RAN4 should revise current band n258 specifications to implement +1 dBm/200 MHz immediately, and leave -5 dBm/200 MHz for a future revision, when applicable.  T-Mobile notes that the +1 dBm/200 MHz option is missing in the proposals. T-Mobile suggests it be included.  Samsung: Support Option 3, but the both phased requirementd of WRC-19 can also be added to additional requirements  Intel: None of them. Suggest to add option -4: follow WRC-19 two step approach. |
| -2 | (Wait for indication from regulators) |
| -3 | -8 dBm/200 MHz |

#### Summary of 1st rounds of discussion on Sub topic #4.1.1: WRC-19 resolutions

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| Open Issue | Description | Summary |
| 4.1.1.1 | Additional or general requirements | Majority seems to prefer introduction in to the additional limits. Minority refers to the -8 dBm limit in general requirement however in an other discussion, sub topic #4.1.2, this -8 dBm is considered as a mistake. The problem of adding new NS to existing bands should be discussed in topic #5. |
| 4.1.1.2 | Timing of introduction of new requirements | Opinions on when to introduce new requirements are divided. We would need assurance that Softbank comment is true. Would it then overrule also EU limit? |
| 4.1.1.3 | Emissions Limit to adopt in 3GPP | Also +1 dBm was proposed in addition to the options. |
| It is evident that no CR’s will be agreed but we will need a further discussion in next meeting. Overall summary and proposed 2nd round actions: Docomo to lead a WF to see what actions are needed and what can 3GPP agree now. | | |

#### Discussions on 2nd rounds of discussion on Sub topic #4.1.1: WRC-19 resolutions

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| Open Issue | Description |
| WF from NTT Docomo **R4-2002729** | SoftBank: As a response to 4.1.1.2 above, a comment [SoftBank-2] was not intended for EU where a tighter requirement has already been in place. Rather, this is for where no requirement has been set for EESS protection. From ITU-R standpoint, I guess that there is no issue if an aggressor provides protection tighter than recommended for any reason since the context of "protection" is apparent.  So, for EU, it is better to watch what is going to happen but for the rest of the world, it is better to consider to comply with WRC-19 limit promptly. |

### Sub topic #4.1.2: Correction on -8 dBm / 200 MHz

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000212**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000212.zip) | CR to 38.101-2: A-MPR Corrections | Qualcomm Incorporated | Removal of -8dBm/200 MHz general requirement duplicated in error from general requirements |

### Sub topic #4.1.3: Impact of ETSI harmonized std

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000214**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000214.zip) | Impact of EN 301 908-25 on FR2 | Qualcomm Incorporated | Proposal 1: NS\_201 and NS\_202 A-MPR framework in TS38.101-2 must be modified to include n257 in a release-independent manner if the ETSI harmonized standard EN 301 908-25 includes n257 |
| [**R4-2000218**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000218.zip) | dCR to 38.101-2: NS extension to n257 | Qualcomm Incorporated | CR according to 214 |

### Sub topic #4.1.4: PCMAX CA correction (Agenda 6.5.7.1)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000109**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000109.zip) | Background for Pcmax correction for CA | Qualcomm Incorporated | Observation 1: PUSCH preparation time is short  Observation 2: Power control process can not be iterative  Observation 3: Section 7.1 through 7.4 conclude what are the desired powers for the channels in a transmission  Observation 4: Actual power to be transmitted is known only after scaling according to section 7.5 in TS 38.213 is performed  Observation 5: PCMAX can be calculated for each transmission occasion once based on only on grant  Observation 6: RAN4 specification is misaligned with the assumptions made in RAN1 specification  Proposal: RAN4 specification must be corrected to align with the RAN1 specification |
| [R4-2000107](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000107.zip) | Pcmax correction for CA | Qualcomm Incorporated | CR According to 109 |
| [**R4-2001765**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001765.zip) | CR for FR2 CA Pcmax\_Rel-15 | Huawei, HiSilicon | CR seems same as Qualcomm |

### Sub topic #4.1.5: Pumax evaluation period (Agenda 6.5.7.1)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2000507](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000507.zip) | CR to 38.101-2 (Rel-15) Configured transmitted power for CA | Intel Corporation | Adds :” The evaluation period for PUMAX is determined by the longest slot duration among CCs. A UE expects there is no slot across the boundaries of an evaluation period. MPR and A-MPR are the largest values within the evaluation period.” to CA PCMAX  From Agenda 6.5.7.3 |

### Sub topic #4.1.6: Relative power tolerance alignment (Agenda 6.5.7.1)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2001387](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001387.zip) | Correction on transmission gap for FR2 relative power tolerance | Ericsson | Adds less than or equal in “transmission gap between these sub-frames is less than or equal to 20 ms” n 6.3.4.3 Relative power tolerance. Justifies alignment with FR1 |

### Sub topic #4.1.7: Beam Correspondence correction (Agenda 6.5.7.2)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2001763](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001763.zip) | CR for 38.101-2 side condition for BC\_Rel15 | Huawei, HiSilicon | Adds agreed side conditions for power class 3 |

### Sub topic #4.1.8: Max duty cycle clarifications (Agenda 6.5.7.3)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000005**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000005.zip) | Clarification for the definition of the UL duty cycle | Apple Inc. | Proposal 1: Clarify that a UE maximum transmission power is assumed for the definition of the Rel-15 maximum UL duty cycle.  Proposal 2: Send LS to RAN WG2 asking to introduce further clarifications into the definition of maximum UL duty cycle. |
| [R4-2000084](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000084.zip) | [draft] LS on clarification for the definition of the UL duty cycle | Apple Inc. | To RAN WG2 group. ACTION: RAN WG4 asks RAN WG2 to introduce changes into the definition of maxUplinkDutyCycle-FR2 parameter. |

### Sub topic #4.1.9: UL RMC correction for undefined slots (Agenda 6.5.7.3)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2000003](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000003.zip) | Correction of the FR2 RMC slot patterns for MOP test cases | Apple Inc. | Correcting usage of undefined slots in Ul RMC:  mod(slot index, 4040404040404040404040404040) = {36,…,39} |

### Sub topic #4.1.10: PTRS introduction to 64 QAM RMC (Agenda 6.5.7.3)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2000010](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000010.zip) | Correction of FR2 64QAM UL RMC | Apple Inc. | Proposes to Introduce PTRS to 64 QAM UL RMC and EVM test |

### Sub topic #4.1.11: Correction to link angles (Agenda 6.5.6)

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [R4-2000198](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000198.zip) | CR to 38.101-2 to correct Link and Meas Angles | Keysight Technologies UK Ltd | Numerous corrections to link angle definitions and measurement grid definitions |

## Summary for FR2 transmitter

### Discussions for 1st round on FR2 transmitter

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| Sub topic | Company views: |
| 4.1.2: Correction on -8 dBm / 200 MHz | Huawei: for Refsens, it is not clear that whether both NS 201 and 202 or one of them is configured. NS 200 could be also alternatively for n258..  NTT DOCOMO, INC: We have an objection for the CR from Qualcomm. Our views are documented in R4-2000230 and R4-2000231. |
| 4.1.3: Impact of ETSI harmonised std | [SoftBank] For EESS requirements, they are limited to small range of frequencies in n257. It is straightfoward that the modification of 3GPP requirements also limit to the related frequency range in n257. It is preferable to avoid the introducion of new NS if other scheme can solve this problem since NS resources are limited.  Huawei: Adding n257 to ETSI is still under reviewing process, we don’t think the EESS protection requirement is so urgent for n257, since it is relatively far from the 24GHz.  Ericsson: we agree that NS\_201 and NS\_202 be added. There is also a note in the EN: “NOTE:Radio equipment in band n257 is only allowed to operate from 26 500 MHz to 27 500 MHz”. The modifiedMPRbehaviour could possibly be used to allow Rel-15 devices indicate support of the new NS values for e.g. SCG configuration by the EN-DC (gNB aware that n257 supports the new NS, should not configure SCG otherwise).  NTT DOCOMO, INC: We have an objection for the CR from Qualcomm. Our views are documented in R4-2000230 and R4-2000231. With respect to adding a new NS to an existing band, as proposed in R4-2000223, we need a mechanism to make UEs report which NS they can deal with to a network. Whatever ETSI harmonised std introduces, the decision of WRC19 shall be introduced because not all the countries uses ETSI harmonised std. There is no logical justification to wait for the decision of ETSI harmonised std. If ETSI decision is different from what WRC19 concluded, we just introduce that with some solution later on.  Nokia: Does the same A-MPR apply to n257 as n258? n257 is in much higher frequency. As an editorial concearning Table 6.2.3.2.3-1 and Table 6.2A.3.2.3-1 only one row would be sufficient to n258 A-MPR.  Intel: If ETSI officially includes n257 (expect at end of 2020), we must consider n257. Comments for CR:  for NS\_201, it looks like n257 does not need AMPR at least for PC2-4 for single CC, since its low band edge is larger than AMPR offset range defined for n258.  Qualcomm: (To Nokia) Please refer to draft CR (0218) to see exactly how it impacts standard. In some cases (PC3 NS\_201), the higher frequency of n257 helps. In others (NS\_202 all PC, NS\_201 PC1, etc), the AMPR is not offset sensitive. |
| 4.1.4: PCMAX CA correction | Huawei: our CR have more discription on power scaling part cpmpared with QC.  Ericsson: (comments to R4-2000107 and R4-2001765) the intention of the deleted provision in the first paragraph was to include in PCMAX the CCs that are activated and with a transmission grant, but not deactivated but configured CCs. An iterative scaling procedure of the PCMAX is not implied. Then the PCMAX is also subject to the power class (defined in a different plane of reference) measured as PUMAX. 1) Now PCMAX is undefined. 2) The PUMAX is not scaled according to 38.213, but the power of the transmissions PUSCH/PUCCH and SRS in case PCMAX implies a PUMAX higher than the power class. 3) The PUMAX formula: there is only one frequency f per carrier c in FR2. We do not agree the CR in R4-2000107 without modifications.  Apple: We agree with Qualcomm that the current definition may imply an iterative scaling procedure and support a correction to clearly refer to the scaling rules. |
| 4.1.5: Pumax evaluation period | Qualcomm: Evaluation period for PUMAX is new term. Does it mean here the evaluaion period for the test or for the UE setting? If for UE setting, evaluation period should be the shortest of the channels or hops in a channel amnd reference perdios is the one described in this change.  Ref language in 38101-1 6.2A.4: *TREF and Teval are specified in Table 6.2A.4.1.3-0 when same and different slot patterns are used in aggregated carriers. For each TREF, the PCMAX\_L is evaluated per Teval and given by the minimum value taken over the transmission(s) within the Teval; the minimum PCMAX\_L over the one or more Teval is then applied for the entire TREF*.  A discussion paper for this change or more explantions would be good. |
| 4.1.6: Relative power tolerance alignment |  |
| 4.1.7: Beam Correspondence correction | Apple: Our understanding is that ”reference point” in the side condition refer to the baseband reference. Furthermore, we do agree that the core requirement assumes SNR ≥ 6 dB at this reference point.  However, in an RF test setup it is not possible to control the SNR at the baseband reference, since there is no additional noise injected by the test system. Thus, it is not feasible for the RF test setup to implement these side conditions. One option is to define these side conditions at the radiated interface boundary (RIB) of the UE. Then the SNR as perceived by the UE baseband would vary as a function of UE orientation and antenna array response. We recommend studying this further to determine what SNR side condition at the RIB we can specify in TS38.101-2. |
| 4.1.8: Max duty cycle clarifications | OPPO: maxULdutycycle capability applies to all UE powers single only one capability is reported. How to derive this duty cycle capability is up to UE implementation, there is no need to define in the spec. And with this change it will be misleading, i.e. which duty cycle should this UE appliy if this duty cycle is only defined for max power? Therefore, we suggest to keep as it is.Huawei: we would like to know the network behavior if the maxUplinkdutycycle is clarifed at only MOP.Ericsson: OK. The max duty cycle should be mapped to power class.  NTT DOCOMO, INC: We agree with the motiation. We should clarify the meaning of ”UE maximum transmission power”. Does this mean TRP or EIRP, and maximum power that each UE has or maximum power related to power class? According to 6.2.4 in the latest 38.101-2, P-MPR seems to be appried to minimum peak EIRP relate to power class.  Intel: A reference is needed to know how to interpret the chosen UL duty cycle %. Just for clarification, what exactly is meant by UE maximum transmission power in this paper? If it is Pcmax, that is one option. Whichever reference is used, it would be good to align with the dynamic duty cycle if introduced in enhanced solution (use same reference for both).  Apple: Here are some further comments and answers to the questions from other companies:  @OPPO: A UE does not apply any duty cycle, it is the network that decides which UL duty cycle should be used. If a UE reports that its preferred cycle, e.g. 20%, for the maximum transmission power, then the network knows that it is safe to apply 20% in all the cases, including a lower transmission power. However, it is of course up to the network implementation which UL duty cycle to use.  @Huawei: We do not enforce any particular network implementation. Referring to the example provided above, with this clarification the network will know that it is safe to apply a particular UL duty cycle even at the maximum transmission power. It is however up to the network implementation to apply a different UL duty cycle when a UE transmits at lower power.  @NTT DOCOMO/Ericsson: Yes, the intention is to clarify UL duty cycle definition in relation to the maximum power as defined/governed by the corresponding power class.  @all: We can discuss further what maximum transmission power could refer to in the capability definition, but we were thinking of Pcmax or TRP. EIRP is not desirable as the UE does not know the direction. |
| 4.1.9: UL RMC correction for undefined slots | Ericsson. OK |
| 4.1.10: PTRS introduction to 64 QAM RMC | Huawei: we have a CR on PTRS configuration in previous meetings. It’s better to have a new table on PTRS configurations.  Ericsson: if the exact TBS is not provided, RAN5 cannot implement this test. No point to approve in this meeting.  Qualcomm: This changes core requirement and discussion has allready once concluded not to introduce this. Not ok with the change.  Apple: We agree that the exact TBS configuration is needed; however, it is not provided for the DL RMC either. Both can be finalized next meeting. To Qualcomm: we would appreciate seeing technical reasons for not introducing this change; at least R4-1812340 is aligned with our proposal.  Qualcomm: (to Apple) In our view CR alignment does not make it agreeable. We would appreciate seeing technical data from interested companies on how much the EVM improves as a function of PTRS configuration and MCS. This would help in deciding if PTRS is needed |
| 4.1.11: Correction to link angles | Huawei: do not need  Anritsu: In addition to the limitionsuggested changes in the CR (R4-2000198), we think two changes are needed.   1. Definition of EIS is needed with RX beam peak direction as the link angle. 2. We found that meas and link are alwaysthe link angle condition for TRP is not clear whether it is describing the initial link condition (TX beam peak direction) or the condition for during the measurement (any arbitral direction).   Suggested changes are as follows.  **Newly added**  **EIS(Link=RX beam peak direction, Meas=Link angle):** measurement of the EIS of the UE such that the measurement angle is aligned with the RX beam peak direction within an acceptable measurement error uncertainty.  **Add some clarification texts.**  **Link angle:** a DL-signal AoA from the view point of the UE, as described in Annex J. If the beam lock function is used to lock the UE beam(s), the initial link angle before the beam lock can become any arbitrary AoA once the beam lock has been activated.  **R&S:** Some small corrections are needed in our view, in general we are ok to improve the wording. Remove EIS from EIRP in Tx beampeak (same comment as Anritsu). Regarding spherical coverage, correction here is needed in our view, since also the beampeak search grid may be (re-)used for spherical coverage according to TR 38.810.  **Apple**: We are OK with KS: I have made some corrections in the Keysight proposed draft CR based on feedback from Anritsu and R&S.  Not making any changes. However, we don’t understand the motivation for introducing additional dependencies can lead to significant confusion, e.g.,   * Min EIRP is currently suggesting to measure EIRP based on the beam peak search grid, i.e., multiple directions? This is incorrect * EIRP and EIS Spherical Coverage is currently only allowed based on the beam lock function,peak search grid; this is not in line with previous agreements to use a coarser grid for spherical coverage * REFSENS currently suggests to perform measurements along the beam peak search grid directions. This is wrong as suggested by Anritsu.it needs to be limited to RX Beam Peak direction only   Anritsu2: We are fine with the revised CR (DRAFT R4-200xxxx (rev of 0198) MeasLinkAnglesR15.docx)  Qualcomm: We support this change, in some case the definitions are clearly wrong and should be corrected and aligned. We are also ok to remove them completely and put them in to ran5 specifications. |

### Summary of discussions after 1st round for FR2 transmitter

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| Sub topic | Summary |
| 4.1.2: Correction on -8 dBm / 200 MHz | Refsens issue needs a revision but it seems NTT Docomo has an alternative change in mind but that seems to be related to WRC19 whicvh is isolated topic from this change.  Proposal is to continue discussion in 2nd round to conclude if -8 dBm in general requirements for CA was the intent originally. |
| 4.1.3: Impact of ETSI harmonised std | Comments on both sides, it seems maybe reasoning for the change has not been understood.  Proposal for 2nd round is that CR R4-2000218 is postponed until more information is available. |
| 4.1.4: PCMAX CA correction | Proposed WF is that either [Qualcomm or Huawei, TBC which one] provides a revision of the CR trying to capture concerns from Ericsson. |
| 4.1.5: Pumax evaluation period | Keep discussing the CR [R4-2000507](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000507.zip) int he 2nd round |
| 4.1.6: Relative power tolerance alignment | CR [R4-2001387](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001387.zip) is agreed |
| 4.1.7: Beam Correspondence correction | CR [R4-2001763](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2001763.zip) is agreed.  To Apple, this CR and content was allready agreed in previous meeting after long debate. It was resubmitted to this meeting since cat.A CRs were not available in time for plenary submission. |
| 4.1.8: Max duty cycle clarifications | Proposal is to continue discussion in 2nd round. Apple to lead WF. |
| 4.1.9: UL RMC correction for undefined slots | Proposal is to agree CR [R4-2000003](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000003.zip). |
| 4.1.10: PTRS introduction to 64 QAM RMC | CR is missing details and there are opposing views on introducing this feature at all.  Proposal is to postpone CR [R4-2000010](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000010.zip) to next meeting and continue discussion with more details with discussion papers if proponents choose so. |
| 4.1.11: Correction to link angles | Proposal is to continue discussion on 2nd round based on revised CR already provided  <ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/DRAFT%20R4-200xxxx%20%28rev%20of%200198%29%20MeasLinkAnglesR15.docx> |

### Discussions for 2nd round on FR2 transmitter

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| Sub topic | Company views: |
| #4.1.2: Correction on -8 dBm / 200 MHz |  |
| #4.1.4: PCMAX CA correction, revised CR R4-2002730 | Qualcomm: Revised [CR R4-2002730 draft](ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/DRAFT%20R4-2002730_CR0084_Cat.F_Rev_1%2038101-2_Pcmax%20correction%20for%20CA.docx) is in drafts folder that incorporates Ericsson concerns and included Huawei changes.  To Ericsson: it seems in your comments that you assume PCMAX is configured power for each transmission occation but it is not, that would be PC and RAN4 deals only with PCMAX which is maximum of configured output power and PCMAX is not a sum of any granted output powers but sum of those determined transmission power (as per 38.213 language) is compared against PCMAX. So to your concerns:   * + - PCMAX has always been defined in the second sentence but now it is defined more, pls see the CR     - I removed PUMAX scaling but added a informative note that determined powers may have been scaled (again 38.213 language) . IMO there is no need to have normative overlapping text in ran4.   I removed carrier f from PUMAX. I am not sure if you meant to remove it from PCMAX too. |
| #4.1.5: Pumax evaluation period | [Intel] Your understanding is correct. If evaluation period is for UE setting, evaluation period should be the shortest of the channels or hops in a channel. Our CR is for evaluation period for Pumax as specific in CR.  Qualcomm: Same comment as 1st round, it should be clarified in the text that measurement evaluation period is in question. As we can see, the UE needs to also set the PUMAX since scaling rules. |
| #4.1.6: Relative power tolerance, revision of CR (cover page) R4-2002731 |  |
| #4.1.7: Beam Correspondence correction, **revised CR R4-2002732, cover page** |  |
| #4.1.8: Max duty cycle clarifications (WF) Apple R4-2002733 and LS R4-2000084 | OPPO: Our understanding is currently there is only one maxULdutycycle capability reported to the network and how network apply actually up to NW. Regarding how to derive this duty cycle capability is up to UE implementation. With this change it will be misleading, i.e. which duty cycle should this UE appliy if this duty cycle is only defined for max power? If the definition is changed, this misleading shall also be avoided.  Qualcomm: To Oppo: Current rel-15 parameter is static UE capability that informs network how large UL ratio UE is able to transmit. UE can choose what number it declares but there has to be a common referencewhat it means. What you say in your comment leave the whole capability completely ambiguous fo rthe network if the reference power is not defined so then we should remove it. |
| 4.1.11: Correction to link angles, revised CR **R4-2002734** |  |

### Summary for 2nd round on FR2 transmitter

## FR2 Receiver (Agenda 6.5.8)

### Sub topic #4.3.1: Change on IBB blocker location

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000436**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000436.zip) | Condition of IBB blocker location in FR2 | Anritsu Corporation | Observation 1: Original motivation to place the blocker throughout the pass band is to confirm spurious responses within a UE. (e.g. Image response and Half-IF spurious response.)  Observation 2: From the current design of the mmWave UE frontend architecture, an image of the interferer does not appear in a same FR2 band of the wanted signal.  Observation 3: The half-IF spurious response also does not appear in-band or can be assumed as negligible in FR2.  Proposal 1: Modify the requirement of IBB in TS 38.101-2 to place the in-band blocker only at the first non-adjacent channel position (FIoffset = +/- 2\*Channel BW). |

### Sub topic #4.3.2: RX requirements for UL MIMO

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000697**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000697.zip) | CR to 38.101-2: Removal of Rx requirement for UE in UL MIMO | Qualcomm Incorporated | Voids sections 7.3D, 7.4D |

### Sub topic #4.3.3: Uplink level change for RX tests

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| [**R4-2000749**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000749.zip) | CR for TS 38.101-2: Clarifications on transmitter power for recevier requirements | MediaTek Inc. | Changes the tx level reference in max input level test to pumax, from “lower limit of pumax” and adds this condition to ACS and inband blocking |

### Sub topic #4.3.4: Change on SSB and TRS configurations

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| R4-20xxxxx | CR to TRS and SSB configurations in FR2 | Qualcomm Incorporated | SSB and TRS configurations are modified in such a way that those do not collide in the time domain, which is aligned with test configuration in TS38.101-4. |

## Summary for FR2 receiver

### Discussions for 1st round on FR2 receiver

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| Sub topic | Company views: |
| 4.3.1: Change on IBB blocker location | Huawei: We support this contribution. For the worst case with image and fIF/2, there is not possible that the interferer fall within the band on FR2. There is no need to test on all non-adjacent channel for IBB. For the other issues, the first non-adjacent test would be enough.  NTT DOCOMO, INC: We have a concern about the change of in band blocking requirements, and we need further studies since there is no out of band blocking requirent is FR2.  Qualcomm: Changes core requirement due to testability concerns. Not ok with the change.  Anritsu: We appreciate if interested companies in addition to Huawei can confirm the properness of our suggestion. Also we are fine to keep core requirement and discuss only test requirement in RAN5 as far as the technical validity is confirmed in RAN4. |
| 4.3.2: RX requirements for UL MIMO | OPPO: Ok with the change, but how about other Rx cases like ACS, blcoking, etc?  Huawei: UL MIMO RX requirement is not defined only for FDD band. We prefer to keep the RX requirement for UL MIMO.  Qualcomm: To Huawei, would you please explain what is being tested in 7.3D that is being missed in 7.3, for TDD UEs? |
| 4.3.3: Uplink level change for RX tests | Qualcomm: Change penalises UE with higher EIRP capability. Not ok with the change  Xiaomi: Thanks MTK for the paper 2000749. Like our paper R4-2000449, we propose Changing TX from Pcmax 4 dB below PUMAX,f,c to 24 dB below PUMAX,f,c for ACS case 2 in table 7.5-3 and 7.5A-3.  ZTE: In xiaomi’s CR [449], it is ‘..4 dB below PCMAX\_L,f,c ..’, but in MTK’ CR[749], it is ‘...4 dB below the PUMAX,f,c...’. So which one is correct??  Huawei: Agree.  [MTK] Thanks for Qualcomm, Xiaomi, ZTE and Huawei’s comments. For Qualcomm, it is not clear to us why UE with higher EIRP capability would be penalized. For Xiaomi, we are fine with your change for FR1 ACS case 2 as it is consistent with LTE. However, LTE itself already has some inconsistency in UL power level setting for maximum input power and ACS case 2 where the former is set to be the same as ACS case 1 at 4 dB below Pcmax even though the wanted signal is much higher. For FR2, due to large path loss, we think it is better not to set the UL power level at 24 dB below Pumax to ensure the UL signal can be reliably received and demodulated by the tester. For ZTE, in FR2 Pumax is what truly represents UE’s maximum output power. It can be easily set by sending a series of TPC UP commends till the output power saturates, but not for PCMAX\_L,f,c nor for the lower limit of Pumax. |
| 4.3.4: Change on SSB and TRS configurations |  |

### Summary of discussions after 1st round for FR2 receiver

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| Sub topic | Summary |
| 4.3.1: Change on IBB blocker location | Core requirement chance does not seem possible but narrowing down the scope of testing maybe applicable.  Proposal is to continue discussions in ran5 and possibly in next ran4 meeting to confirm the validity of the narrowing the testing scope if proponents chooses so. |
| 4.3.2: RX requirements for UL MIMO | Proposal is to continue discussions on 2nd round. |
| 4.3.3: Uplink level change for RX tests | It seems to be a change to core requirements. There is a request to clarify notations. Proposal is to postpone CR [**R4-2000749**](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_94_e/Docs/R4-2000749.zip)**.** |
| 4.3.4: Change on SSB and TRS configurations | Proposal is to allocate TDoc and CR number CR “R4-20xxxxx CR to TRS and SSB configurations in FR2” found in  <ftp://ftp.3gpp.org/tsg_ran/WG4_Radio/TSGR4_94_e/Inbox/Drafts/%234_NR_NewRAT_UE_RF/R4-20xxxxx.zip> |

### Discussions for 2nd round on FR2 receiver

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| Sub topic | Company views: |
| 4.3.1: Change on IBB blocker location | Anritsu: We appreciate if interested companies in addition to Huawei can confirm the properness of our suggestion.  Also is it possible to correct views from UE vendors regarding the actual IF position in FR2 UE? |
| #4.3.2: RX requirements for UL MIMO |  |
| #4.3.4: Change on SSB and TRS configurations CR **R4-2002735** Qualcomm | Qualcomm: The Tdoc number has been updated to R4-2002873 due to CR number missing in R4-2002735. Other than CR number updte, contents are the same.  Anritsu: 1) If this CR (R4-2002873) is the revision of R4-2002735, then the revision number on the cover page need to be “1” instead of “-“.  Qualcomm) It is indicated as “-“ in the CR allocation table from Kai-Erik.   | Tdoc | Title | Source | Doc-type | Replaces | CRnbr | CRrev | CRcat | .. |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | R4-2002873 | R15 CR to 38.101-2: TRS and SSB configurations in FR2 | Qualcomm Incorporated | CR | R4-2002735 | 0135 | - | F | … |  |   Anritsu: 2)Isn’t this change also needed with 38.101-1 in a similar way?  Qualcomm) We’re internally reviewing it as well. As this CR had been requested during RAN5 e-meeting before a similar issue in 101-1 was found, we didn’t have time to double check and prepare a similar CR for FR1. And from what I heard, CR on 101-2 is more urgent. So we plan to further check 101-1 and will correct 101-1 in a similar way as 101-2 in the next meeting, if the submitted CR is approved and we come to a conclusion that 101-1 should be corrected as well. |

### Summary for 2nd round on FR2 receiver

# Topic #5: Signalling supported NS values

## Submitted contributions

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| **Tdoc** | Title | Company | **Proposals / Observations** |
| R4-2000220 | Necessity of signaling supported NS values | NTT DOCOMO, INC. | This contribution addressed to clarify the issues without means to convey supported NS values for a band by a UE to a NW. As a conclusion, we share three observations and propose the following. Companion CRs are also provided in [2-4].  **Observation 1:**  **If at least two types of UEs whose supported NS values are different for a band exist simultaneously in a NW and the NW cannot distinguish them, Standalone NW will see *RRCReconfiguration failure* during handover and Nonstandalone NW will see *RRCReconfiguration failure* during EN-DC configuration.**  **Observation 2:**  **Without solving the issues, RAN4 has to create a new band whenever RAN4 identifies a new spectrum emission requirement for the existing bands.**  **Observation 3:**  **There is no RAN2 spec impact on broadening the definition of modifiedMPR-Bhaviour.**  **Proposal:**  **Broaden a definition of “*modifiedMPR-Behaviour*” in RAN4 specifications in a way that a new bit is defined when MPR or A-MPR for the existing NS is modified or a new NS is added to an existing band from Rel15.** |
| R4-2000221 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-1 | NTT DOCOMO, INC. | Adds annex H to 38.101-1 |
| R4-2000222 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-1 | NTT DOCOMO, INC. | Adds annex H to 38.101-1 |
| R4-2000223 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-2 | NTT DOCOMO, INC. | Adds annex H to 38.101-2 |
| R4-2000224 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-2 | NTT DOCOMO, INC. | Adds annex H to 38.101-2 |
| R4-2000225 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-3 | NTT DOCOMO, INC. | Adds annex H to 38.101-3 |
| R4-2000226 | Broadening a definition of “modifiedMPR-Behaviour” for 38.101-3 | NTT DOCOMO, INC. | Adds annex H to 38.101-3 |

## Open issues

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| **Issue #** | Issue | Company views |
| **#5.2.1** | Change the modified MPR behavior to define 15.8 as baseline | Ericsson: we support the idea that support of a new NS value can be indicated as a modifiedMPRbehaviour – a new NS usually implies an MPR or A-MPR modification -- to avoid RRC reconfiguration reject (this should not happen). An old problem from LTE days. However, the absence of the bitmap should mean that the UE supports features according to its indicated release and be specified in the 38.331 (behavior is not specified in RAN4 specifications), i.e. there are no modifications (in later releases) supported. For NS values absence means it supports all NS values of that indicated release. The statement "Absence of the modifiedMPR-Behaviour for a supported band means that the UE supports all of the NS values that were specified for the band in Table 6.2.3.1-1A of TS 38.101-1 version 15.8.2." cannot be used since modified behavior is not only about *new* NS values. The bits of the bitmap can be mapped to different versions of the specifications so a particular baseline version for the entire bitmap cannot be used.  Huawei: Modified MPR capability is used to indicate whether UE support the updated MPR or AMPR to a certain NS per band.  For the cell access procedure defined in RAN2 spec, the UE will check whether the current NS is supported, if it is not, UE will drop the access procedure.  In the CR, it is mentioned “Absence of the modifiedMPR-Behaviour for a supported band means that the UE supports all of the NS values that were specified for the band in Table 6.2.3.1-1A of TS 38.101-1 version 15.8.2 and Table 6.2.3.1-2 and 6.2A.3.1-2 of TS 38.101-2 version 15.8.0.”, if an UE produced for version 15.8.0 is absence with this signalling, then a later release gNB will consider this UE can support all NS defined in a later release. Then the RRCreconfiguration failure will still happen.  OPPO: Understand the intentionentire bitmapintention, and for clarification, if the “modifiedMPR-Behaviour” is not absent, how to understand this bit? Is it for modified MPR or NS signaling since these two are using same bit in RAN2. And in a later release if a new NS signaling is introduced then what is the expected behavior of legacy UE and new UE?  NTT DOCOMO, INC.:  For Huawei, with regard to a comment about *“if an UE produced for version 15.8.0 is absence with this signalling, then a later release gNB will consider this UE can support all NS defined in a later release. Then the RRCreconfiguration failure will still happen.”*  No it will not happen anymore. The gNB will consider the UE without signaling supporting at least all the NS defined until version of 15.8.0. Thus, if the gNB uses a new NS which was defined “after” v15.8.0, the gNB can avoid having RRC reconfiguration failure because the gNB know that UE cannot deal with the new NS since the UE does not report signaling.  For OPPO, [Q1]how to understand this bit? Is it for modified MPR or NS signaling since these two are using same bit in RAN2  [Ans1] Since each of the bits is listed in a table in the Annex together with the definition, NW can distinguish the meaning of each of them, i.e., if a bit is for MPR change for a band, AMPR change or a new NS (together with AMPR if necessary).  [Q2] in a later release if a new NS signaling is introduced then what is the expected behavior of legacy UE and new UE  [Ans2]  For legacy UE, a network using a new NS knows that the legacy UE does not support the new NS. In SA, the UE cannot understand the NS, thus, the UE considers the cell as barred. In NSA, the UE firstly access to the network via LTE and the network can know that this UE can NOT handle the new NS. Thus, the network would not configure EN-DC with the band (with the new NS). So no failure.  For new UE, In SA, the UE can understand the NS, thus, the UE can access to the band. Also handover does work smoothly since the network knows appropriate NS for the UE and convey that information to a destined gNB during handover. In NSA, the UE firstly access to the network via LTE and the network can know that this UE can handle the new NS. Thus, the network would configure EN-DC with the band (with the new NS). Handover does work well as explained in SA.  For Ericsson, an alternative would be as follows. For the existing bands, we set the version of 15.8.2 as boundary. That means UEs supporting bands specified in 15.8.2 shall at least all the NS captured in version 15.8.2. if a new NS is introduced into one of the bands, that will be captured in a table at that time. For new bands, we will have a list showing that when the band is introduced and which version is the boundary.  Qualcomm (late comment to NTT Docomo response): Not clear how the new UE in SA would support all the new the NS’s. And how the network would know what UE support since UE never attaches to the network. NS is in SIB. |
| **#5.2.2** | Add modified MPR to all -1, -2 and -3 specs | Ericsson; only to -1 and -2 for modifications bands in the respective frequency range. The bitmap is sent per band in the UE-NR-Capability. Introduce in -2 once there is a modification for an FR2 band. |

## Summary of Open issues

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| **Issue #** | Summary |
| **#5.2.1** | Idea seems to be supportable but some details need to be cleared.  Proposal is to continue discussions and clarifications in the second round. |
| **#5.2.2** | Proposal in the comments is -1 and -2 but in a comments to other issue, it was pointed that NSA UE behavior is enhanced since it can signal through LTE what are supported NS values in NR.  Proposal is to continue discussions in the 2nd round.  For both topics, it looks CR’s can not be agreed but WF lead by NTT Docomo would be appropriate. |

## Discussions on 2nd round

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| Sub topic | Company views: |
| WF on Signalling supported NS values from NTT Docomo R4-2002737 |  |
| Issue #5.2.1 | Ericsson:  indication of support of a new NS value can be achieved using the modifiedMPRbehaviour. No need to assume a certain baseline version of the specification (such as e.g. 15.8.2); if a new NS value is specified for Band nX in Rel-N (in v.N.x.y say) then UEs compliant with Rel-N shall set the bit to 1 whereas an earlier UE of Rel-M with M < N can set the bit to 1 (if NS supported) or 0 (if NS not supported).  The bitmap must always be included if the UE supports Band nX, no implicit behavior.  A revision of the CR in R4-2001308 can be found in “R4-2001308\_rev1 modification of modifiedMPRbehavior R15”  T-Mobile – a question to DOCOMO for clarification  Assume that NS\_202 and NS\_203 are adopted for n258 to signal WRC two-phases emission limits; phase-1 limits apply to UE and BS deployed before Sep 1, 2027 and phase-2 limits apply to those deployed after.  Two different scenarios:  Scenario 1: both NS\_202 and NS\_203 are agreed at same time and implemented in the same version of TS 38.101-2 and 38.104 for UE and BS respectively.  Scenario 2: NS\_202 is agreed first and NS\_203 is agreed at a later time; and NS\_202 is implemented into TS 38.101-2 version xx.x.x and NS\_203 is implemented into TS 38.101-2 at a later version. NS\_202 and NS\_203 are implemented into different versions of 38.104 in a similar manner.  Suppose we adopt DOCOMO’s proposal. If an operator deploys BS and UE before 2027 based on 38.101-2 version xx.x.x, which has NS\_202 but does not yet have NS\_203. Then the operator deploys BS and UE after 2027 based on a later version of 38.101-2, which has both NS\_202 and NS\_203. Let’s call a UE deployed before 2027 based on 38.101-2 version xx.x.x “legacy” UE, and call a UE deployed after 2027 based on a later version of 38.101-2 ‘new’ UE. Let’s also call ‘legacy’ BS and ‘new’ BS in a similar manner.  Question 1: With scenario 2, when a legacy UE moves to a new BS area, will the UE consider the cell barred because it does not understand NS\_203? If so, is there a way to avoid such a problem? Note operators want ‘legacy’ UEs to be able to access ‘new’ BS as well.  Question 2: With scenario 1, when a UE deployed before 2027 moves to a BS deployed after 2027, will the UE be able to access to the BS without a problem?  NTT DOCOMO, INC.: To T-Mobile  Our answers are in terms of SA  To: Question 1  It depends on if BS uses multiple NS with NR-NS-PmaxList.   * If BS does not use the feature and signals only NS\_203, the legacy UE considers the cell as barred. * If BS uses the feature and signals both NS\_203 and NS\_202 by giving NS\_203 first priority, the legacy UEs can understand NS\_202 so that it can camp on the cell.   To: Question 2  Yes it will be access to the BS without a problem.   * In this case, even if the BS only signals NS\_202 before 2027 and NS\_203 after 2027. * But if I were a Tmobile, I would use NR-NS-PmaxList   Please understand that the assumption is that there are no n258 capable UEs now.  Also, please note that the above scenario 1, legacy UEs A-MPR suddenly increase from 2027. |
| Issue #5.2.2 | Ericsson: the modifiedMPR behavior annex should not be included in 38.101-3, only in the SA specifications (in 38.101-2 when the first bit is defined or possibly with an empty list). |

## Summary from 2nd round