**3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-220000x**

**Electronic Meeting, January 17-25, 2022**

**Agenda item:** 6.5.2

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [101-bis-e][302] NR\_Repeater\_RF\_Part1

**Document for:** Information

# Introduction

RAN#90e approved a new “New WID on NR Repeaters” with RAN4 as the responsible WG, which includes development of FR1 FDD specifications as well as TDD specifications for FR1 and FR2. The scope of this email discussion focuses on RF conducted core requirements, the same as the agenda 8.5.2 for current meeting.

List of candidate target of email discussion for 1st round and 2nd round

* 1st round: discuss the open issues and strive to minimize the open issues
* 2nd round: according to 1st round discussion, discuss left open issues for 2nd round, and strive to minimize the open issues, and strive to approve WF.

# Topic #1: power related conducted requirements

NR repeater power related conducted requirements are discussed in this thread, including WA UL co-existence and ALC testing metric.

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2200178**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200178.zip) | NTT DOCOMO, INC. | **Observation 1: It is difficult to make unique assumptions for such as a limit of antenna gain and a maximum beam width, and such requirements could be a constraint in actual operations.****Proposal 1: RAN4 doesn’t define explicitly RF requirements on specific parameters in repeater specification but add the recommendation as requirements to notice the specification reader that deploying operators shall consider to avoid inter-operator interference.****Proposal 2: RAN4 add following recommendation into repeater specification.****In terms of UL Wide Area class repeaters, there were no co-existence study in 3GPP. Therefore, when UL Wide Area class repeaters will be used, it needs to consider to avoid inter-operator interference. It’s left to deploying operators how to avoid interference for UL Wide Area class repeaters. Candidate solutions include planned deployment, potential antenna gain limit or UL beam width limit.** |
| [**R4-2200822**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200822.zip) | CMCC | **Observation 1: repeater could be regarded as UE** **in interference simulation if they have same maximum output power.****Proposal 1: 31dB ACLR could ensure adjacent channel interference co-existence if its output power is not larger than 29dBm.****Observation 2: no output power limit expresses that there is still limit which is declared by repeater vendor based on operator’s demand but not explicitly defined in the spec to give more room for real deployment.****Proposal 2: in most cases, current ACLR is enough and only in extreme case we need extra solutions for adjacent channel system co-existence. We don’t need to explicitly define RF requirement only for very extreme cases.** |
| [**R4-2201459**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201459.zip) | ZTE Corporation | **Proposal 1**: antenna gain or UL beamwidth could be part of declaration for conformance testing;**Proposal 2:** the spurious emission requirement and EVM requirement should also been tested under the ALC mode; |
| [**R4-2201658**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201658.zip) | Nokia, Nokia Shanghai Bell | Observation 1: It cannot be assured without doing a proper analysis whether the UL beamwidth of the repeater is the dominant factor that would cause inter-operator interference.Observation 2: In case of IAB, the selection of antenna parameters (e.g., array spacing, element gain, and element beamwidth, etc.) has been carefully selected to do the coexistence simulations. But in case of repeaters, there has been no such discussion, and arbitrary parameter selection is not a logical approach.Observation 3: The beamwidth of the backhaul beam impacts the level of self-interference experienced by the repeater itself.Proposal 1: It may not be possible to select a value for the beamwidth of the repeater antennas without proper analysis. This analysis may consist of inter-operator interreference as well as the self-interference. Therefore, we propose to not to select nor specify values for such parameters, for e.g., antenna gain or beamwidth limit, at this stage.Proposal 2: It should be left for the operators to handle the coexistence issues (may be case by case basis). Add informative note in specification for example “Co-existence is not covered by the 3GPP specifications” when UL output power is unlimited. |
| [**R4-2201930**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201930.zip) | Huawei | TP to TS 38.106 6.1 and 6.2 |

## Open issues summary

Agenda 6.5.2.1

DL means access link and UL means backhaul link.

### Sub-topic 1-1

**Issue 1-1-1: WA UL co-existence issue**

* Proposals
	+ Option 1: don’t explicitly define RF requirements but add some recommendation/note in the spec to notice the specification reader that deploying operators shall consider to avoid inter-operator interference. (DOCOMO, Nokia, CMCC)
	+ Option 2: antenna gain or UL beamwidth could be part of declaration for conformance testing (ZTE)
* Recommended WF
	+ Don’t explicitly define RF requirements but add some recommendation in the spec.

**Issue 1-1-2: recommendations for WA UL co-existence**

* Proposals
	+ Option 1: In terms of UL Wide Area class repeaters, there were no co-existence study in 3GPP. Therefore, when UL Wide Area class repeaters will be used, it needs to consider to avoid inter-operator interference. It’s left to deploying operators how to avoid interference for UL Wide Area class repeaters. Candidate solutions include planned deployment, potential antenna gain limit or UL beam width limit. (NTT DOCOMO)
	+ Option 2: TBA
* Recommended WF
	+ Approve to add above recommendation into the spec.

### Sub-topic 1-2

ALC related requirements

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| The agreements in RAN4 #101 e-meeting:* For ALC core requirements, including below requirements OBUE, ACLR , output power, spurious emission and EVM requirements
* FFS whether spurious emission and EVM requirements need to be test under ALC test condition which can be further discussed in conformance phase
 |

**Issue 1-2-1: ALC testing metric**

* Proposals
	+ Option 1: the spurious emission requirement and EVM requirement should also been tested under the ALC mode. (ZTE)
* Recommended WF
	+ TBA.

## Companies views’ collection for 1st round

### Open issues

**Sub topic 1-1**

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| **Company** | **Comments** |
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**Sub topic 1-2**

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| **Company** | **Comments** |
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### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2201930 | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

## Discussion on 2nd round (if applicable)

1. Topic #2: Emission related conducted requirements

NR repeater emission related conducted requirements are discussed in this thread, including LA UL ACLR, CACLR and UL regional emission requirements*.*

* 1. Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2200092**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200092.zip) | CATT | **Proposal 1: For repeater UL, local area ACLR reuse PC2 UE requirement.****Proposal 2: Reuse BS approach to handle CACLR requirements for non-contiguous and multi-band requirements.****Proposal 3: No inside pass band OBUE requirement is defined for repeater.****Proposal 4: UL regional spurious emission requirements are based on declaration and the details can be left to implementation.** |
| [**R4-2200823**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200823.zip) | CMCC | Proposal 1: 31dBc is suggested for LA UL ACLR.Proposal 2: CACLR requirement for repeater is also applicable for multi-operation band cases.Proposal 3: the same exceptions for CACLR application range as gNB spec could be reused for both repeater’s DL and UL by replacing RF bandwidth and sub-block with repeater passband bandwidth.Observation 1: inside OBUE requirement is larger than amplified noise floor and could be measurable if it is defined.Proposal 4: it seems we could not define inside passband OBUE requirements for both UL and DL if we test EVM with all the carriers in the passband transmitting simultaneously.Proposal 5: inside passband OBUE is much larger than NF and it can’t be equivalently reflect NF characteristics of repeater.Proposal 6: no need to define NS signalling.Proposal 7: Additional regional emission requirements as in UE spec should be declared by vendor to compliant with regional requirements and only general requirements are required in the spec. |
| [**R4-2201460**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201460.zip) | ZTE Corporation | Proposal 1: to reuse FR1 PC2 UE ACLR requirements for local area class;Proposal 2: to define the OBUE requirement with pass-band if there are any empty carriers within it.Proposal 3: propose CACLR requirement as 31dBc with its Wgap configuration inherited from TS38.104 Table 6.6.3.2-3Proposal 4: additional regional emission requirements should be declared by vendors to comply with regional requirements; |
| [**R4-2201528**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201528.zip) | Ericsson | Proposal 1: Local area UL ACLR is 31dBProposal 2: The core EVM requirement needs to capture an input power range over which EVM is valid. FFS power levels for conformance requirement.Observation 1: EVM with minimum output power can guarantee NF, but not NF+gainObservation 2: Output power with no input can guarantee NF+gain (i.e. interference into the network) but not NF alone. Gain can include amplifier gain and antenna gain if the requirement is EIRP.Observation 3: OBUE requirements may not be sufficient to avoid interference in the DL, as they are greater than interference from adjacent channel BS.Proposal 3: If there is a requirement for maximum output power with no input, it should be the same as the absolute ACLR for DL.Observation 4: Unlike UEs, repeaters will point directly at donor BS continuously in uplink and thus have the potential to create continuous interference.Observation 5: Interference from repeaters with no input signal is in addition to in-band emissions from UEs and adjacent channel emissions from other operators.Observation 6: To avoid interference that is greater than in-channel emissions or adjacent channel interference from UEs, the repeater maximum output power with no input signal would need to be lower than -15 to -25 dBm (depending on bandwidth)Observation 7: Unlike UEs, repeaters will not be close to the donor node (but are likely to have higher antenna gain)Observation 8: -13dBm/MHz (i.e. WA level proposed for DL) would not cause desensitization as long as the coupling loss between the repeater and BS would be in the order of 100dB.Observation 9: If a cell contains many repeaters then the interference would be cumulative and either the output power with no input would need to be lower or the coupling loss would need to be greater.Proposal 4: If there is a requirement for maximum output power with no input, it should be the same as the downlink absolute ACLR also for UL.Proposal 5: If SNR degradation due to NF should be regulated then EVM with low input power should be tested. If interference towards the donor with no input signal should be regulated then instead maximum output power with no input power should be defined and tested. |
| [**R4-2201532**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201532.zip) | Ericsson | Proposal 1: Use the BS method of declaring a single output power with a tolerance.Proposal 2: There is no need to consider NS values in the RAN4 repeater specification. |
| [**R4-2201654**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201654.zip) | Nokia, Nokia Shanghai Bell | TP to TS 38.106 clause 6.5 Unwanted emissions conducted |
| [**R4-2201660**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201660.zip) | Nokia, Nokia Shanghai Bell | Proposal 1: At least OBUE requirements are specified inside passband, to be met within resource blocks which are not allocated.Proposal 2: UE in-band emission requirements are adapted to be used for repeaters. Proposal 3: Take requirements shown in Table 2 as starting point for repeater emission requirements within passband.Observation 1: The formula in Table 2 can be used to derive a single absolute maximum power limit to be used.Proposal 4: RAN4 needs to set requirements guaranteeing that additional UL emission requirements are met.Proposal 5: Additional emissions requirements are defined as regional requirements without any corresponding NS-signalling for repeaters.Proposal 6: MPR and A-MPR is not defined for repeaters.Proposal 7: No separate output power declarations are allowed based on emission requirements. Proposal 8: Local Area repeater UL ACLR is defined as 31 dBc. Proposal 9: RAN4 to discuss whether to replace channel bandwidth with passband bandwidth or define a nominal channel bandwidth which is used to define repeater ACLR/CACLR requirements.Proposal 10: RAN4 to confirm whether same OBUE and absolute ACLR requirements apply for both DL and UL |
| [**R4-2201935**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201935.zip) | Huawei | Observation 1: Passband OBUE is not needed in DLObservation 2: Protection of a low power channel inside the pass band in the UL may be required.Observation 3: OBUE in UL only required if repeater is capable of multiple channels in UL (by declaration).Following the observations on OBUE as OBUE is not required in all cases and yet a noise figure requirement is we make the following proposal:Proposal 1: Use option 1, EVM with min power, to specify the noise performance.An example would be an 8% EVM limits for a 10MHz 64QAM signal an input level of -77dBm. |

* 1. Open issues summary

Agenda 6.5.2.2

Inside OBUE requirement related discussion is removed into section 3-1 to discuss together with NF equivalent requirements because in last meeting, inside OBUE is approved as the other option for NF equivalent requirements.

* + 1. Sub-topic 2-1

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| The agreements in RAN4 #101 e-meeting:* For passband definition, it’s allowed to have some empty carrier without signal transmitted from the donor BS that belongs to the same operator or collaborating operators.

ACLR:* No inside passband ACLR requirements for both DL and UL
* Further discuss in conformance phase, EVM test condition with all the ‘carriers’ in the passband are transmitting simultaneously.
* Reuse the same gNB ACLR requirements for repeater DL outside passband including relative(45dBc) and absolute ACLR. The least stringent requirement is suggested as the applicable one.
* For Local area class, UL ACLR follow ACLR from UE side, FFS which PC (PC3 or PC2) should be referred
* For wide area class, UL ACLR follow gNB requirement

OBUE* FFS whether inside passband OBUE requirements or other requirements needed for DL and UL for the case with non-full passband transmission.
* For outside passband, the same OBUE as BS WA and LA class are also applicable for two repeater UL classes respectively. i.e. BS WA OBUE for repeater without power limitation and BS LA OBUE for repeater with power limitation.
* Reuse BS OBUE requirement for DL at least outside pass band(s) in RAN4 #100 e-meeting
 |

**Issue 2-1-1: LA UL ACLR**

* Proposals
	+ Option 1: 31dBc (Ericsson, Nokia, CATT, CMCC, ZTE)
* Recommended WF
	+ 31dBc ACLR for LA UL ACLR.

**Issue 2-1-2: bandwidth for ACLR/CACLR requirement definition**

* Proposals
	+ Option 1: replace channel bandwidth with passband bandwidth (Nokia)
	+ Option 2: define a nominal channel bandwidth (Nokia)
* Recommended WF
	+ TBA.

*In R4-2101660(Nokia), it is proposed that whether same OBUE and absolute ACLR requirements apply for both DL and UL. For OBUE, all the approved agreements are listed in above table and it seems we have defined specific OBUE for both UL and DL, so maybe there is no need to discuss OBUE anymore.*

*About absolute ACLR, DL reuses the same value as gNB, this would include absolute and relative ACLR. For WA UL, UL ACLR follow gNB requirement but it doesn’t express whether include absolute ACLR or not. For LA UL, it says follow UE spec and I guess this obviously means no absolute ACLR, so I list the issue below for further check.*

**Issue 2-1-3: UL absolute ACLR**

* Proposals
	+ Option 1: for WA, reuse the same absolute ACLR as WA gNB; for LA, no absolute ACLR.
	+ Option 2: TBA
* Recommended WF
	+ for WA, reuse the same absolute ACLR as WA gNB; for LA, no absolute ACLR.
		1. Sub-topic 2-2

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| The agreements in RAN4 #101 e-meeting:* The Cumulative Adjacent Channel Leakage power Ratio (CACLR) in the Inter passband gap is the ratio of:
* a) the sum of the filtered mean power centred on the assigned channel frequencies for the two carriers adjacent to each side of the Inter passband gap, and
* b) the filtered mean power centred on a frequency channel adjacent to one of the respective repeater passband edges.
* For DL and WA UL, CACLR follows the same relative CACLR and absolute CACLR requirements as gNB. The least stringent requirement could be applicable
* For LA UL, CACLR follows the same value as ACLR requirement. i.e. 30 or 31dB should be referred
* No CACLR inside passband.
 |

**Issue 2-2-1: CACLR**

* Proposals
	+ Option 1: reuse BS approach to handle CACLR requirements for non-contiguous and multi-band requirements (CATT)
	+ Option 2: the same exceptions for CACLR application range as gNB spec could be reused by replacing RF bandwidth and sub-block with repeater passband (CMCC)
	+ Option 3: 31dBc for LA UL with its Wgap configuration inherited from TS38.104 Table 6.6.3.2-3 (ZTE)
* Recommended WF
	+ CACLR is also applicable for multi-band.
	+ CACLR is 31dB for LA UL
	+ CACLR applicable range (Wgap configuration) is inherited from gNB spec but replacing RF bandwidth and Sub-block related description with repeater passband
		1. Sub-topic 2-3

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| The agreements in RAN4 #101 e-meeting:Additional regional emission requirements as in UE spec should be [defined in repeater spec] or [declared by vendor to compliant with regional requirements]. * No A-MPR requirement is required for repeater.
* FFS Whether to define NS signaling.
* FFS whether would the manufacturer declare one power level for general requirements and another level for more stringent requirement
 |

**UL regional emissions**

**Issue 2-3-1: additional UL regional emission requirements**

* Proposals
	+ Option 1: based on declaration to compliant with regional requirement (CATT, CMCC, ZTE)
	+ Option 2: RAN4 needs to set requirements (Nokia)
* Recommended WF
	+ UL regional spurious emission requirements are based on declaration.

**Issue 2-3-2: NS signalling**

* Proposals
	+ Option 1: no NS signalling (Nokia, CMCC, Ericsson)
* Recommended WF
	+ No NS signalling for repeater.

**Issue 2-3-3: whether would the manufacturer declare one power level for general requirements and another level for more stringent requirement**

* Proposals
	+ Option 1: declaring a single output power with a tolerance (Ericsson, Nokia)
* Recommended WF
	+ Manufacturer should only declare one power level to support all requirements including general and additional regional emission requirements.
	1. Companies views’ collection for 1st round
		1. Open issues

**Sub topic 2-1**

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| **Company** | **Comments** |
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**Sub topic 2-2**

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| **Company** | **Comments** |
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**Sub topic 2-3**

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| **Company** | **Comments** |
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* + 1. CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2201654 | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 1. Summary for 1st round
		1. Open issues

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

* + 1. CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

* 1. Discussion on 2nd round (if applicable)
1. Topic #3: other RF conducted requirements

NR repeater other RF conducted requirements are discussed in this thread, including EVM requirements, NF equivalent requirements, IMD requirements, out of band gain, ACRR requirements and co-location requirement*.*

* 1. Companies’ contributions summary

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| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| [**R4-2200093**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200093.zip) | CATT | **Proposal 1: [35] dB DL ACRR for both co-existence with NR and E-UTRA is the requirement for the repeater with corresponding to the pass band bandwidth. The detail requirement can be defined similar with Table 1.****Table 1: Repeater ACRR limit proposal**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Repeater channel bandwidth* of *lowest/highest carrier* transmitted BWChannel (MHz)** | **BS adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted** | **Assumed adjacent channel carrier (informative)** | **Filter on the adjacent channel frequency and corresponding filter bandwidth** | **ACRR limit** |
| [5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90,100] | BWChannel | NR of same BW | Square (BWConfig) | [35] dB |
|  | 2 x BWChannel | NR of same BW | Square (BWConfig) | [35] dB |
|  | BWChannel /2 + 2.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | [35] dB |
|  | BWChannel /2 + 7.5 MHz | 5 MHz E-UTRA | Square (4.5 MHz) | [35] dB |

**Proposal 2: UL ACRR requirement is defined the same as DL ACRR.**For out of band gain requirement, we think there can be two approaches to define the requirement. Both of them need more discussion. |
| [**R4-2200819**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200819.zip) | CMCC | **Observation 1: OOB gain in UTRA repeater spec is determined by IF filter’s characteristics considering the situation of technology at that time in 2000 year.****Observation 2: OOB gain in E-UTRA repeater spec reuse the same limit as UTRA spec but updating frequency offset from channel edge because OOB gain use CW signals for testing.****Proposal 1: the same OOB gain limit as E-UTRA repeater could still apply for NR FR1 repeater. Repeater vendors are invited to further check whether we need to relax frequency offset because larger bandwidth make the attenuation outside passband hard to be achievable.****Proposal 2: ACRR requirements only apply for the scenario that NR repeater co-exist with UTRA system.****Proposal 3: In normal conditions the ACRR shall be higher than the value specified in following table. More inputs from vendors are encouraged to further check whether repeater could achieve such requirements with 5/10MHz offset and whether 31dBm is the splitting point to differentiate ACRR limit.**Table 1: NR Repeater ACRR

|  |  |  |  |
| --- | --- | --- | --- |
| Co-existence with other systems | Repeater maximum output power | Channel offset from the centre frequency of the first or last 5MHz channel within the pass band. | ACRR limit |
| UTRA | P ≥ [31] dBm | [5] MHz | 33dB |
| P ≥ [31] dBm | [10] MHz | 33dB |
| P < [31] dBm | [5] MHz | 20dB |
| P < [31] dBm | [10] MHz | 20dB |

 |
| [**R4-2200825**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2200825.zip) | CMCC | Proposal 1: three testing points for input IMD should be considered. i.e. lower edge, centre and high edge of passband.Proposal 2: for edge testing, IMD production should be tested at 0.5MHz near to edge of highest carrier – guard band or 0.5MHz near to edge of lowest carrier + guard band with 1MHz measurement bandwidth.Proposal 3: the same method of interference signal definition as E-UTRA repeater could be reused to test input IMD. For the first CW interference signal, it is located 1MHz offset from lowest or highest carrier edge and for the other CW interference signal, the frequency location is derived to guarantee final IMD production fall into where is supposed to be.Also the TP for TS 38.106 is listed in this tdoc. |
| [**R4-2201461**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201461.zip) | ZTE Corporation | Proposal 1: for NF equivalent requirements, we are fine with both options. Maybe option 1 is more preferred since its NF might be higher with minimum input power. Proposal 2: propose to use two CW signals the same as LTE repeater with intermodulation product is positioned in the centre of the pass band. Proposal 3: LTE out of band gain requirement could be reused for FR1 NR based repeater;Proposal 4: LTE ACRR requirement could be reused for FR1 NR based repeater with updating coexistence system; |
| [**R4-2201527**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201527.zip) | Ericsson | Proposal 1: The input IMD core requirement should be applicable for all IM frequencies within the passband. The number of frequency points to test should be discussed during the conformance phase.Observation 1: ACRR of 33dB is likely to be sufficient for uplink.Observation 2: The analysis in [2] has not evaluated average DL throughput degradation due to interference in the adjacent channel of the victim (it only considered blocking within a limited zone).Observation 3: If the DL ACRR > ACLR then there will potentially be a greater amount of interference in the victim adjacent channel that is typical for BS, and increased degradation may be expected.Observation 4: In principle, the sum of ACLR and ACRR should be within the BS limit for ACLR for DL.Observation 5: For small bandwidths, the effective ACRR if the E-UTRA out of band gain requirement is applied is lower than ACLR; for bandwidths above 40MHz it is greater than ACLR. |
| [**R4-2201661**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201661.zip) | Nokia, Nokia Shanghai Bell | **Observation 1: EVM requirement can disqualify repeaters that are beneficial in real in-the-field conditions, in addition to increasing the cost and complexity in many cases unnecessarily.****Observation 2: Specifying repeater EVM at low input power is not a guarantee that same noise performance is applicable through the operating power/gain range.****Proposal 1: Do not introduce low power EVM requirements, consider power limit instead.****Observation 3: Reasonable selection for separation distance and antenna gain needs to be done when deriving the OOB gain requirement.****Proposal 2: Consider re-using LTE repeater requirements at below 2000 MHz frequencies.****Proposal 3: Consider using mask in table 5 is used for OOB gain above 2 GHz frequencies.****Table 5: Proposed OOB gain for above 2 GHz frequencies**

|  |  |
| --- | --- |
| **Frequency offset, f\_offset\_CW** | **Maximum gain** |
| 0,2 £ f\_offset\_CW < 5,0 MHz | 60 dB |
| 5,0 £ f\_offset\_CW < 15,0 MHz | 45 dB |
| 15,0 MHz £ f\_offset\_CW | 35 dB |

**Observation 4: Proposals 2 and 3 do not take into account other signal sources than donor BS and therefore there is a risk that the requirements are not stringent enough.****Proposal 4: RAN4 to consider whether OOB gain requirement is needed for UL** |
| [**R4-2201933**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201933.zip) | Huawei | This paper looks at the requirement for OOB gain and how the addition of repeater classes to the NR repeater may affect the required values. Looking at the different BS classes the existing OOB gain values look to be sufficient so option 1 from the WF is ok.For ACRR for the UL then option 2 is ok, for UL option 1 should be used but with the added requirement that ACLR and ACRR meet 45dBc at the same time. |
| [**R4-2201934**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-bis-e/Docs/R4-2201934.zip) | Huawei | Proposal 1: OOB gain in co-location bands must be less that [-70dB].Proposal 2: Repeater meet co-location emissions requirementsObservation 1: repeater to repeater OOB co=location gain is sufficient for repeater to BS co-location protectionProposal 3: For co-location blocking the repeater NF could be tested with a low power wanted signal and a large blocking signal in the co-location band.Proposal 4: No FR2 co-location requirements are needed. |

* 1. Open issues summary

Agenda 8.5.2.3. DL means access link and UL means backhaul link.

* + 1. Sub-topic 3-1

EVM related requirements.

**Issue 3-1-1: EVM**

* Proposals
	+ Option 1: the core EVM requirement needs to capture an input power range over which EVM is valid. FFS power levels for conformance requirement (Ericsson)
* Recommended WF
	+ TBA.
		1. Sub-topic 3-2

NF equivalent requirements.

|  |
| --- |
| The agreements in #101 e-meetings:NF can be covered by the equivalent requirements with below options:o Option 1: Perform EVM conformance test with minimum input power o Option 2: Absolute maximum output power with no input within part of passband e.g. inside passband OBUEo Only one option should be selected in the end from RAN4 core requirements aspect |

**Issue 3-2-1: inside passband OBUE**

* Proposals
	+ Option 1: no inside passband OBUE requirements (CATT)
	+ Option 2: no inside passband OBUE requirements for both UL and DL if we test EVM with all the carriers in the passband transmitting simultaneously (CMCC)
	+ Option 3: Passband OBUE is not needed in DL and only required if repeater is capable of multiple channels in UL (by declaration). (Huawei)
	+ Option 4: define OBUE with passband if there are any **empty carriers** within it (ZTE)
	+ Option 5: at least define OBUE inside passband, to be met within **resource blocks** which are not allocated and UE in-band emission requirements are adapted to be used for repeaters both in UL and DL as shown for UL in table 2 in R4-2201660. (Nokia)
	+ Option 6: If finally approve to define requirements, it should be the same as the downlink absolute ACLR for both UL and DL(Ericsson)
* Recommended WF
	+ TBA.

**Issue 3-2-2: NF equivalent requirements**

* Proposals
	+ Option 1: If SNR degradation due to NF should be regulated then EVM with low input power should be tested. If interference towards the donor with no input signal should be regulated then instead maximum output power with no input power should be defined and tested (Ericsson)
	+ Option 2: Perform EVM conformance test with minimum input power (Huawei, ZTE, CMCC)
		- Also one example for how to define EVM limit is listed that 8% EVM limits for a 10MHz 64QAM signal an input level of -77dBm.
	+ Option 3: inside-passband emission limit (Nokia)
* Recommended WF
	+ TBA.
		1. Sub-topic 3-3

Input intermodulation related requirements

|  |
| --- |
| The agreements in RAN4 #101 e-meetingDefine 2CW signals as interference signal for input IMDFFS: IMD testing points Option 1: [3] testing point, the begin, center and end frequency position in the passband Option 2: Test every X MHz, where X may depend on the passband bandwidth. FFS value(s) of X Option 3: Only the center of passband |

**Issue 3-3-1: IMD product position**

* Proposals
	+ Option 1: tested at 0.5MHz near to edge of highest carrier – guard band, 0.5MHz near to edge of lowest carrier + guard band and centre, total 3 testing points. (CMCC)
	+ Option 2: core requirement should be applicable for all IM frequencies within the passband. The number of frequency points to test should be discussed during the conformance phase (Ericsson)
	+ Option 3: the centre (ZTE)
* Recommended WF
	+ TBA

**Issue 3-3-2: location of interference signal**

* Proposals
	+ Option 1: For the first CW interference signal, it is located 1MHz offset from lowest or highest carrier edge and for the other CW interference signal, the frequency location is derived to guarantee final IMD production fall into where is supposed to be. (CMCC)
	+ Option 2: TBA
* Recommended WF
	+ For the first CW interference signal, it is located 1MHz offset from lowest or highest carrier edge and for the other CW interference signal, the frequency location is derived to guarantee final IMD production fall into where is supposed to be.
		1. Sub-topic 3-4

Out of band gain

*Noted we should conclude OOB gain requirements in this meeting according to the agreement in last meeting.*

**Issue 3-4-1: OOB gain**

* Proposals
	+ Option 1: the same as LTE requirement but further check frequency offset based on filter characteristic (CMCC)
	+ Option 2: **for DL**: the same as LTE requirement at below 2GHz, as for above 2GHz a mask was designed to result in average 55 dB OOB gain at first 20 MHz, matching also the pathloss increase from 700 MHz to 2 GHz as below. **For UL**, RAN4 to consider whether OOB gain requirement is needed. (Nokia)
		- Nokia also emphasize that it doesn’t take into account other signal sources than donor BS and therefore there is a risk that the requirements are not stringent enough.

Table 5: Proposed OOB gain for above 2 GHz frequencies

|  |  |
| --- | --- |
| Frequency offset, f\_offset\_CW | Maximum gain |
| 0,2 £ f\_offset\_CW < 5,0 MHz | 60 dB |
| 5,0 £ f\_offset\_CW < 15,0 MHz | 45 dB |
| 15,0 MHz £ f\_offset\_CW | 35 dB |

* + Option 3: the same as LTE requirement (Huawei, ZTE)
* Recommended WF
	+ the same as LTE value at below 2GHz for both DL and UL but further check the frequency offset.
		1. Sub-topic 3-5

ACRR

**Issue 3-5-1: ACRR for both UL and DL**

* Proposals
	+ Option 1: [35] dB ACRR for both co-existence with NR and E-UTRA with corresponding to passband bandwidth (CATT)
	+ Option 2: the same value as E-UTRA spec but further check measurement bandwidth and power splitting point (CMCC)
	+ Option 3: the same value as E-UTRA spec with updating co-existence system(ZTE)
	+ Option 4: 33dB for UL, for DL in principle, the sum of ACLR and ACRR should be within the BS limit for ACLR (Ericsson and huawei). ACLR and ACRR meet 45dBc at the same time. (Huawei)
		- Ericsson also show information for small bandwidths, the effective ACRR if the E-UTRA out of band gain requirement is applied is lower than ACLR; for bandwidths above 40MHz it is greater than ACLR. So is there a concern for 5 and 10MHz bandwidths?
* Recommended WF for information
	+ 33dB for UL.
	+ For DL, two options:
		- option 1 33dB the same as E-UTRA
		- option 2 ACLR and ACRR should meeting 45dBc at the same time.

**Issue 3-5-2: ACRR applicable scenario**

* Proposals
	+ Option 1: only for the scenario that NR repeater co-exist with UTRA system, the same as E-UTRA spec (CMCC)
	+ Option 3: co-existence with NR and LTE system. (CATT)
* Recommended WF
	+ TBA.
		1. Sub-topic 3-6

Co-located requirements

**Issue 3-6-1: co-located scenario**

* Proposals
	+ Option 1: repeater with repeater
	+ Option 2: repeater co-located with gNB
	+ Option 3: no difference for option 1 and option 2 when define co-location requirements
* Recommended WF for information
	+ TBA.

**Issue 3-6-2: co-located spurious requirements**

* Proposals
	+ Option 1: the same as equivalent BS requirements, i.e. -96dBm/100kHz (Huawei)
	+ Option 2: TBA
* Recommended WF for information
	+ TBA.

**Issue 3-6-3: co-located OOB gain requirements**

* Proposals
	+ Option 1: [-70dB] to avoid self-oscillation due to co-located repeater and co-located gNB (Huawei)
	+ Option 3: TBA
* Recommended WF for information
	+ TBA.

**Issue 3-6-4: co-located blocking requirements**

* Proposals
	+ Option 1: the repeater NF could be tested with a low power wanted signal and a large blocking signal in the co-location band and no co-location requirement for FR2 (Huawei)
	+ Option 3: TBA
* Recommended WF for information
	+ TBA.
	1. Companies views’ collection for 1st round
		1. Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

**Sub topic 3-1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

**Sub topic 3-2**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

**Sub topic 3-3**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

**Sub topic 3-4**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

**Sub topic 3-5**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

**Sub topic 3-6**

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |

* + 1. CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2200825Section 3 | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

* 1. Summary for 1st round
		1. Open issues

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

* + 1. CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

* 1. Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
|  |  |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
|  |  |  |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)