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

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.11.2 & 8.11.3

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [98-bis-e][311] NR\_Repeater\_RF

**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 core requirements, which is separated by radiated and conducted requirements, the same as the agenda 8.11.2 and 8.11.3 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: Conducted requirements

NR repeater conducted related requirements are discussed in this thread, including transmit power related requirements, emission related requirements and the others*.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2107106**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107106.zip) | Huawei | Observation 1: Classes are not required for repeaters  Observation 2: NR EVM target <3.5%  Observation 3: The current repeater output power assumption of 30dBm seems appropriate for both DL and UL.  Observation 4: AGC/ALS is part of installation and does not need to be specified. |
| [**R4-2104612**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104612.zip) | CMCC | Observation 1: in China, DL repeater maximum output power has been classified into three classes with the same method as NR BS and no maximum output power limitation for UL power.  Observation 2: It is noted at least for NR repeater, maximum gain is not limited and repeater could achieve much larger gain than 90dB, the assumption in previous repeater spec. And larger DL output power could perform better coverage.  Proposal 1: DL repeater output power upper limit is needed based on system-level simulation to guarantee coexistence between repeater and other network nodes, either implicitly or explicitly.  Observation 3: For UL repeater, it is reasonable to set the target maximum output power as maximum UE output power. However, the specified maximum output power for repeater should be larger than the target value as the near-far effect could compress gain and reduce practical output power.  Proposal 2: UL maximum output power should be larger than any UE power class.  Proposal 3: UL maximum output power is suggested to be based on declaration.  Observation 4: In high-speed train scenario, much fast ALC adjustment mechanism is required. Further discuss whether current ALC mechanism could be applicable for high-speed train scenario. If not, how to define the ALC requirements.  Proposal 4: there are two options for ALC requirements definition   option 1: no explicit ALC requirements and only stating ALC would not introduce extra tolerance for UL power control algorithm   option 2: defining explicit ALC requirement and taking repeater’s moving speed into account. |
| [**R4-2104671**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104671.zip) | Ericsson | **Proposal 1: Adopt the following output power accuracy:**  **Normal conditions**   |  |  | | --- | --- | | **Rated output power** | **Limit** | | P ³ 31 dBm | +2 dB and -2 dB | | P < 31 dBm | +3 dB and -3 dB |   **Extreme conditions**   |  |  | | --- | --- | | **Rated output power** | **Limit** | | P ³ 31 dBm | +2,5 dB and -2,5 dB | | P < 31 dBm | +4 dB and -4 dB |   **Proposal 2: The same DL power limits, based on declared deployment scenario should be adopted for repeaters as for BS.**  **Observation 1: For a local area repeater, the UL TX power would likely not cause any degradations to neighbor networks.**  **Observation 2: For MR and WA repeaters, a combination of directional antennas and careful location could be used to avoid degradation to neighbors.**  **Proposal 3: Consider requirements with increasing input power level, and also input power that is beyond the declared maximum input power that verify that output power, and some key unwanted emissions requirements are properly met.** |
| [**R4-2104795**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104795.zip) | CATT | **Observation 1: Repeater’s access link output power capability up to medium area BS’s capability may be sufficient.**  **Observation 2: Repeater’s backhaul link output power is usually smaller than access link.**  **Proposal: E-UTRA repeater output power requirement approach can be considered by NR repeater for both FDD and TDD backhaul link and access link. TDD UL/DL pattern for the test can be discussed further.** |
| [**R4-2104988**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104988.zip) | NEC | **Proposal 1: RAN4 do not differentiate DL and UL with separate approaches to set maximum output power limits.**  **Proposal 2: RAN4 do not limit the UL power not exceeding any UE power class defined in the band.**  **Proposal 3: RAN4 reuse BS-like approach of constraining the maximum output power**  **Proposal 4: RAN4 specify dedicated requirements for ALC/AGC** |
| [**R4-2106327**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106327.zip) | Nokia, Nokia Shanghai Bell | ***Proposal 1: Rated carrier output power may be declared by the manufacturers, similar to BS and IAB for conducted requirements. However, it needs to be checked whether the minimum requirements defined for carrier output power of the BS and IAB are still applicable for NR repeaters as well.***  ***Observation 1: Depending on the type and class of the NR repeater, the minimum requirements can be slightly differed.***  ***Proposal 2: For NR repeaters, power control can be done by imposing a maximum power limit in both*** ***gNodeB – Repeater (backhaul) link and Repeater – UE (access) link, as proposed for radiated requirements.***  ***Proposal 3: Having followed the class and type definitions of IAB, some class and type combinations need to have an upper limit for rated carrier output power for NR repeaters. It must be discussed how to handle such a scenario in conducted requirements.*** |
| [**R4-2106350**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106350.zip) | NTT DOCOMO, INC. | **Maximum output power:**  **Observation 1: LTE FDD repeater does not have the upper limit for output power and the acceptable output power deviations are defined with 31 dBm as boundary.**  **Observation 2: If RAN4 avoid additional consideration for interference coordination, NR TDD repeater must have upper limit on maximum output power.**  **Observation 3: The same concept of output power for the Base Station can be applied in DL direction.**  **Proposal 1: RAN4 applies the output power requirements for NR FDD repeater to both DL and UL, and specifies the maximum output power without upper limit.**  **Proposal 2: RAN4 specify the maximum output power for NR TDD repeater without upper limit in DL.**  **Proposal 3: If RAN4 conclude that TDD repeater must have upper output power limit (same with UE power class limit) in UL, the requirements of TDD repeater output power for DL and UL should be considered individually.**  **EVM:**  **Observation 4: It is necessary to consider which modulation is ultimately feasible for DL and UL, respectively.**  **Observation 5: Repeater will be used to cover indoor areas of customers’ homes and it is important to achieve higher modulation scheme.**  **Proposal 4: RAN4 consider which modulation up to 256QAM is feasible in DL and UL, and define the EVM requirements for the feasible modulation.** |
| [**R4-2104617**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104617.zip) | CMCC | **Observation 1: In previous spec, ACLR cannot be measured for repeater because the adjacent channel emission is lower than thermal noise of the Repeater amplifier chain when assuming repeater only have RF domain amplifier without any digital domain processing.**  **Observation 2: as digital signal processor and digital FIR filter may be equipped in NR repeater, noise at adjacent channel could be rejected and ACLR could be measurable.**  **Proposal 1: the same ACLR requirements as NR spec could be used for some repeater, i.e. 45dB for DL and 30dB for UL. It is noted there is some limits for ACLR measuring that the testing signal from signal source such as BS for DL and UE for UL should be transmitted at the lowest and highest carrier in repeater passband.**  **Proposal 2: all the spurious emissions should be in line with BS spec for WA, MR and LA. But for home class repeater, at least co-location spurious requirements should be deleted.**  **Proposal 3: the same spectral emission mask as BS could be reused for repeater.** |
| [**R4-2104669**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104669.zip) | Ericsson | **Observation 1: The E-UTRA OOB gain is likely to be sufficient for >1MHz as long as the repeater is not co-located with other equipment.**  **Observation 2: If co-location of the repeater with other equipment is to be considered, then a more stringent requirement of gain less than around 25 to 30dB should be considered.**  **Observation 3: The E-UTRA requirement of 60dB gain in the first 1MHz may lead to emissions amplification in some circumstances.**  **Proposal 1: Include an ACLR-like requirement for repeaters (may be an absolute adjacent channel emissions power)**  **Proposal 2: Include co-location, co-existence, protection of FDD receiver and “other” spurious emissions requirements**  **Proposal 3: Consider whether out of band gain co-location requirements are needed** |
| [**R4-2104796**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104796.zip) | CATT | **Proposal 1: ACLR with NR adjacent channel is not defined for NR repeater for both access link and service link.**  **Observation: ACLR with E-UTRA adjacent channel can be considered to use the following approach,**  **1) not define the requirement**  **2) do co-exist simulation to see if the requirement can be relaxed.**  **Proposal 2: BS operating band unwanted emission requirement can be reused by NR repeater access link for different output power levels.**  **Observation: NR repeater backhaul link OBUE may consider reusing BS OBUE requirements.**  **Proposal 3: BS spurious emission requirements can be reused for NR repeater access link.**  **Observation: NR repeater backhaul link spurious emission requirement needs more discussion.** |
| [**R4-2106328**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106328.zip) | Nokia, Nokia Shanghai Bell | **Observation 1: As ACLR depends on the desired signal power, it may not be measurable if the desired signal power is in the scale of noise power level.**  **Observation 2: OBUE is an upper bound, which is independent on the signal power level, defined to limit the unwanted emissions in the adjacent bands.**  **Proposal 1: For NR repeaters, if the signal level is in the scale of noise power level, it is meaningful to use OBUE metric to measure the unwanted emissions in the adjacent channels, instead of ACLR.**  **Observation 3:In case of NR repeaters that operate in noncontiguous spectrum, CACLR may not be a suitable metric to measure the unwanted emissions in the adjacent band.**  **Proposal 2: For NR repeaters that operate in noncontiguous spectrum, OBUE can be used to measure the unwanted emissions in each sub-block gap.**  **Observation 4: Direct re-use of gNB/IAB OBUE requirements may not be possible as it would result in different level of protection for adjacent channel operation in case no ACLR is defined.** |
| [**R4-2106351**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106351.zip) | NTT DOCOMO, INC. | **OBUE and spurious emission (Receiver spurious emission):**  **Observation 1: The requirements for receiver spurious emission are specified for BS and IAB and they have the same basic limit.**  **Observation 2: If the receiver spurious emission requirements for TDD don’t exist, then there is no test requirements for the emission in TDD OFF period.**  **Proposal 1: RAN4 specify the receiver spurious emission requirements for TDD based on the one for Base Station.**  **Proposal 2: RAN4 check whether the FDD repeater is assumed to have different antenna connectors between Rx and Tx.**  **Proposal 3: In RAN4 have concluded there are FDD repeaters having the different antenna connector for Rx and Tx, respectively. Then RAN4 specify the receiver spurious emission requirements for FDD repeater.**  **Output intermodulation:**  **Proposal 4: RAN4 consider the requirement for Tx intermodulation for BS as the baseline of requirements for output intermodulation.** |
| [**R4-2104670**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104670.zip) | Ericsson | **Proposal 1: Apply input intermodulation and output intermodulation requirements that are the same as those in the E-UTRA repeater specification.**  **Proposal 2: Apply an ACRR requirement that is the same as in the E-UTRA repeater specification for all signal types.**   * **This protects from amplification of interference in other operators carriers outside of the passband, but not inside the passband.**   **Proposal 4: Apply a TDD switching time requirement**  **Proposal 5: Apply a TDD OFF power requirement** |
| [**R4-2104797**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104797.zip) | CATT | **Proposal 1: E-UTRA repeater requirement, i.e. 0.01 ppm is reused for both FDD and TDD NR repeater conducted requirement for access link and service link.**  **Proposal 2: Conducted EVM requirements for NR repeater access link and service link are defined as 6%.**  **Observation 1: Out of band gain requirement may need co-existence analysis or simulation.**  **Observation 2: E-UTRA input intermodulation approach can be considered by NR repeater access link and backhaul link with some adjustment of the frequency offset.**  **Observation 3: BS output intermodulation can be reused for NR repeater intermodulation requirement for access link.**  **Observation 4: Whether output intermodulation for access link is defined should be discussed.** |
| [**R4-2106329**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106329.zip) | Nokia, Nokia Shanghai Bell | **Observation 1: Relative timing of UL/DL signals are essentially the same for all UEs at the repeater.**  **Observation 2: Normal TA control loop for UL timing will have no additional requirements due to usage of repeaters.**  **Observation 3: Any group delay through the repeater will contribute the same way for timing as the propagation delays over the radio links.**  **Observation 4: The RX/TX switching times will be larger at the repeater than guaranteed for gNB and the UE with NR TA control loop and related parameters.**  **Proposal: The usage of repeaters does not cause additional requirements for DL timing or UL timing control.** |
| [**R4-2104615**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104615.zip) | CMCC | **Observation 1: more stringent EVM requirements is suggested for NR repeater to reduce noise.**  **Observation 2: vector error produced by NR repeater could be less than NR transmitter or LTE repeater.**  **Proposal 1: to reduce whole link EVM, [5%-6%] EVM is suggested for 64QAM or other lower order modulation scheme for FR1 and FR2**  **Proposal 2: 256 QAM is also suggested for repeater EVM definition with more stringent EVM than 3.5% to reduce extra interference to wanted signal.**  **Proposal 3: for both FR1 and FR2, the same ±0.01 ppm frequency error could still apply to NR repeater.** |

## Open issues summary

Agenda 8.11.2

It is noted for Tx related discussion, DL means repeater-UE (access) link and UL means repeater-gNB (backhaul) link while for Rx related discussion, e.g. out of band gain requirements, DL means gNB - repeater (backhaul) link and UL means UE - repeater (access) link.

### Sub-topic 1-1

Output power related conducted requirements for both FDD and TDD*.*

**Issue 1-1-1: whether/how to define AGC/ALC related requirements?**

* Proposals
  + Option 1: no need to be specified (Huawei)
  + Option 2: specify dedicated requirements for ALC/AGC (NEC)
  + Option 3: implicitly specify ALC/AGC requirements, e.g. by verifying current requirements are properly met in some special cases
    - Option 3-1: Consider requirements with increasing input power level, and also input power that is beyond the declared maximum input power that verify that output power, and some key unwanted emissions requirements are properly met (Ericsson)
  + Option 4: further discussion about the high-speed train scenario (CMCC)
* Recommended WF
  + TBA

**Issue 1-1-2: DL output power**

* Proposals
  + Option 1: 30dBm upper limits (Huawei)
  + Option 2: reuse the same approach and upper limits as BS, i.e. no upper limits for WA, 38dBm and 24dBm upper limits for MR and LA respectively. (Ericsson, NEC)
  + Option 3: reuse the same approach as BS/IAB, however, further check the upper limits, especially for those classes that don’t have such limits in BS/IAB spec (Nokia, Nokia Shanghai Bell, CMCC).
  + Option 4: reuse the same approach as E-UTRA repeater for FDD DL and TDD DL, i.e. output power is based on declaration without any power upper limits specification (NTT DOCOMO, CATT)
* Recommended WF
  + TBA.

**Issue 1-1-3: UL output power**

* Proposals
  + Option 1: 30dBm upper limits (Huawei)
  + Option 2: not exceeding existing UE power class
  + Option 3: exceeding existing UE power class considering gain compression (CMCC, NEC)
  + Option 4: reuse the same approach as E-UTRA repeater for both FDD UL and TDD UL, i.e. output power is based on declaration without any power upper limits specification (CATT)
  + Option 5: reuse the same approach as E-UTRA repeater only for FDD UL, i.e. output power is based on declaration without any power upper limits specification (NTT DOCOMO)
  + Option 6: reuse the same approach as BS/IAB, however, further check the upper limits, especially for those classes that don’t have such limits in BS/IAB spec (Nokia, Nokia Shanghai Bell)
* Recommended WF
  + TBA.

**Issue 1-1-4: how to avoid performance degradation of other networks?**

* Proposals
  + Option 1: For MR and WA UL, managed by antenna and deployment scenarios; for LA UL, the degradation could be avoided. (Ericsson)
  + Option 2: power upper limits for UL TDD repeater (NTT DOCOMO)
* Recommended WF
  + TBA

**Issue 1-1-5: power tolerance**

* Proposals
  + Option 1: the same as E-UTRA repeater spec (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 1-2

Unwanted emission related conducted requirements including ACLR, operating band unwanted emissions and spurious emissions requirements.

**Issue 1-2-1: whether/ how to define ACLR with NR adjacent channel or some equivalent requirements**

* Proposals
  + Option 1: yes
    - Option 1-1: an ACLR-like requirement for repeaters (may be an absolute adjacent channel emissions power) (Ericsson)
    - Option 1-2: modified OBUE as equivalent requirements for ACLR if the signal level is in the scale of noise power level (Nokia)
    - Option 1-3: modified OBUE as equivalent requirements for CACLR to measure the unwanted emissions in each sub-block gap (Nokia)
  + Option 2: no ACLR with NR adjacent channel for both access link and service link (CATT)
* Recommended WF
  + ACLR with NR adjacent channel or some equivalent requirements are required to match the same adjacent channel protection as NR/IAB spec. The equivalent requirements include modified OBUE requirements and absolute adjacent channel emissions power.

**Issue 1-2-2: whether/ how to define ACLR with E-UTRA adjacent channel or some equivalent requirements**

* Proposals
  + Option 1: co-existence simulation to see if the requirements could be relaxed (CATT)
  + Option 2: no ACLR with E-UTRA adjacent channel for both access link and service link (CATT)
* Recommended WF
  + TBA

**Issue 1-2-3: operating unwanted emission requirements**

* Proposals
  + Option 1: BS requirements can be reused by NR repeater for DL and UL (CATT, CMCC)
  + Option 2: modified OBUE level to match the same level of adjacent channel protection as the full set of gNB/IAB requirements provides (Nokia)
* Recommended WF
  + TBA

Spurious related requirements

**Issue 1-2-4: which of following spurious emission categories should be specified for NR repeater**

* Proposals
  + Option 1: general spurious emission (Ericsson, CMCC)
  + Option 2: Co-location with other base stations. (Ericsson, CMCC)
  + Option 3: Co-existence with other systems in the same geographical area. (Ericsson, CMCC)
  + Option 4: Protection of BS receiver for FDD operating band. (Ericsson, CMCC)
  + Option 5: regional and regulation related requirements. (Ericsson, CMCC)
  + Option 6: receiver spurious emission for transmitter OFF period for TDD repeater (NTT DOCOMO)
* Recommended WF
  + NR repeater spurious emission could include general spurious emission, co- location with other base stations, Co-existence with other systems in the same geographical area, Protection of BS receiver for FDD operating band, regional and regulation related requirements and TDD receiver spurious emission for transmitter OFF period.

**Issue 1-2-5: referring to BS or UE spec for Tx spurious emission requirements?**

* Proposals
  + Option 1: BS
    - Option 1-1: reuse the same BS requirements only for DL (CATT)
    - Option 1-2: further check whether the same BS requirements could be reused for UL (CATT)
    - Option 1-3: reuse the same BS requirements for both DL and UL (CMCC)
  + Option 2: TBA
* Recommended WF
  + The same spurious emission requirements as BS spec still apply to DL repeater. Further check whether it could be reused for UL repeater.

**Issue 1-2-6: Rx spurious emission requirements**

* Proposals
  + Option 1: (NTT DOCOMO)
    - For TDD: based on BS spec
    - For FDD: specify Rx spurious emission if different antenna connectors are assumed between Rx and Tx
  + Option 2: TBA
* Recommended WF
  + Take Rx spurious emission requirements in BS spec as baseline for TDD repeater. Further discussion about FDD repeater.

**Issue 1-2-7: whether unwanted emission requirements are the same for all classes?**

* Proposals
  + Option 1: distinguished by classes
  + Option 2: the same for all repeaters
  + Option 3: at least low power repeater may have more relax requirements whether there are classes classification or not. (CMCC)
* Recommended WF
  + TBA
    1. Sub-topic 1-3

The requirements except for power and unwanted emission related requirements for both FDD and TDD, including frequency stability, EVM, input intermodulation, output intermodulation, ACRR, out of band gain, TDD switching time, TDD OFF and REFSENSE requirements.

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: frequency stability for both TDD and FDD conducted requirements**

* Proposals
  + Option 1: 0.01ppm (CMCC, CATT)
* Recommended WF
  + 0.01 ppm for FR1 conducted requirements

**EVM related issues**

**Issue 1-3-2: whether to consider feasible modulation schemes for DL and UL, respectively?**

* Proposals
  + Option 1: necessary (NTT DOCOMO)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-3-3: EVM aligned with which modulation scheme?**

* Proposals
  + Option 1: 256QAM (Huawei)
  + Option 2: 64 QAM and 256 QAM. Two EVM level, one level for modulation order less than or equal to 64QAM and the other level for 256QAM (CMCC)
* Recommended WF
  + RAN4 consider which modulation up to 256QAM is feasible, and define the EVM requirements for the feasible modulation

**Issue 1-3-4: whether to improve EVM beyond what is required for NR BS/UE spec**

* Proposals
  + Option 1: yes,
    - <3.5% (Huawei)
    - 6% (CATT)
    - 5%-6% for modulation order less than or equal to 64QAM (CMCC)
  + Option 2: TBA
* Recommended WF
  + More stringent EVM requirement compared with NR spec is required to reduce the degradation of system performance.

**Input intermodulation related requirements**

**Issue 1-3-5: input intermodulation requirements**

* Proposals
  + Option 1: reuse the same approach as E-UTRAN repeater
    - Option 1-1: the same as E-UTRAN repeater (Ericsson)
    - Option 1-2: with some adjustment of the frequency offset for both UL and DL (CATT)
  + Option 2: TBA
* Recommended WF
  + Take the same approach of E-UTRAN repeater as baseline including general requirements, co-existence and co-location requirements. Further discussion about whether some adjustment is necessary or not, e.g. frequency offset.

**Output intermodulation related requirements**

**Issue 1-3-6: output intermodulation for DL**

* Proposals
  + Option 1: the same as E-UTRAN repeater requirement (Ericsson)
  + Option 2: BS Transmitter intermodulation as the baseline (CATT, NTT DOCOMO)
* Recommended WF
  + Take BS Transmitter intermodulation requirement as the baseline for DL repeater with 30dB coupling loss assumption when define interfering signal level.

**Issue 1-3-7: whether to define output intermodulation for UL**

* Proposals
  + Option 1: further discussion (CATT)
  + Option 2: yes, take BS Transmitter intermodulation requirement as the baseline for UL repeater with 30dB coupling loss assumption when define interfering signal level. (Ericsson, NTT DOCOMO)
* Recommended WF
  + TBA

**ACRR related requirements**

**Issue 1-3-8: ACRR**

* Proposals
  + Option 1: Apply an ACRR requirement that is the same as in the E-UTRA repeater specification for all signal types, not just WCDMA (Ericsson)
  + Option 2: TBA
* Recommended WF
  + Take E-UTRA repeater specification as the baseline when define ACRR requirement for NR repeater.

**Out of band gain related requirements**

**Issue 1-3-9: whether co-existence simulation is needed to derive out of band gain for NR repeater**

* Proposals
  + Option 1: yes (CATT)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-3-10: whether to consider out of band co-location requirement for NR repeater**

* Proposals
  + Option 1: yes
  + Option 2: no
* Recommended WF
  + TBA

**Issue 1-3-11: out of band gain requirements**

* Proposals
  + Option 1: some modification based on E-UTRAN repeater spec (Ericsson)
    - 35-45 dB for >1MHz from the passband if not co-located with other equipment
    - Less than 25-30dB for >1MHz from the passband if co-located with other equipment
    - 60 dB gain is not enough for the first 1MHz
  + Option 2: TBA
* Recommended WF
  + Take E-UTRA repeater spec as the baseline when define out of band gain requirements for NR repeater. Further discuss about the modification and whether consider co-location scenarios.

**timing related requirements**

**Issue 1-3-12: whether to define TDD switching requirements, if so how to define these requirements?**

* Proposals
  + Option 1: necessary (Ericsson)
  + Option 2: no need for tighter requirements for timing that is already specified for gNB and UE (Nokia)
* Recommended WF
  + TDD switching requirements is necessary for TDD repeater and the value is FFS.

**Issue 1-3-13: group delay requirements, taking following aspects into consideration**

* Proposals
  + Option 1: group delay contributes the same way for timing as the propagation delays (Nokia)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-3-14: whether/how to define TDD OFF requirements**

* Proposals
  + Option 1: necessary (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-3-15: whether to define REFSENSE or equivalent requirements**

* Proposals
  + Option 1: REFSENSE or NF (CMCC)
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

**Example 2**

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 1-1-1: whether/how to define AGC/ALC related requirements?**  As stated (option 3-1), we believe that AGC/ALC requirements should be captured, but this can be done by meeting other key requirements on output power and emissions with several input power levels.  **Issue 1-1-2: DL output power**  One issue to discuss further is that the BS power limits are per carrier. When setting limits as in option 1 or 2 we need to agree whether these are per carrier or per passband, and whether “carriers” can easily be defined within the passband  **Issue 1-1-3: UL output power**  The safest approach from a co-existence viewpoint is to not exceed any UE power class. IAB does not limit UL power, but has explicit power control and also there is an underlying assumption that the IAB is positioned in a planned manner by the operator considering the location of the donor BS and other BS. Also, IAB is not applicable in all bands, in particular FDD bands.  First check could be whether there is any objection to limit to the largest UE power class ? (option 2) |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 1-2-1: whether/ how to define ACLR with NR adjacent channel or some equivalent requirements**  We think there is not much difference between the option 1 sub-options; in principle set absolute requirements that are equivalent to ACLR. One question to discuss is whether “modified OBUE” means that the requirement is not over the whole adjacent channel but instead with a narrower measurement bandwidth, like OBUE. We are open to either if the requirement ends up equivalent to ACLR. (Option 1)  **Issue 1-2-2: whether/ how to define ACLR with E-UTRA adjacent channel or some equivalent requirements**  We do not see a need for co-existence simulations; absolute requirement levels could be set to give equivalent emissions levels to a UE or BS with typical power conforming to the ACLR.  Option 3: Set absolute requirements based on achieving same emissions power as an assumed UE/BS meeting ACLR requirements with a reference power.  **Issue 1-2-3: operating unwanted emission requirements**  We are OK with modified OBUE to provide the same protection as ACLR (option 2). It needs to be obvious though that also the regulatory requirements are met.  It is OK to take BS regulatory requirements, but it should be double checked whether there are regulatory issues when taking BS requirements for UL, in particular for FDD.  **Issue 1-2-5: referring to BS or UE spec for Tx spurious emission requirements?**  It should be checked whether there are any regulatory issues using BS requirements for UL transmissions, in particular for FDD.  Option 1-4: BS requirements are default. Check if any regulatory issues concerning UL.  **Issue 1-2-7: whether unwanted emission requirements are the same for all classes?**  Option 1: The BS requirements are currently differentiated between BS classes  Sub-topic 1.3:  **Issue 1-3-3: EVM aligned with which modulation scheme?**  **Issue 1-3-4: whether to improve EVM beyond what is required for NR BS/UE spec**  The need for EVM may differ depending on the repeater deployment scenario. If the repeater is near to the edge of coverage, then it may be that SNR limits the modulation order. Such repeaters should not be burdened by needing to meet low EVM. On the other hand, for the train carriage to outside scenario mentioned by CMCC, low EVM may be very relevant. So at least some kind of requirement differentiation is needed.  Unlike a BS or UE, EVM conformance testing represents a larger proportion of the test load for repeaters. Another possibility is to skip a 3GPP minimum requirement for EVM (hence reduce conformance testing) and leave it for repeater vendors to differentiate in product specs/tests.  Option 2: More than on EVM level  Option 3: Do not define EVM requirement for repeater  **Issue 1-3-5: input intermodulation requirements**  We agree with the WF  **Issue 1-3-6: output intermodulation for DL**  We are OK to take the BS approach (option 2) or with option 1  **Issue 1-3-9: whether co-existence simulation is needed to derive out of band gain for NR repeater**  The requirement can be defined based on an assumption on coupling loss to and power of another transmitter. Power is rather difficult to guess for another system but assuming the same power as a BS seems reasonable.  Option 2: Base on assumed MCL to another transmitter with the same output power as a BS  **Issue 1-3-10: whether to consider out of band co-location requirement for NR repeater**  Yes, but the requirements should be optional (in the same way as BS co-location requirements)  Option 1a: Yes, but optional  **Issue 1-3-11: out of band gain requirements**  The E-UTRA repeater spec does not fully protect the first 1MHz  **Issue 1-3-13: group delay requirements, taking following aspects into consideration**  Agree with Nokia. Also, we think that introducing requirements could risk of constrainingimplementations. Some implementations may include some digital processing and potentially separation between parts of the repeater. A small minimum group delay requirement may constrain such implementations. On the other hand, a large requirement might not be useful for some integrated analogue only repeaters. We do not see a need for a minimum requirement; the guard period needs to be set adequately for the group delay.  Option 2: No need to define a requirement  **Issue 1-3-15: whether to define REFSENSE or equivalent requirements**  Although some repeaters may detect SSB and decode other repeaters, we should not force all repeaters to do so.  It is not obvious how to test REFSENSE; the BS and UE tests rely on an FRC, feedback etc. |

### 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** |
| XXX | 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### 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)

# Topic #2: Radiated requirements

NR repeater radiated related requirements are discussed in this thread, including transmit power related requirements, emission requirements and the others*.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104613**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104613.zip) | CMCC | **Observation 1: For FR2, 3GPP only define maximum output power upper limits requirements for UE. For BS, power requirements are declared by manufacturer with specified tolerance for normal and extreme condition.**  **Proposal 1: For DL repeater the same approach as BS spec could be reused that the output power requirements are based on declaration with some specified tolerance requirements.**  **Proposal 2: minimum peak EIRP for UL repeater should be larger than UE spec, taking the near-far effect into consideration.**  **Proposal 3: The same UL maximum output power in terms of EIRP are suggested since they are derived from regulatory requirements.**  **Proposal 4: DL coexistence study has high priority to give guidance for maximum output power requirements while UL coexistence study has relatively lower priority.**  **Observation 2: considering much complex antenna array could be equipped on FR2 repeater, the beam correspondence capability may be required to make repeater use the same DL Rx antenna as UL Tx antenna. Otherwise, tolerance is not negligible when calculating UL output power.** |
| [**R4-2104674**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104674.zip) | Ericsson | **Proposal 1: The TRP accuracy requirement for a repeater should be the same as for BS.**  **Proposal 2: DL TRP output power can be declared with no restriction on power.**  **Proposal 3: For UL power consider an approach similar to IAB**   * **Wide area class with no restriction on power** * **Local area class with power restricted to 31dBm**   **Proposal 4: Consider requirements that ensure that with changing input power level, and also input power level that leads to gain limitation, EVM and some key unwanted emissions requirements are properly met.** |
| [**R4-2104798**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104798.zip) | CATT | **Observation 1: FR1 radiated output power can be discussed after the conclusion of NR type discussion.**  **Observation 2: FR2 NR repeater BS FR2 power approach can be considered by NR repeater for both access link and service link. Whether there’s difference for the two links needs more discussion.**  **Observation 3: ALC requirement may be needed to guarantee the output signal quality, how to define it FFS.** |
| [**R4-2106330**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106330.zip) | Nokia, Nokia Shanghai Bell | ***Proposal 1: For FR2 NR repeaters both rated beam EIRP level and rated carrier TRP output power, during ON period, need to be considered.***  ***Proposal 2: Rated beam EIRP level and rated carrier TRP output power may be declared by the manufacturers, similar to BS and IAB. However, it needs to be checked whether the minimum requirements defined for rated beam EIRP level and rated carrier TRP output power of the BS and IAB are still applicable for NR repeaters as well.***  ***Observation 1: Depending on the type and class of the NR repeater, the minimum requirements can be slightly differed.***  ***Proposal 3: For NR repeaters, power control can be done by imposing a maximum power limit in both*** ***gNodeB – Repeater (backhaul) link and Repeater – UE (access) link.***  ***Proposal 4: If the class and type definitions of the IAB is followed for NR repeaters, some class and type combinations do not define an upper limit of the rated carrier TRP output power. This is not an issue for IABs as there exists a method to control the output power. For NR repeaters, it must be discussed how to handle such a scenario.***  ***Observation 2: Automatic gain controlling may not need to be specified for repeater; the same functionality could be obtained by using an implementation specific approach. AGC in only needed in context of limiting maximum output power and unwanted emissions with high-power input signal.***  ***Observation 3: The dynamic ranges of the NR repeater access and backhaul links could vary depending on the deployment scenario.***  ***Proposal 5: Dynamic range of the NR repeater backhaul and access links must be defined based on the class and type of the repeaters.*** |
| [**R4-2106352**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106352.zip) | NTT DOCOMO, INC. | **Maximum output power:**  **Observation 1: Base Station and IAB for FR2 don’t have upper limit on the output power and they are based on declaration.**  **Proposal 1: RAN4 specify the maximum output power for FR2 repeater based on declaration without upper limit in DL.**  **EVM:**  **Observation 2: It is necessary to consider which modulation is ultimately feasible for DL and UL, respectively.**  **Observation 3: Repeater will be used to cover indoor areas of customers’ homes and it is important to achieve higher modulation scheme.**  **Proposal 2: RAN4 consider which modulation up to 256QAM and 64QAM is feasible in DL and UL, respectively, and define the EVM requirements for the feasible modulation.** |
| [**R4-2104618**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104618.zip) | CMCC | **Observation 1: if fixed gain and pattern is assumed for FR2 repeater, the directional requirement is not based on manufacturer’s declaration any more but based on the fixed assumption.**  **Proposal 1: for FR2 repeater, output intermodulation requirement is not suggested and input intermodulation could follow the same requirements as FR2 BS receiver requirements.**  **Observation 2: for FR2 ACLR, extra evaluation may be needed to verify whether the increased repeaters could produce extra adjacent interference to other networks.**  **Proposal 2: FR2 repeater should follow BS spec for spurious requirement by defining general requirements and additional OTA requirements for protection of Earth Exploration Satellite Service** |
| [**R4-2104672**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104672.zip) | Ericsson | **Observation 1: In the DL, the ACLR requirement drives the amount of BS emissions in the adjacent channel. If only the OBUE requirement is present, emissions are increased by around 7dB.**  **Observation 2: To provide the same amount of DL adjacent channel protection as a BS or IAB, a repeater must comply to at least the absolute BS ACLR requirement (with adjustment if the maximum power is >31dBm).**  **Observation 3: The general spurious emissions for a repeater should be the same as those for a BS/UE (including category A/B and protection of ESS)** |
| [**R4-2104799**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104799.zip) | CATT | **Proposal 1: FR2 BS relative ACLR can be considered to be reused by NR FR2 repeater for both access link and backhaul link.**  **Observation: FR2 Absolute ACLR needs more discussion with some input of the mmWave repeater implementation architecture and noise floor analysis.**  **Proposal 2: FR2 BS operating band unwanted emission requirement can be reused by FR2 NR repeater for both access link and backhaul link.**  **Proposal 3: FR2 BS spurious emission requirements can be reused for FR2 NR repeater access link.** |
| [**R4-2106331**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106331.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: As ACLR depends on the desired signal power, it may not be measurable if the desired signal power is in the scale of noise power level.***  ***Observation 2: OBUE is an upper bound, which is independent on the signal power level, defined to limit the unwanted emissions in the adjacent bands.***  ***Proposal 1: For NR repeaters, if the signal level is in the scale of noise power level, it is meaningful to use OBUE metric to measure the unwanted emissions in the adjacent channels, instead of ACLR.***  ***Observation 3In case of NR repeaters that operate in noncontiguous spectrum, CACLR may not be a suitable metric to measure the unwanted emissions in the adjacent band.***  ***Proposal 2: For NR repeaters that operate in noncontiguous spectrum, OBUE can be used to measure the unwanted emissions in each sub-block gap.***  ***Observation 4: Direct re-use of gNB/IAB OBUE requirements may not be possible as it would result in different level of protection for adjacent channel operation in case no ACLR is defined.*** |
| [**R4-2106353**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106353.zip) | NTT DOCOMO, INC. | **OBUE and spurious emission (Receiver spurious emission):**  **Observation 1: If the receiver spurious emission requirements for TDD don’t exist, then there is no test requirements for the emission in TDD OFF period.**  **Proposal 1: RAN4 specify the receiver spurious emission requirements for TDD based on the one for Base Station.**  **Tx/output intermodulation and input intermodulation requirements:**  **Proposal 2: RAN4 doesn’t specify the output intermodulation requirements for FR2 NR repeater.**  **Proposal 3: RAN4 consider the input intermodulation requirements based on the receiver intermodulation requirements for FR2 Base Station.** |
| [**R4-2104675**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104675.zip) | Ericsson | **Proposal 1: No need for TX intermodulation requirements for FR2**  **Proposal 2: In place of receiver requirements, a requirement on out of passband gain should be defined. This should be based on the UE blocking requirement level within the band and the BS out of band blocking levels for out of band.**  **Proposal 3: A requirement on input intermodulation should be created, with levels based on the BS RX intermodulation requirement.**  **Observation 1: There may be implications of not specifying requirements relating to frequencies that apply to another operator but are within the passband.** |
| [**R4-2104800**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104800.zip) | CATT | **Proposal 1: E-UTRA repeater requirement, i.e. 0.01 ppm is reused for both access link and backhaul link.**  **Proposal 2: EVM requirements for FR2 NR repeater are defined as 6% for both access link and backhaul link.**  **Observation 1: Out of band gain requirement may need co-existence analysis or simulation.**  **Observation 2: Input intermodulation may not be needed for backhaul link.**  **Observation 3: Output intermodulation may not be needed for both backhaul link and access link.** |
| [**R4-2106332**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106332.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: In case of FR2, having two distant-units (backhaul and access units) with frequency conversion happened in each unit, could introduce frequency error in NR repeaters.***  ***Proposal 1: While defining the frequency error values for NR repeaters in FR2, the frequency error that could result in frequency conversion should be considered. Additionally, the hardware complexity and cost required to achieve a lower frequency error must be discussed.***  **Proposal 2: Keep frequency error requirement in square brackets until more complete understanding on system performance impact and implementation feasibility has been achieved.** |

## Open issues summary

Agenda 8.11.3

FR1 radiated requirements are listed here just because some companies show their views for FR1 OTA requirements, which doesn’t imply we finally approve to define radiated requirements for FR1. To differentiate FR1 and FR2 discussion it seems reasonable to separate all the requirements by FR1 and FR2. However, this will duplicate the numbers of issues, making it very complex to reply this summary. Therefore, in topic #2 all the issues apply for both FR1 and FR2 without specific statement. Otherwise, the applicable frequency range would be emphasized if they are only applicable for either FR1 or FR2.

It is noted for Tx related discussion, DL means repeater-UE (access) link and UL means repeater-gNB (backhaul) link while for Rx related discussion, e.g. out of band gain requirements, DL means gNB - repeater (backhaul) link and UL means UE - repeater (access) link.

### Sub-topic 2-1

**Issue 2-1-1: whether to define radiated requirements for FR1?**

* Proposals
  + Option 1: yes
  + Option 2: no
* Recommended WF
  + TBA

### Sub-topic 2-2

Output power related radiated requirements for both FR1 and FR2.

**Issue 2-2-1: how to define output power requirement (TRP) for FR1?**

* Proposals
  + Option 1: further check whether the same minimum requirements as BS/IAB still apply to FR1 repeater. further discuss about whether define upper limits for all classes (Nokia)
  + Option 2: TBA
* Recommended WF
  + It is suggested to discuss FR1 radiated output power after the conclusion of NR class and types discussion.

**Issue 2-2-2: whether to define both the rated beam EIRP level and rated carrier TRP output power for FR2?**

* Proposals
  + Option 1: yes, both EIRP and TRP (Nokia)
  + Option 2: TBA
* Recommended WF
  + Both rated beam EIRP level and rated carrier TRP output power, during ON period, need to be considered for FR2 NR repeater

**Issue 2-2-3: DL output power requirement (TRP) for FR2**

* Proposals
  + Option 1: output power based on declaration without upper limit in DL for FR2. (NTT DOCOMO, Ericsson, CATT, Nokia, CMCC)
* Recommended WF
  + RAN4 specify the maximum output power for FR2 repeater based on declaration without upper limit in DL.

**Issue 2-2-4: DL TRP accuracy**

* Proposals
  + Option 1: the same as BS for DL (Ericsson, CMCC)
  + Option 2: TBA
* Recommended WF
  + The TRP accuracy requirement for FR2 DL repeater should be the same as BS spec

**Issue 2-2-5: UL output power requirements (TRP) for FR2?**

* Proposals
  + Option 1: the same approach as IAB. Wide area class with no restriction on power; Local area class with power restricted to 31dBm. (Ericsson)
  + Option 2: the same approach as NR BS, i.e. output power based on declaration without upper limit for FR2. (CATT)
  + Option 3: higher than UE spec considering gain compression. (CMCC)
* Recommended WF
  + TBA

**Issue 2-2-6: whether/how to define ALC/AGC requirement**

* Proposals
  + Option 1: dedicated requirements
  + Option 2: no ALC/AGC requirements
  + Option 3: implicitly specify ALC/AGC requirements, e.g. by verifying current requirements are properly met in some special cases
* Recommended WF
  + TBA

**Issue 2-2-7: how to define ALC/AGC requirement either implicitly or explicitly, taking following aspects into consideration**

* Proposals
  + Option 1: Consider requirements that ensure that with changing input power level, and also input power level that leads to gain limitation, and some key unwanted emissions requirements are properly met. (Ericsson)
  + Option 2: ALC requirements may be needed to guarantee the output signal quality (CATT)
  + Option 3: AGC may not be needed, the same functionality could be obtained by using an implementation specific approach. AGC in only needed in context of limiting maximum output power and unwanted emissions with high-power input signal. (Nokia)
  + Option 4: the beam correspondence capability may be required to make repeater use the same DL Rx antenna as UL Tx antenna. otherwise, tolerance is not negligible when calculating UL output power. (CMCC)
* Recommended WF
  + TBA

**Issue 2-2-8: whether/how to define dynamic range of NR repeater DL and UL**

* Proposals
  + Option 1: yes
    - Option 1-1: based on the class and types of repeaters. (Nokia)
  + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 2-3

Unwanted emission related radiated requirements including ACLR, operating band unwanted emissions and spurious emissions requirements.

It is noted all the issues are applicable for both FR1 and FR2 if no specific statement. Otherwise, the applicable FR would be emphasized if it is only for either FR1 or FR2.

**Issue 2-3-1: whether/how to define relative ACLR for FR2 UL and DL**

* Proposals
  + Option 1: yes
    - Option 1-1: reuse BS relative ACLR (CATT)
    - Option 1-2: based on system level evaluation (CMCC)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-3-2: whether/how to define absolute ACLR for FR2 UL and DL**

* Proposals
  + Option 1: yes
    - Option 1-1: at least comply to absolute BS ACLR requirements (with adjustment if the maximum power is >31dBm) for DL to provide the same amount of DL adjacent channel protection as BS and IAB (Ericsson)
    - Option 1-2: more discussion with some input of implementation architecture and NF (CATT)
* Recommended WF
  + ACLR or some equivalent requirements are required to match the same adjacent channel protection as NR/IAB spec. the equivalent requirements include modified operating band unwanted emission and absolute ACLR for FR2 repeater.

**Issue 2-3-3: operating band unwanted emission requirement for UL and DL**

* Proposals
  + Option 1: for FR2 the same as BS(CATT)
  + Option 2: updated OBUE as equivalent requirements for ACLR (Nokia)
  + Option 3: updated OBUE as equivalent requirements for CACLR to measure the unwanted emissions in each sub-block gap (Nokia)
* Recommended WF
  + TBA

Spurious related requirements

**Issue 2-3-4: Tx spurious emission requirements for FR2**

* Proposals
  + Option 1: the same as those for BS could be reused for both DL and UL including category A/B and protection of ESS (Ericsson, CMCC)
  + Option 2: the same as those for BS could be reused for DL repeater (CATT)
* Recommended WF
  + At least for DL, the same spurious emissions requirements as BS could be reused for NR repeater including category A/B and protection of ESS

**Issue 2-3-5: Rx spurious emission requirements for FR2**

* Proposals
  + Option 1: receiver spurious emission requirements based on the one for BS (NTT DOCOMO)
* Recommended WF
  + Define receiver spurious emission requirements for FR2 repeater.

### Sub-topic 2-4

The requirements except for power and unwanted emission related requirements for both FR1 and FR2, including frequency stability, out of passband gain, EVM, input intermodulation and output intermodulation.

It is noted all the issues are applicable for FR2.

**Issue 2-4-1: frequency stability for FR2**

* Proposals
  + Option 1: 0.01ppm for both DL and UL (CMCC, CATT)
  + Option 2: keep 0.01ppm in square brackets until more complete understanding on system performance impact and implementation feasibility (Nokia)
* Recommended WF
  + [0.01ppm] for FR2 both DL and UL

**Issue 2-4-2: out of passband gain for FR2, taking following aspects into consideration**

* Proposals
  + Option 1: based on FR2 UE blocking requirement level within the band and the BS out of band blocking level for out of and (Ericsson)
  + Option 2: based on co-existence analysis and simulations (CATT)
* Recommended WF
  + TBA

**FR2 EVM related requirements**

**Issue 2-4-3: whether to consider feasible modulation schemes for DL and UL, respectively?**

* Proposals
  + Option 1: necessary (NTT DOCOMO)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-4-4: EVM aligned with which modulation scheme, 256 QAM or 64 QAM?**

* Proposals
  + Option 1: feasible modulations up to 256 QAM for DL and 64 QAM for UL respectively (NTT DOCOMO)
  + Option 2: TBA
* Recommended WF
  + RAN4 consider which modulation up to 256QAM and 64QAM is feasible in DL and UL, respectively, and define the EVM requirements for the feasible modulation.

**Issue 2-4-5: EVM requirements**

* Proposals
  + Option 1: 6% for both DL and UL(CATT)
  + Option 2: TBA
* Recommended WF
  + More stringent EVM requirement compared with NR spec is required to reduce the degradation of system performance.

**Issue 2-4-6: input intermodulation for FR2**

* Proposals
  + Option 1: based on FR2 BS receiver intermodulation (NTT DOCOMO, Ericsson, CMCC)
  + Option 2: may not be needed for backhaul link and further discussion for access link because BS requirements can’t be reused (CATT)
* Recommended WF
  + TBA

**Issue 2-4-7: output intermodulation for FR2**

* Proposals
  + Option 1: not needed for both DL and UL (NTT DOCOMO, Ericsson, CATT, CMCC)
  + Option 2: TBA
* Recommended WF
  + RAN4 doesn’t specify the output intermodulation requirements for FR2 NR repeater

**Issue 2-4-8: requirements relating to frequencies that belonging to other operators but are within the passband**

* Proposals
  + Option 1: there may be implication of not specifying such requirements (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

**Example 2**

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 2. Our preference is not to include OTA requirements. The scope of the WI is repeaters without active beamforming and it is not expected that repeaters with many active TX and no connectors would be used for FR1. The conformance work for OTA will be somewhat complex as there are no reference test procedures from BS or UE, and the assessments will differ between FR1 and FR2. So we think there is little gain from FR1 OTA, and effort should be focused on FR2 OTA conformance. |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 2-2-2: whether to define both the rated beam EIRP level and rated carrier TRP output power for FR2?**  Since the repeater does not perform beamforming, we do not see a need for an EIRP requirement. It is not like a BS where there is a requirement on accurately steering a beam in a number of directions. We can discuss if some requirement is needed for regulatory considerations.  Option 2: TRP only.  **Issue 2-2-6: whether/how to define ALC/AGC requirement**  As with FR1, we believe that ALC/AGC can be tested by demonstrating compliance to output power and some other key requirements with several input power levels. Option 3.  **Issue 2-2-7: how to define ALC/AGC requirement either implicitly or explicitly, taking following aspects into consideration**  We do not see the need for option 4 as there is no active beamforming  **Issue 2-2-8: whether/how to define dynamic range of NR repeater DL and UL**  This could be met with the requirements described in 2-2-7. Option 2: Meet implicitly as described in 2.2.7 option 1 |

Sub topic 2-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 2-3-1: whether/how to define relative ACLR for FR2 UL and DL**  We think that an absolute emissions requirement dimensioned so that the emissions are the same as a BS/UE with a reference power level is OK; no relative requirement needed. Recommended WF is OK for us.  **Issue 2-3-3: operating band unwanted emission requirement for UL and DL**  We agree with options 2 & 3 |

Sub topic 2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | **Issue 2-4-1: frequency stability for FR2**  We are OK with the recommended WF  **Issue 2-4-5: EVM requirements**  Different deployments may need different levels of EVM. In some cases, the repeater may not experience extremely high SNR and then there is no point to design for high EVM. In other cases, high EVM is relevant. Two EVM requirement levels could be defined. Alternatively, since EVM conformance testing is a more significant fraction of total conformance testing for repeaters and a one size fits all requirement may not work EVM could be left out of 3GPP conformance and left for manufacturer specification for repeaters.  **Issue 2-4-8: requirements relating to frequencies that belonging to other operators but are within the passband**  If other operators have carriers within the passband, there is the risk that the repeater amplifies nearby interference sources for those carriers and causes interference if the neighbour operators BS or UE are in the same direction as the repeater. More comments welcome on this topic and whether/how it could be solved. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2107106 | Discussion on RF parameters to be specified | Huawei |  |  |
| R4-2104612 | Discussion on transmitter power related conducted requirements | CMCC |  |  |
| R4-2104671 | Conducted TX power requirements for repeaters | Ericsson |  |  |
| R4-2104795 | Discussion on NR repeater conducted output power | CATT |  |  |
| R4-2104988 | Discussion on NR repeater FR1 maximum output power and ALC/AGC | NEC |  |  |
| R4-2106327 | Conducted power related requirements consideration for NR-Repeaters | Nokia, Nokia Shanghai Bell |  |  |
| R4-2106350 | Views on transmitted power related requirements for FR1 NR repeater | NTT DOCOMO, INC. |  |  |
| R4-2104617 | Discussion on emission related conducted requirements | CMCC |  |  |
| R4-2104669 | Conducted unwanted emissions requirements for repeaters | Ericsson |  |  |
| R4-2104796 | Discussion on NR repeater conducted emission requirement | CATT |  |  |
| R4-2106328 | Conductive emission requirement consideration for NR-Repeaters | Nokia, Nokia Shanghai Bell |  |  |
| R4-2106351 | Views on emission requirements for FR1 NR repeater | NTT DOCOMO, INC. |  |  |
| R4-2104615 | Discussion on signal quality related requirements for NR repeater | CMCC |  | *Moved from agenda 8.11.1.4* |
| R4-2104670 | NR repeaters conducted other requirements | Ericsson |  |  |
| R4-2104797 | Discussion on NR repeater conducted other requirements | CATT |  |  |
| R4-2106329 | Repeater timing | Nokia, Nokia Shanghai Bell |  |  |
| R4-2104613 | Discussion on transmitter power related FR2 radiated requirements | CMCC |  |  |
| R4-2104674 | Radiated TX power for repeaters | Ericsson |  |  |
| R4-2104798 | Discussion on power requirement for FR2 NR repeater | CATT |  |  |
| R4-2106330 | Radiated power related requirements consideration for NR-Repeaters | Nokia, Nokia Shanghai Bell |  |  |
| R4-2106352 | Views on transmitted power related requirements for FR2 NR repeater | NTT DOCOMO, INC. |  |  |
| R4-2104618 | Discussion on transmitter emission related radiated requirements | CMCC |  |  |
| R4-2104672 | Radiated emissions requirements | Ericsson |  |  |
| R4-2104799 | Discussion on emission requirements for FR2 NR repeater | CATT |  |  |
| R4-2106331 | Radiated emission requirement consideration for NR-Repeaters | Nokia, Nokia Shanghai Bell |  |  |
| R4-2106353 | Views on emission requirements for FR2 NR repeater | NTT DOCOMO, INC. |  |  |
| R4-2104675 | Other radiated repeater requirements | Ericsson |  |  |
| R4-2104800 | Discussion on other requirements for FR2 NR repeater | CATT |  |  |
| R4-2106332 | Frequency error considerations for FR2 NR-Repeaters | Nokia, Nokia Shanghai Bell |  |  |

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