**3GPP TSG-RAN WG4 Meeting # 98-e R4-21xxxxx**

**Electronic Meeting, Jan. 25-Feb. 5, 2021**

**Agenda item:** 11.11.2 and 11.11.3

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [98e][313] 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 for current meeting. As the first meeting, this email discussion aims to conclude which requirements could be defined for NR repeater and all the associated aspects would be listed for further study.

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: Common issues for conducted and radiated requirements

NR repeater classes are discussed in this thread.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100376 | CATT | Proposal 1: NR repeater output power requirement follows LTE repeater output power approach including the ALC requirements, i.e. no class is defined.  Proposal 2: For the NR repeater in FR1 FDD bands, we think following LTE FDD repeater requirements is ok.  Proposal 3: TDD repeaters downlink Tx power requirements follow FDD repeaters’ requirements.  Proposal 4: TDD repeater uplink requirements are be defined as following,  Table 1: TDD Repeater uplink output power; normal conditions   |  |  | | --- | --- | | Rated output power | Limit | | P ≤ 31 dBm | +3 dB and -3 dB |   Table 2: Repeater uplink output power; extreme conditions   |  |  | | --- | --- | | Rated output power | Limit | | P ≤ 31 dBm | +4 dB and -4 dB |   Proposal 5: ALC requirement is defined for NR repeater for both FDD and TDD, the requirements are defined to follow LTE repeaters. |
| R4-2100378 | CATT | Proposal 1: EVM requirements for NR repeater downlink and uplink are defined as 6%. The proposal applies to both FR1 and FR2.  Proposal 2: Frequency stability requirement for NR repeater reuse BS approach and define the requirement as ± 0.01 ppm. The proposal applies to both FR1 and FR2. |
| R4-2100828 | CMCC | Observation 1: NR repeater could be deployed inside the high-speed train to provide blanket inside coverage for UE in the high-speed train considering the large penetrate loss generated by carriages.  Observation 2: There are two methods of defining repeater classes. One is IAB-like definition that using the terminologies in the set of MA/MR/LA with some modification and the other is LTE repeater-like definition that is based on manufactures declarations of the minimum donor couple loss for flexible deployment.  Observation 3: IAB power related requirements include output power, output power dynamics and power control related requirements while LTE repeater only has the power accuracy requirements.  Proposal 1: 1-C type is the only option for FDD repeater to reduce testing complexity.  Proposal 2: TDD repeater is suggested to support all the four types 1-C, 1-O, 1-H, 2-O.  Proposal 3: it is suggested to define MA/MR/LA classes for NR repeaters.  Proposal 4: maximum output power limit should be designed to avoid harmful interference to neighbouring cells. |
| R4-2102109 | Ericsson | Observation 1: For wide area deployment scenarios and downlink transmission, the repeater specification applies the same approach as the BS specification.  Observation 2: For downlink, unlike the BS specifications, the repeater does not ensure protection of other operators’ channels in other frequency layers for heterogeneous deployments of medium range/local area repeaters.  Observation 3: Unlike the UE specification, the repeater specification does not regulate losses to victim networks due to receiver blocking and adjacent channel selectivity in neighbor networks. |
| R4-2102110 | Ericsson | Observation 1: Applying only the wide area OBUE mask in downlink means that repeaters create more adjacent channel interference than basestations by 2dB for Category B mask, 10dB for category B mask in 10MHz.  Observation 2: Applying only the wide area OBUE mask in uplink can lead to performance degradation for adjacent operators, especially in regions where the category A mask is applicable. The UL ACLR degradation may be 17dB.  Observation 3: If a relay would have 32dBm or lower power and meet the medium range BS OBUE then in downlink the same protection would be achieved as for a gNB. In UL, the UE spectrum emissions mask would be met, but adjacent channel power would still be 10dB greater than a UE meeting ACLR.  Observation 4: A local area repeater meeting local area BS OBUE requirements would protect DL co-existence. In UL, adjacent channel emissions could be degraded by around 3dB or more.  To avoid degradation of the co-existence performance, the following could be considered:  • For repeaters in medium range and local area scenarios, the OBUE mask corresponding to those environments could be applied. This would reduce but not eliminate the ACLR degradation compared to BS  • The repeater could be required to meet the BS absolute ACLR requirement of -13dBm/MHz. This would mostly eliminate the emissions increase in downlink, but not fully in uplink.  • The repeater could be required to meet an adjacent channel emissions limit set by considering the ACLR for a PC3 UE (regardless of repeater power). This would eliminate the DL and UL emissions increase. |

## Open issues summary

Before the definition of RF conducted and radiated requirements, some common issues should be discussed at first, e.g. distinguishing repeater classes, about which there are several proposals that are discussed as below.

### Sub-topic 1-1

NR repeater class definition.

**Issue 1-1: Whether to explicitly distinguish repeater classes in the specification?**

* Proposals
  + Option 1: Yes
    - Option 1-1: selection from the set of MA/MR/LA with some modification, if needed, e.g. similar as IAB-MT classes definition. (CMCC, Ericsson)
  + Option 2: No class is defined. (CATT)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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

### 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:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Conducted requirements

NR repeater conducted 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** |
| R4-2100376 | CATT | Proposal 1: NR repeater output power requirement follows LTE repeater output power approach including the ALC requirements, i.e. no class is defined.  Proposal 2: For the NR repeater in FR1 FDD bands, we think following LTE FDD repeater requirements is ok.  Proposal 3: TDD repeaters downlink Tx power requirements follow FDD repeaters’ requirements.  Proposal 4: TDD repeater uplink requirements are be defined as following,  Table 1: TDD Repeater uplink output power; normal conditions   |  |  | | --- | --- | | Rated output power | Limit | | P ≤ 31 dBm | +3 dB and -3 dB |   Table 2: Repeater uplink output power; extreme conditions   |  |  | | --- | --- | | Rated output power | Limit | | P ≤ 31 dBm | +4 dB and -4 dB |   Proposal 5: ALC requirement is defined for NR repeater for both FDD and TDD, the requirements are defined to follow LTE repeaters. |
| R4-2100377 | CATT | Observation: ACLR with NR adjacent channel may be omitted. ACLR with LTE adjacent channel needs some discussion for the decision.  Proposal: Reuse BS operating band unwanted emissions and transmitter spurious emissions requirements for NR repeater. |
| R4-2100378 | CATT | Proposal 1: EVM requirements for NR repeater downlink and uplink are defined as 6%. The proposal applies to both FR1 and FR2.  Proposal 2: Frequency stability requirement for NR repeater reuse BS approach and define the requirement as ± 0.01 ppm. The proposal applies to both FR1 and FR2. |
| R4-2100828 | CMCC | Observation 1: NR repeater could be deployed inside the high-speed train to provide blanket inside coverage for UE in the high-speed train considering the large penetrate loss generated by carriages.  Observation 2: There are two methods of defining repeater classes. One is IAB-like definition that using the terminologies in the set of MA/MR/LA with some modification and the other is LTE repeater-like definition that is based on manufactures declarations of the minimum donor couple loss for flexible deployment.  Observation 3: IAB power related requirements include output power, output power dynamics and power control related requirements while LTE repeater only has the power accuracy requirements.  Proposal 1: 1-C type is the only option for FDD repeater to reduce testing complexity.  Proposal 2: TDD repeater is suggested to support all the four types 1-C, 1-O, 1-H, 2-O.  Proposal 3: it is suggested to define MA/MR/LA classes for NR repeaters.  Proposal 4: maximum output power limit should be designed to avoid harmful interference to neighbouring cells. |
| R4-2100830 | CMCC | Proposal 1: we suggest to involve the following emission requirements for repeater as the start point. It is noted all the regulatory requirements of BS could be reused.   * Transmitted signal quality, including Frequency error and EVM while IBE and EVM equalizer spectrum flatness requirements could be eliminated. * Unwanted emissions, including ACPR, Out of band gain, Operating band unwanted emissions * Transmitter spurious emissions, including mandatory requirements, Protection of the BS receiver of own or different BS, Additional spurious and Co-location requirements with other BS/repeaters * output intermodulation * input intermodulation |
| R4-2102109 | Ericsson | Conducted requirements  Observation 1: For wide area deployment scenarios and downlink transmission, the repeater specification applies the same approach as the BS specification.  Observation 2: For downlink, unlike the BS specifications, the repeater does not ensure protection of other operators’ channels in other frequency layers for heterogeneous deployments of medium range/local area repeaters.  Observation 3: Unlike the UE specification, the repeater specification does not regulate losses to victim networks due to receiver blocking and adjacent channel selectivity in neighbour networks. |
| R4-2102110 | Ericsson | Observation 1: Applying only the wide area OBUE mask in downlink means that repeaters create more adjacent channel interference than basestations by 2dB for Category B mask, 10dB for category B mask in 10MHz.  Observation 2: Applying only the wide area OBUE mask in uplink can lead to performance degradation for adjacent operators, especially in regions where the category A mask is applicable. The UL ACLR degradation may be 17dB.  Observation 3: If a relay would have 32dBm or lower power and meet the medium range BS OBUE then in downlink the same protection would be achieved as for a gNB. In UL, the UE spectrum emissions mask would be met, but adjacent channel power would still be 10dB greater than a UE meeting ACLR.  Observation 4: A local area repeater meeting local area BS OBUE requirements would protect DL co-existence. In UL, adjacent channel emissions could be degraded by around 3dB or more.  To avoid degradation of the co-existence performance, the following could be considered:  • For repeaters in medium range and local area scenarios, the OBUE mask corresponding to those environments could be applied. This would reduce but not eliminate the ACLR degradation compared to BS  • The repeater could be required to meet the BS absolute ACLR requirement of -13dBm/MHz. This would mostly eliminate the emissions increase in downlink, but not fully in uplink.  • The repeater could be required to meet an adjacent channel emissions limit set by considering the ACLR for a PC3 UE (regardless of repeater power). This would eliminate the DL and UL emissions increase. |
| R4-2102111 | Ericsson | Observation 1: The requirement on frequency stability in the E-UTRA repeater specification is likely to be sufficient  Observation 2: For the out of band gain requirement to be sufficient, the gain must be lower than the coupling loss to any radio transmitter from the repeater, not just the donor.  Observation 3: The behavior of the repeater if it is situated close to another node that is transmitting on an adjacent channel should be further considered (it may amplify the signal from the adjacent channel node)  Observation 4: The EVM definition in the E-UTRA repeater specification is not the same as the EVM defined in the BS and UE specifications.  Observation 5: The EVM is probably not sufficient for 256QAM operation.  Observation 6: The input intermodulation requirements cover UL passband repeat and co-existence/co-location to other bands and seem to be sufficient.  Observation 7: The output intermodulation requirements in the E-UTRA repeater specification are sufficient.  Observation 8: It is not obvious that an ACRR requirement is needed, but further consideration should be given to the behavior of the repeater if there is another node close by that either creates emissions on an adjacent channel or actually uses an adjacent channel.  Observation 9: A TDD switching time requirement may be applicable for a repeater. |
| R4-2102418 | Huawei | Many of the requirements are the same or at least follow the same principle of using the BS limits. Requirements on emissions are broadly in line with the equivalent BS requirements, requirements limiting gain to prevent repeater oscillation are the same across all variants and would likely be similar for an NR repeater.  There are a number of interesting requirements however which have implications on repeater design and possible implication of a NR TDD repeater:  Frequency Stability: The allowable value is so small that any up/down conversion and demodulation seems improbable to implement.  Modulation accuracy: The EVM requirement is assuming a “clean” input signal, the allocation to the repeater is hence added to the BS/UE EVM when considering the link. Current requirements are very high and possibly only suitable for QPSK or 16QAM links. For NR it is possible this value needs to be improved.  Timing accuracy: As NR is considering TDD a similar timing accuracy requirement may be needed. The current requirement is based on the chip rate and only for low chip rate UTRA, this will need further study if it is applied to NR.  In addition existing repeater variants are designed for networks which do not have AAS, whilst the repeater itself may not use AAS beam forming, the BS and UE it communicates between may, this should further be investigated. |
| R4-2102831 | Qualcomm Incorporated | This paper discusses some conducted requirements specified for LTE and comments on inclusion for NR FR1, including maximum output power for FR1, out of band gain, unwanted and spurious emissions, coexistence with co-located base stations, EVM, repeater gain control, repeater delay and frequency error. |
| R4-2100635 | CommScope Technologies AG | Proposal: Adopt these requirements as necessary and sufficient for specifying the radio transmission and reception requirements for a NR repeater. |

## Open issues summary

As the first meeting, conducted requirements are discussed based on the legacy EUTRAN/UTRAN repeater specs with comments on inclusion in FR1 NR. There are several proposals that are listed below.

Agenda 11.11.2.

### Sub-topic 2-1

The principle for FR1 FDD and TDD

**Issue 2-1-1: the principle for defining NR FDD requirements**

* Proposals
  + Option 1: Following LTE FDD repeater requirements is OK. (CATT)
  + Option 2: at least the following requirements need further discussion
    - Option 2-1: EVM (Huawei)
    - Option 2-2: OBUE (Ericsson)
    - Option 2-3: maximum output power (Ericsson, CMCC)
    - Option 2-4: out of band gain
* Recommended WF
  + NR FDD requirements could follow LTE FDD requirements. However, at least following requirements should be further discussed.
    - EVM, OBUE, maximum output power, out of band gain

**Issue 2-1-2: extra requirements only for TDD rather than FDD, following aspects could be taken into account:**

* Proposals
  + Option 1: Time accuracy (Huawei)
  + Option 2: TDD switching requirements (Ericsson)
  + Option 3: REFSENSE (CMCC in R4-2100827)
  + Option 4: transmit off requirements (CATT in R4-2100375)
  + Option 5: transient period requirements (CATT in R4-2100375)
* Recommended WF
  + Candidate TDD specific requirements for further discussion: time accuracy, TDD switching, REFSENSE, transmit off requirements and transient period requirements.
    1. Sub-topic 2-2

Output power related conducted requirements for both FDD and TDD.

**Issue 2-2-1: Whether/how to set maximum output power upper limits, following approaches could be taken into account:**

* Proposals
  + Option 1: BS-like approach of constraining the maximum output power for MR and LA repeaters for coexistence in heterogeneous network deployment (CMCC, Ericsson)
  + Option 2: Differentiating DL and UL with separate approaches (CATT)
    - power of Repeater not exceeding any UE power class defined in the band
    - LTE FDD-like approach based on manufacture’s declaration
* Recommended WF
  + TBA

**Issue 2-2-2: whether to assume and/or set a requirement for fixed gain:**

* Proposals
  + Option 1: for further study (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-2-3: ALC/AGC capability is maintained or not?**

* Proposals
  + Option 1: Yes, the requirements are defined to follow LTE repeaters. (CATT)
  + Option 2: Yes, further discussion on how to regulate this requirement to ensure satisfactory radio link performance with following aspects
    - Option 2-1: Self-oscillation impact (Huawei, Qualcomm)
    - Option 2-2: AGC should be a slow adjustment compared to the symbol rates (Qualcomm)
* Recommended WF
  + From moderator’s point of view, ALC and AGC play the same role. They are only the different names to regulate repeater’s gain control capability.
  + ALC/AGC capability should be maintained with further discussion on how to regulate this requirement to ensure satisfactory radio link performance
    1. Sub-topic 2-3

Signal quality related requirements for both FDD and TDD, including EVM, frequency error.

**Issue 2-3-1: EVM definition, following aspects should be taken into account**

* Proposals
  + Option 1: Whether/how to consider 256QAM? (Ericsson)
  + Option 2: EVM needs to be improved taking both the extra noise in repeater and the received signal quality into consideration, (CATT 6%，Huawei)
* Recommended WF
  + TBA

**Issue 2-3-2: frequency error**

* Proposals
  + Option 1: ±0.01ppm
  + Option 2: TBA
* Recommended WF
  + ±0.01ppm
    1. Sub-topic 2-4

Unwanted emission related conducted requirements including ACLR, OBUE, spurious emission, out of band gain, and ACRR for both FDD and TDD.

**Issue 2-4-1: Whether to define ACLR**

* Proposals
  + Option 1: No
    - Option 1-1: more stringent requirement for adjacent channel emission/absolute ACLR could be considered to avoid degradation of the co-existence performance. (Ericsson)
  + Option 2: ACLR with NR adjacent channel may be omitted. ACLR with LTE adjacent channel needs some discussion for the decision. (CATT)
* Recommended WF
  + TBA

**Issue 2-4-2: OBUE definition, following aspects should be considered**

* Proposals
  + Option 1: follows BS specification for the appreciate requirements, following aspects should be considered. (CATT, Huawei, CMCC)
    - Option 1-1: whether including addition requirements, e.g.(DTT)
    - Option 1-2: whether including Protection of the BS receiver in the operating band requirements
  + Option 2: Compared with ACLR requirements, more stringent adjacent channel emissions limit may be required to avoid degradation of the co-existence performance (Ericsson)
* Recommended WF
  + TBA

**Issue 2-4-3: spurious emission**

* Proposals
  + Option 1: follows BS specification for the appreciate requirements, following aspects should be considered. (CATT, Huawei, CMCC)
    - Option 1-1: whether all the requirements of BS still apply for repeater, including the mandatory requirements, the coexistence with other system, the Protection of the BS receiver of own or different BS and the co-location with base stations
    - Option 1-2: Whether include all the classes or implicitly refer to one class. (CMCC)
* Recommended WF
  + NR repeaters spurious requirements should follow BS specification for the appreciate requirements. Further discussion on whether to include all the spurious requirements for all classes.

**Issue 2-4-4: out of band gain, following aspects should be considered**

* Proposals
  + Option 1: minimum coupling loss to donor BS (Huawei)
  + Option 2: minimum coupling loss to any radio transmitter from the repeater, not just the donor (Ericsson)
* Recommended WF
  + TBA

**Issue 2-4-5: ACRR requirements, following aspects should be considered**

* Proposals
  + Option 1: the behaviour of the repeater if there is another node close by that either creates emissions on an adjacent channel or actually uses an adjacent channel. (Ericsson)
  + Option 2: co-existence with UTRA/EUTRA rather than NR operating on an adjacent channel
* Recommended WF
  + TBA
    1. Sub-topic 2-5

others

**Issue 2-5-1: output intermodulation**

* Proposals
  + Option 1: Referring to BS Rx intermodulation requirements.
  + Option 2: TBA
* Recommended WF
  + The same requirements as BS Rx intermodulation could still apply for FR1 NR repeater

**Issue 2-5-2: input intermodulation, may cover following scenarios**

* Proposals
  + Option 1: passband repeater. (Ericsson)
  + Option 2: co-location repeaters. (Ericsson)
  + Option 3: co-existence repeaters. (Ericsson)
* Recommended WF
  + TBA

**Issue 2-5-3: whether include repeater delay requirements**

* Proposals
  + Option 1: Further discussion is necessary. (Qualcomm)
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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

Companies are suggested to express their views about whether to define following conducted requirements for NR repeater. “Y” means the related requirements in the first column should be specified. “TBD” means the inclusion needs further discussion. “N” means the requirements should be eliminated in NR repeater specification.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Candidate requirements | Company A | Company B | Company C | Company D | Company E | Company F |
| Classes  e.g. IAB-MT-like approach, BS-like approach |  |  |  |  |  |  |
| Maximum output power limits for some classes, the same as BS |  |  |  |  |  |  |
| Maximum output power based on declaration |  |  |  |  |  |  |
| Maximum output power not exceeding any UE power class |  |  |  |  |  |  |
| ALC/AGC capability |  |  |  |  |  |  |
| Dynamic range |  |  |  |  |  |  |
| Power control |  |  |  |  |  |  |
| Requirements for fixed gain |  |  |  |  |  |  |
| Transmit off |  |  |  |  |  |  |
| Transient period |  |  |  |  |  |  |
| Repeater delay |  |  |  |  |  |  |
| EVM |  |  |  |  |  |  |
| Frequency error |  |  |  |  |  |  |
| Time accuracy |  |  |  |  |  |  |
| TDD switching requirements |  |  |  |  |  |  |
| OBUE |  |  |  |  |  |  |
| Spurious emission |  |  |  |  |  |  |
| Co-location with other BS |  |  |  |  |  |  |
| ACLR |  |  |  |  |  |  |
| Absolute ACLR |  |  |  |  |  |  |
| ACRR |  |  |  |  |  |  |
| Out of band gain |  |  |  |  |  |  |
| Input intermodulation |  |  |  |  |  |  |
| Output intermodulation |  |  |  |  |  |  |
| REFSENSE  e.g. for baseband processor |  |  |  |  |  |  |
| Blocking related requirements |  |  |  |  |  |  |
| Some other suggestions  … |  |  |  |  |  |  |

### 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:* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

1. Topic #3: Radiated requirements

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

Agenda 11.11.3

* 1. Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100377 | CATT | Observation: ACLR with NR adjacent channel may be omitted. ACLR with LTE adjacent channel needs some discussion for the decision.  Proposal: Reuse BS operating band unwanted emissions and transmitter spurious emissions requirements for NR repeater. |
| R4-2100379 | CATT | Proposal 1: NR FR2 repeater Tx power requirements follow BS approach.  Observation: The beam forming assumption of the received signal for FR2 Tx power requirement needs to be discussed.  Proposal 2: No ALC requirement is defined for NR FR2 repeater. |
| R4-2100829 | CMCC | Observation 1: IAB power related requirements include radiated transmit power, output power, output power dynamics and power control related requirements, which are referred from both BS and UE requirements while LTE repeater has no radiated requirements.  Observation 2: To achieve blanket coverage, both the network node, IAB and LTE repeaters are allowed to transmit power exceeding any UE classes.  Proposal 1: Radiated transmit power requirement is required for blanket and reliable connection.  Proposal 2: to achieve blanket coverage and avoid interference, it is reasonable to set maximum output power upper limit for repeater but not exceeding any UE power class seems too stringent.  Proposal 3: repeater’s output power per connector and scaling factor should be redefined, if needed.  Proposal 4: RE dynamic range, total dynamic range and UE power control requirements doesn’t apply for NR repeaters. |
| R4-2100831 | CMCC | Proposal 1: For FR1 OTA, we should focus on conducted requirement as the start point and then identify whether the same scaling factor of IAB could be reused. For FR2, new analysis is necessary for requirements except regulatory requirements. The following lists all the potential requirements for OTA emission requirements   * Transmitted signal quality, including Frequency error, EVM * Unwanted emissions, including ACPR, Out of band gain, Operating band unwanted emissions * Transmitter spurious emissions   + including mandatory spurious, additional spurious, Co-location spurious with other BS/repeater for FR1   + including mandatory spurious and additional spurious for FR2 * output intermodulation * input intermodulation |
| R4-2102112 | Ericsson | Radiated transmit power is considered in this contribution. |
| R4-2102113 | Ericsson | Radiated requirements:  Observation 1: For repeaters with TX power in the range 31-39dBm, the ACLR is more stringent close to the carrier than the emissions mask.  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). |
| R4-2102114 | Ericsson | Radiated requirements  Observation 1: To avoid significant impact of the repeater to the link, the frequency error needs to be specified to be a fraction of the UE and BS frequency error.  Observation 2: EVM should be based on either the definition in the BS or the UE spec. Further discussion should take place on whether the EVM should be aligned to 256QAM or 64QAM.  Observation 3: No need for TX intermodulation requirements for FR2  Observation 4: In place of receiver requirements, a requirement on out of carrier 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.  Observation 5: A requirement on input intermodulation should be created, with levels based on the BS RX intermodulation requirement. |

* 1. Open issues summary

As the first meeting, radiated requirements are discussed based on the legacy BS/IAB specs with comments on inclusion in NR radiated requirements. There are several proposals that are listed below*.*

* + 1. Sub-topic 2-1

*Beam related requirements:*

**Issue 2-1: beam related requirements, following aspects should be taken into account**

* Proposals
  + Option 1: discussion in core requirements/ conformance test stages
  + Option 2: Beam forming assumption of the received signals (CATT)
* Recommended WF
  + TBA
    1. Sub-topic 2-2

*Output power related requirements:*

**Issue 2-2-1: Tx power**

* Proposals
  + Option 1: following BS approach (CATT)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-2-2: ALC requirements**

* Proposals
  + Option 1: No ALC requirements (CATT)
  + Option 2: TBA
* Recommended WF
  + TBA
    1. Sub-topic 2-3

*Signal quality related requirements:*

**Issue 2-3-1: Frequency error requirements**

* Proposals
  + Option 1: A fraction of the UE and the BS frequency error (Ericsson)
  + Option 2: ± 0.01 ppm (CATT)
* Recommended WF
  + TBA

**Issue 2-3-2: EVM, following aspects should be considered**

* Proposals
  + Option 1: Based on BS or UE spec (Ericsson)
  + Option 2: Aligned to 256 QAM or 64 QAM (Ericsson)
  + Option 3: EVM equals to 6% (CATT)
* Recommended WF
  + TBA
    1. Sub-topic 2-4

*Unwanted emission related requirements including OBUE and out of carrier gain:*

**Issue 2-4-1: emission including OBUE and spurious, considering the following aspects**

* Proposals
  + Option 1: 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) (Ericsson)
  + Option 2: Reuse BS operating band unwanted emissions and transmitter spurious emissions requirements for NR repeater. (CATT)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-4-2: Out of carrier gain, considering the following aspects**

* Proposals
  + Option 1: UE blocking requirement level within the band and the BS out of band blocking levels for out of band (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-4-3: ACLR, considering the following aspects**

* Proposals
  + Option 1: ACLR with NR adjacent channel may be omitted. ACLR with LTE adjacent channel needs some discussion for the decision. (CATT)
  + Option 2: TBA
* Recommended WF
  + TBA
    1. Sub-topic 2-5

*Others including Tx/output intermodulation requirements and input intermodulation:*

**Issue 2-5-1: Whether to define Tx/output intermodulation requirements**

* Proposals
  + Option 1: No (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 2-5-2: whether/how to define input intermodulation, considering the following aspects**

* Proposals
  + Option 1: based on the BS RX intermodulation requirement (Ericsson)
  + Option 2: TBA
* Recommended WF
  + TBA
  1. Companies views’ collection for 1st round
     1. Open issues

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

Companies are suggested to express their views about whether to define following radiated requirements for NR repeater. “Y” means the related requirements in the first column should be specified. “TBD” means the inclusion needs further discussion. “N” means the requirements should be eliminated in NR repeater specification.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Candidate requirements | Company A | Company B | Company C | Company D | Company E | Company F |
| Classes  e.g. IAB-MT-like approach, BS-like approach |  |  |  |  |  |  |
| Maximum output power limits for some classes, the same as BS |  |  |  |  |  |  |
| Maximum output power based on declaration |  |  |  |  |  |  |
| Maximum output power not exceeding any UE power class |  |  |  |  |  |  |
| ALC/AGC capability |  |  |  |  |  |  |
| Dynamic range |  |  |  |  |  |  |
| Power control |  |  |  |  |  |  |
| Requirements for fixed gain |  |  |  |  |  |  |
| Transmit off |  |  |  |  |  |  |
| Transient period |  |  |  |  |  |  |
| Repeater delay |  |  |  |  |  |  |
| EVM |  |  |  |  |  |  |
| Frequency error |  |  |  |  |  |  |
| Time accuracy |  |  |  |  |  |  |
| TDD switching requirements |  |  |  |  |  |  |
| OBUE |  |  |  |  |  |  |
| Spurious emission |  |  |  |  |  |  |
| Co-location with other BS |  |  |  |  |  |  |
| ACLR |  |  |  |  |  |  |
| Absolute ACLR |  |  |  |  |  |  |
| ACRR |  |  |  |  |  |  |
| Out of band gain |  |  |  |  |  |  |
| Input intermodulation |  |  |  |  |  |  |
| Output intermodulation |  |  |  |  |  |  |
| REFSENSE  e.g. for baseband processor |  |  |  |  |  |  |
| Blocking related requirements |  |  |  |  |  |  |
| Some other suggestions  … |  |  |  |  |  |  |

* + 1. 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 |
|  |

* 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.*

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

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

* + 1. 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”* |

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

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |