**3GPP TSG-RAN WG4 Meeting # 102-e R4-2207427**

**Electronic Meeting, February 21st – March 3rd , 2022**

**Agenda item:** 10.5.1

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [101bis-e][304] NR\_Repeater\_General

**Document for:** Information

# Introduction

This email thread is discussing several issues regarding the introduction of repeaters for NR in both FR1 and FR2. The main topics for discussion are listed below:

* 1st round:
	+ Co-location requirements
	+ TDD Repeater Switching Requirements
	+ Other issues mainly related to the specification drafting
* 2nd round:
	+ Revision of TPs
	+ WF on TDD Repeater Switching

# Topic #1: Co-location Requirements

*Several system parameters are discussed in this section. The discussion is mainly on continuations from the last meeting.*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2204555**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204555.zip) | CMCC | **Observation 1: there is possibility that NR repeater maybe co-located with other operator’s repeaters over non-overlapping spectrum, especially for O2I scenario.****Proposal 1: it is suggested to include repeater-repeater co-location scenario into the spec.****Proposal 2: it is suggested to reuse the same co-location spurious emission requirement as gNB spec for repeater-repeater co-location scenario and also differentiate RF requirements for different classes.** **Proposal 3: co-location spurious requirements apply for both DL and UL for FDD, only DL for un-synchronization TDD and only UL for synchronization TDD with maximum gain assumption.****Proposal 4: the same interference signal level as in gNB’s co-located out of band blocking requirement could also apply for the co-location input IMD requirements for repeater-repeater co-location scenario.****Proposal 5: co-location input IMD requirements apply for both DL and UL for FDD, only DL for synchronization TDD and only UL for un-synchronization TDD with maximum gain assumption.****Proposal 6: interference signal strength is assumed to be 30dB lower than wanted signal when define output IMD requirements for repeater-repeater co-location scenario.****Proposal 7: output IMD level should not exceed corresponding unwanted emission limits of repeater DL.** **Proposal 8: co-location output IMD requirements apply for DL for FDD and synchronization TDD.** |
| [**R4-2205031**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205031.zip) | Ericsson | **Proposal 1: The same co-location requirements can be applied for co-located BS or co-located repeater.****Proposal 2: Enable separate declaration of whether the BS side, UE side or both sides of the repeater can be co-located (per band).****Proposal 3: If the BS side is declared to meet co-location requirements, then it should meet TX co-location requirements for the uplink and RX co-location requirements for the downlink.****Proposal 4: If the UE side is declared to meet co-location requirements, then it should meet TX co-location requirements for the downlink and RX co-location requirements for the uplink.****Proposal 5: For co-location RX requirements, set the interferer level to be the same as for the BS co-location. The repeater should then meet the in-passband “OBUE” requirement with the co-locaiton interferer present.****Proposal 6: For the repeater output IMD requirement*** **Ensure the repeater is at maximum output power**
* **Apply a reverse IM signal with a power level 30dB lower than the repeater output power**
* **Require that ACLR, OBUE and spurious emissions requirements are met (as applicable) outside of the passband.**
* **Proposal 7: The OOB gain should be no greater than -15dB to avoid re-amplification of a co-located carrier in another band. In case of coupled repeaters, clarify whether the requirement should be -70 or -30dB. The OOB gain requirement for co-location could be set as the worst case gan (i.e. lowest value)**

**Observation 1: Under co-location scenario, the spurious emission requirement is determined by the NF of the victim receiver.****Proposal 1: The NR repeater-repeater co-location spurious emission requirements are necessary and the value should be aligned with WA BS i.e. -96dBm/100kHz.** |
| [**R4-2205106**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205106.zip) | ZTE Corporation | **Observation 1: Under co-location scenario, the spurious emission requirement is determined by the NF of the victim receiver.****Proposal 1: The NR repeater-repeater co-location spurious emission requirements are necessary and the value should be aligned with WA BS i.e. -96dBm/100kHz.** |
| [**R4-2205969**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205969.zip) | Huawei | **Proposal 1:** Co-location blocking levels are based on the class of the transmission side of the repeater.**Proposal 2:** UE side (DL transmission) we can use the same class based levels as the BS spec so the repeater BS co-location requirements are sufficient.**Proposal 3:** BS side (UL transmission) use the repeater class power limits – 30dB**Proposal 4:** The output IMD requirement is sufficient and no additional band specific co-location requirement is needed.**Proposal 5:** The co-located emission requirement for repeater to repeater is same as repeater to BS so no need for a specific repeater to repeater requirement.**Proposal 8:** Repeater to repeater co-location in-band output IMD is specified for the UL also.Where we state the existing repeater to BS co-location requirements are sufficient clearly it would need to be explained they also apply to repeater to repeater.On the issue of BS to repeater co-location for the UL we make the following proposal.**Proposal 6:** Input IMD should apply to DL and UL**Proposal 7:** Output IMD does not need specifying for the UL in BS-repeater co-location. |
| [**R4-2206050**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206050.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: For the co-located repeaters of the same class, the co-location spurious emission requirements specified in the BS specification can be used.******Observation 2: Unlike for the BS, in case of repeaters there can be deployment configurations where there can be two different classes for access and backhaul sides.******Observation 3: When there are two classes for the access and backhaul sides, the ‘same class constraint’ specified in the BS specification cannot be satisfied in possible scenarios (as depicted in Figure 1 (a) and Figure 1 (b)).******Proposal 1: In case of repeater-repeater co-location (including repeaters with different class configurations in backhaul and access links), when considering the spurious emissions, input IMD, or output IMD apply the most stringent constraint (selected from the ones specified for each class) so that it is applicable to both classes.******Proposal 2: In case of NR repeaters, co-location input and output intermodulation requirements must be applied for both UL and DL directions.******Proposal 3: Discuss whether the threshold value of 10 dB is still valid when there are different repeater classes.******Proposal 4: In case of NR repeater co-location, the interfering signal mean power values (for each BS class) specified for co-location blocking in TS 38.104 can be applicable for repeater output intermodulation depending on the repeater class.*** ***Observation 4: It is not clear why co-location requirements must be specified at maximum repeater gain.*** |

## Open issues summary

### Sub-topic 1-1

Requirements for co-located repeaters:

**Issue 1-1: Repeater co-location**

* Proposals
	+ Option 1: Define requirements for the repeater-repeater co-location
	+ Option 2: Requirements are not needed
* Recommended WF
	+ Option 1

If Option 1 is not agreeable, please provide arguments why requirements are needed

Agreement: Introducing Repeater co-location requirements covering BS-repeater co-location and repeater co-location.

### Sub-topic 1-2

Co-location spurious requirements:

**Issue 1-2: Spurious requirements for co-location**

* Proposals
	+ Option 1: Reuse the co-location spurious requirements defined for gNBs , differentiate requirements based on classes (reuse WA BS)
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If Option 2 is preferred, please provide an alternative proposal

Agreement: Option 1

### Sub-topic 1-3

Co-location blocking requirements:

**Issue 1-3: Co-location blocking requirements**

* Proposals
	+ Option 1: Co-location blocking levels are based on the class of the transmission side of the repeater.
		- UE side (DL transmission) : use the same class based levels as the BS spec so the repeater BS co-location requirements are sufficient.
		- BS side (UL transmission) : use the repeater class power limits – 30dB
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If option 2 is preferred, please provide an alternative proposal

**GTW discussion**

Nokia: How about repeater with different classes in DL and UL ?

We prefer to choose highest class between DL and UL on repeater.

Huawei: We can rely on transmission side.

Agreement:

* Option 1: Co-location blocking levels are based on the class of the transmission side of the repeater.
	+ UE side (DL transmission) : use the same class based levels as the BS spec so the repeater BS co-location requirements are sufficient.
	+ BS side (UL transmission) :
		- For WA class: use BS co-location requirements
		- For LA class: use the repeater class power limits – 30dB

### Sub-topic 1-4

Co-location requirement applicability/declaration – BS side

**Issue 1-4: Co-location requirement declaration**

* Proposals
	+ Option 1: If the BS side is declared to meet co-location requirements, then it should meet TX co-location requirements for the uplink and RX co-location requirements for the downlink.
	+ Option 2: Other options
* Recommended WF
	+ Option 1:

If Option 2 is preferred, please provide an alternative proposal

Agreement: option 1

### Sub-topic 1-5

Co-location requirement applicability/declaration – UE side

**Issue 1-5:**

* Proposals
	+ Option 1: If the UE side is declared to meet co-location requirements, then it should meet TX co-location requirements for the downlink and RX co-location requirements for the uplink.
	+ Option 2: other options
* Recommended WF
	+ Option 1:

If Option 2 is preferred, please provide an alternative proposal

Agreement: Option 1

### Sub-topic 1-6

Co-location requirement applicability for repeaters with different classes

**Issue 1-6: Requirement applicability**

* Proposals
	+ Option 1: For repeater-repeater co-location (including repeaters with different class configurations in backhaul and access links), when considering the spurious emissions, input IMD, or output IMD apply the most stringent constraint (selected from the ones specified for each class) so that it is applicable to both classes.
	+ Option 2: other options
* Recommended WF
	+ Option 1:

If Option 2 is preferred, please provide an alternative proposal

Agreement:

NO need to link co-location requirements ~~applicability~~ among backhaul and access links on repeater ~~from co-location requirements perspective.~~

### Sub-topic 1-7

Output IMD

**Issue 1-7: Output IMD**

* Proposals
	+ Option 1: output IMD level should not exceed corresponding unwanted emission limits of repeater DL.
	+ Option 2: other options
* Recommended WF
	+ Option 1:

If Option 2 is preferred, please provide an alternative proposal

Agreement:

DL output IMD: The unwanted emission with output IMD applied should not exceed corresponding unwanted emission limits of repeater DL.

UL output IMD: The unwanted emission with output IMD applied should not exceed corresponding unwanted emission limits of repeater UL.

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Ok with it and prefer to no extra requirements compared with co-location with BS. |
| Ericsson | We think that the requirements for BS co-location are in general also sufficient for repeater co-location. So we support option 1 but prefer to define a single set of requirements for co-location (agnostic to BS or repeater) |
| Huawei | OK with WF, only issue with using BS-repeater co-location for repeater to repeater is how the power levels for class dependent UL requirements are chosen? |
| Qualcomm  | Ok with the proposed WF.  |
| Nokia, Nokia Shanghai Bell | OK with WF. |
| ZTE | We are OK with WF. |
| NEC | Ok with WF. |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Ok with option 1. |
| Ericsson | We are OK with option 1 apart from the “reuse WA BS” in parentheses. This seems to contradict the aim to differentiate requirements based on classes. |
| Huawei | OK with option 1, we think the class differences should remain. |
| Qualcomm | Ok with the proposed WF.  |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | We are OK with Option 1. But to be honest, the co-location requirement is determined by the noise figure of victim devices. Is it appropriate to align the NF of the repeater with the BS by default?  |
| NEC | Ok with option 1. |

Sub topic 1-3

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Ok with option 1. |
| Ericsson | Option 1 does not work for the BS side for the WA UL class, where there is no limit for the power class. For the UL WA, we propose to use the same co-location blocking level as the BS WA class. Apart from that, we are OK. |
| Huawei | Option 1 with Ericsson’s clarification is ok. |
| Qualcomm | Ok with the proposed WF taking into consideration the WA power class limit note as highlighted by Ericsson above.  |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | We are OK with Option 1. |
| NEC | Ok with option 1. |

Sub topic 1-4

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| **Company** | **Comments** |
| XXX |  |
| CATT | We have the same understanding, but prefer not to include too many clarifications in spec. Defining requirements for uplink and downlink may be sufficient. |
| Ericsson | Option 1 is OK. Note that the BS side part of the receiver, if it is a separate unit will have UL TX and DL RX. For co-location requirements it is necessary to differentiate to the BS or UE repeater side. |
| Huawei | Option 1 is ok, this seems obvious maybe can be clarified in the declaration table in the conformance spec |
| Qualcomm | No strong opinion against the WF, but as already flagged, this should be implicitly considered when defining downlink and uplink requirements.  |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | We are OK with Option 1. |
| NEC | Ok with option 1. |

Sub topic 1-5

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | The same comment as 1-4. |
| Ericsson | Option 1 is OK. Again for the UE side of the receiver, if it is a separate unit it will have UL RX and DL TX together. |
| Huawei | Option 1 ok, similar to 1-4 maybe we can make clear is declaration definition in conf spec. |
| Qualcomm | Similar comment as 1-4. |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | Similar with 1-4. |
| NEC | Ok with option 1. |

Sub topic 1-6

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Not sure about option 1. Our understanding is that the co-location deployment for different class may need specifically treatment, so the assumption of the coupling loss assumption for that scenario may not be the same as what is assumed for BS co-location. So think 1-2 proposal is more reasonable. |
| Ericsson | This would be different to BS-BS co-location, where the co-location requirements do not consider the possibility of a BS being co-located with a BS of a different class. Why would this principle only be applied for repeater-repeater co-location and not for repeater-BS co-location ? In general, this approach may be rather complex, but if it is applied we think it should be applied for repeater-BS co-location too. |
| Huawei | A repeater may have f=different classes on different sides (BS or UE) does this refer to this case (rather than the system it is co-located with) if so I guess that why it’s different to BS case. If different sides are different classes then assume they would be somewhat isolated from each other and each applicable to the relevant deployment assumptions. As so not sure this is necessary. |
| Qualcomm | Different repeater classes should be treated differently for co-location deployment. We propose to further discuss the pros and cons of the proposed option 1.  |
| Nokia, Nokia Shanghai Bell | Repeaters can have different classes for BH and AC links, and hence the 'same class constraint' defined in the BS specification may not be applicable for certain scenarios, unless we consider the most stringent case to over all the possibilities.  |

Sub topic 1-7

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Ok with option 1. |
| Ericsson | OK for the UE side of the repeater, but the option could be re-worded more clearly as “Unwanted emissions levels with IMD signal applied should not exceed the repeater DL limits” In our view, there should be an output IMD requirement for the BS side of the repeater too and then the unwanted emissions level should not exceed the repeater UL limits. |
| Huawei | OK with option 1 (think it should apply on both sides as Ericsson state) |
| Qualcomm | Ok with the proposed WF. |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | We are OK with Option 1. |

### CRs/TPs comments collection

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

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| --- | --- |
| **CR/TP number** | **Comments collection** |
|  | Company A |
| Company B |
|  |
|  | 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.*

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|  | **Status summary**  |
| All topics | Agreements were reached for all topics in the GTW discussion, the agreements are marked in green for each sub-topic.No further discussion needed in the 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)

No further discussion needed.

# Topic #2: TDD Repeater Switching Requirements

This section discusses how to define the switching requirements for TDD repeaters.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203944**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203944.zip) | CATT | **Proposal 1: The group delay is not mentioned in the core specification. If it’s need to be specially handled in the conformance test, it can be discussed further in the performance phase.****Proposal 2: EVM test for TDD repeater covers the switching timing accuracy performance. The details are discussed in the conformance test phase.** |
| [**R4-2204556**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204556.zip) | CMCC | **Observation 1: we should regulate group delay requirements to avoid U->D interference.****Proposal 1: repeater vendors should declare its group delay based on practical deployment.** |
| [**R4-2205024**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205024.zip) | Ericsson | **Observation 1: For the ON-OFF transition, the timing of the input signal should be earlier than the transition time by the group delay.** **Observation 2: For the OFF-ON transition, the timing of the input signal should be earlier than the transition time by the group delay.****Observation 3: No knowledge of the group delay is needed for the core requirement.****Observation 4: Knowledge of the group delay is not essential for the TDD switching conformance test assuming that it is defined in the same manner as for a BS.****Observation 5: For the long delay repeater, it is necessary to advance the input signal in time by the group delay at least for the EVM test.****Proposal 1: The group delay needs to be known for conformance testing (at least EVM) and should be considered during the conformance phase.****Proposal 2: The EVM requirement should include the symbol just before the transition (as is the case for the BS requirement).****Observation 6: An additional requirement could in theory be designed considering only symbols before the transition period, but then to obtain the same measurement accuracy a much longer measurement period may be needed.****Observation 7: Reduced MU could be used for EVM in the symbol just before the transition, but that would probably negate the purpose of the additional requirement.****Proposal 3: Do not define any additional EVM requirement for the symbols just before the transition.** |
| [**R4-2205107**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205107.zip) | ZTE Corporation | **Proposal 1:** **TDD operation related definition should be defined; Transmitter OFF period: “Time period during which the repeater downlink or uplink transmitter is not allowed to transmit” ; Transmitter ON period: “time period during which the repeater downlink or uplink transmitter is transmitting signals” ; transmitter transient period: “time period during which the transmitter is changing from the OFF period to the ON period or vice versa”****Proposal 2: RAN4 needs to discuss whether the long delay repeater is completely implementation-dependent, as this may require introducing some new definitions and interfaces.** |
| [**R4-2205968**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205968.zip) | Huawei | The diagram should therefore have a power based y-axis as this is how it’s been agreed to specify the requirements. The level of the input signal needs to be somehow indicated on the diagram or with an accompanying clarificationFor exampleFigure x.x.x-1 DL power ON/OFF TemplateDuring the downlink slot the input power is the level which produces the maximum *rated output power*.Outside the downlink slot and the transient times the input power is zero.Figure x.x.x-2 UL power ON/OFF TemplateDuring the uplink slot the input power is the level which produces the maximum *rated output power*.Outside the uplink slot and the transient times the input power is zero.The agreed OFF power levels and transient times can then be listed in separate tables, along with the agreements on declared long group delay systems etc. |
| [**R4-2206042**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206042.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1: The extended group delay and deployment restrictions are indicated by vendor declaration.****Proposal 2: The long delay repeaters must meet the DL and UL transition time requirements without accounting for the group delay. This can be taken into account in the test definition to be agreed in the conformance part.****Proposal 3.** **EVM measurement is not needed with testing of the repeater switching requirements.** |

## Open issues summary

The following issues are discussed in this section:

### Sub-topic 2-1

Group Delay Handling

**Issue 2-1: Group Delay Handling**

* Proposals
	+ Option 1: The group delay needs to be known for conformance testing (at least EVM) and should be considered during the conformance phase.
	+ Option 2: Other options
* Recommended WF
	+ Option 1.

If Option 2 is prepared, please provide an alternative proposal

### Sub-topic 2-2

Switching time accuracy testing

**Issue 2-2: Switching time testing**

* Proposals
	+ Option 1: EVM test for TDD repeater covers the switching timing accuracy performance. The details are discussed in the conformance test phase.
	+ Option 2: EVM measurement is not needed with testing of the repeater switching requirements
* Recommended WF
	+ Option 1

If Option 2 is preferred please provide an alternative proposal for testing

### Sub-topic 2-3

EVM Requirement and relationship to testing

**Issue 2-3: EVM Requirement and transitions**

* Proposals
	+ Option 1: The EVM requirement should include the symbol just before the transition (as is the case for the BS requirement).
	+ Option 2: Other proposals
* Recommended WF
	+ Option 1

If Option 2 is preferred, please provide an alternate proposal

### Sub-topic 2-4

EVM Requirement and relationship to testing

**Issue 2-4: EVM Requirement**

* Proposals
	+ Option 1: Do not define any additional EVM requirement for the symbols just before the transition
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If Option 2 is preferred, please provide an alternative solution

### Sub-topic 2-5

Definitions for TDD Operation

**Issue 2-5: TDD Operation Definitions**

* Proposals
	+ Option 1: TDD operation related definition should be defined;
		- Transmitter OFF period: “Time period during which the repeater downlink or uplink transmitter is not allowed to transmit” ;
		- Transmitter ON period: “time period during which the repeater downlink or uplink transmitter is transmitting signals” ;
		- Transmitter transient period: “time period during which the transmitter is changing from the OFF period to the ON period or vice versa”
	+ Option 2: Other definitions
	+ Option 3: No need for any definitions
* Recommended WF
	+ TBD

If Option 2 is preferred, please provide an alternative proposal. If Option 3 is preferred, please provide arguments.

### Sub-topic 2-6

Handling of exceptions for group delay

**Issue 2-6: Exceptions for group delay**

* Proposals
	+ Option 1: The extended group delay and deployment restrictions are indicated by vendor declaration.
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If Option 2 is preferred, please provide an alternative proposal.

### Sub-topic 2-7

Handling of the long delay repeater

**Issue 2-7: Long Delay Repeater handling**

* Proposals
	+ Option 1: The long delay repeaters must meet the DL and UL transition time requirements without accounting for the group delay. This can be taken into account in the test definition to be agreed in the conformance part.
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If Option 2 is preferred, please provide an alternative proposal.

### Sub-topic 2-8

Long delay repeater related specs handling

**Issue 2-8: Long delay repeater spec handling**

* Proposals
	+ Option 1: New Definitions and interfaces are required for the long delay repeater
	+ Option 2: Nothing special is needed
* Recommended WF
	+ TBD

If Option 1 is preferred, please provide some concrete proposals. If Option 2 is preferred, please provide arguments

### Sub-topic 2-9

TDD Switching requirement and diagrams

**Issue 2-9: Switching requirement and diagrame**

* Proposals
	+ Option 1: Should a diagram for switching be included in the specifications? If yes, any comments on the diagrams proposed in R4-2205968?
	+ Option 2: No need for any diagrams
* Recommended WF
	+ Option 1

If option 1 is preferred, please provide comments on the diagrams proposed

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | We have different understanding with option 1. We discussed with TE vendors, TE can find the correct timing according to the output signal. EVM test doesn’t need the group delay information. |
| Ericsson | This can be discussed more during the conformance phase. It may depend on the test setup |
| Huawei | Not sure why the group delay is needed for testing, test equipment can measure EVM without tghsi knowledge |
| Qualcomm | We prefer to discuss this during the conformance discussion. Moreover, EVM measurement can be conducted without group delay knowledge,  |
| Nokia, Nokia Shanghai Bell | This issue should be discussed during conformance part of work item. |
| ZTE | We prefer to discuss this issue during the conformance phase. |
| NEC | We prefer to discuss this during the conformance phase. |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | We support option 1. |
| Ericsson | Our view is that there is no need for anything in addition to the already agreed EVM requirement. If this is the same as option 1 then we are OK. Could the moderator clarify if option 1 is implying any need to add anything to the EVM requirement or not though ? |
| Huawei | For BS the EVM test model is different o the ON/OFF test model so if we test at same time then we would be moving away from the test models we use for BS. Might be better to stick with BS format (can be discussed further in conformance, nothing in core should perhaps mandate this one way or the other) |
| Qualcomm | We support option 2. It is not clear for us if option 1 will mean that we will need to propose new test methods compared to the existing ones in BS.  |
| Nokia, Nokia Shanghai Bell | This issue should be discussed during conformance part of work item.  |
| ZTE | We believe that there is no need for an “additional” EVM testing, it is sufficient to include the switching operation in the EVM test. |
| NEC | We prefer to discuss this during the conformance phase. |

 Sub topic 2-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Is there’s a typo? “before” should be “after”? If it’s “after”, we have the same understanding. |
| Ericsson | The TM should be the same as for the BS EV.M. Note that in this case, the TM is generated by the test equipment, not the device under test. Whether the symbol is before or after the transition depends on whether the transition is OFF-ON or ON-OFF. |
| Huawei | Same as BS is ok |
| Qualcomm | We are ok with option 1.  |
| Nokia, Nokia Shanghai Bell | OK with similar to BS approach. |
| ZTE | We are OK with Option 1. |
| NEC | We are Ok with option 1. |

Sub topic 2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Don’t understand the issue and the proposal. There’s no data before the transition, it should be off period in our understanding. |
| Ericsson | We don’t think any kind of single symbol EVM would be useful as it would not be easy to measure the EVM in a reasonable time with good accuracy. |
| Huawei | As with BS EVM is average for burst I think, so should be ok for repeater as well so option 1 is ok. |
| Qualcomm | Does option 1 implies we use a single symbol to evaluate EVM? If yes, we agree with E///, this will yield the test and the results unreliable.  |
| Nokia, Nokia Shanghai Bell | There should not be define any additional EVM requirement.  |
| ZTE | We are a little confused about the description of this issue. However, EVM needs to be measured over a period of time, so we think it is appropriate to follow the relevant definition of BS. |
| NEC | Agree not to define additional requirement. |

Sub topic 2-5

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Not sure of the necessity of the definition. We used the similar wording with BS spec in R4-2203943. |
| Ericsson | Minor comment is that it may be useful to add “in the corresponding direction” to the ON and OFF period definitions. Otherwise, they class; the repeater is always transmitting in either DL or UL and is also always off in either DL and UL (i.e. either on or the other is ON, whilst the reverse is OFF…).Most likely the reader would understand what is meant anyhow though so not essential. |
| Huawei | As repeater is amplifier I think the words transmit and receive are somewhat deceiving. The repeater does not generate a signal so is not transmitting in the conventional sense for example when ON it only transmits if there is something at the input. The system should be defined by the RF requirements in the ON and OFF conditions, not sure this definition is needed. |
| Qualcomm | We propose the following minor wording changes:* Transmitter OFF period: “time period during which the repeater is not allowed to transmit in downlink or uplink directions”;
* Transmitter ON period: “time period during which the repeater is allowed to transmit in downlink or uplink directions”;
* Transmitter transient period: “time period during which the transmitter is changing from the OFF period to the ON period or vice versa”
 |
| Nokia, Nokia Shanghai Bell | We are not sure TDD operation definition is needed, thus support option 3. |
| ZTE | We propose those definitions is trying to make them more formal in the spec. For instance, the term used in current stage discussion is “transient time”, which is inconsistent with the term in the BS spec. In addition, it is not clear to “whom” this requirement applies: transmitter transient period will apply to transmitter, which is very clear. In any case, we feel that the relevant definition is necessary, but we feel that the suggestions of Qualcomm and Ericsson are reasonable, and the specific wording can be further modified. |

Sub topic 2-6

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | We have the same understanding that it’s based on declaration, but not sure if there should be something in core specification. |
| Ericsson | Agree. |
| Huawei | OK |
| Qualcomm | Agree with option 1.  |
| Nokia, Nokia Shanghai Bell | OK with option 1. |
| ZTE | We arefine with Option 1. |
| NEC | Ok with option 1. |

Sub topic 2-7

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Not sure about the understanding. Group delay includes two parts, one is the delay not impacting transient time such as buffer or path delay, the other is the delay impacting transient time such as the digital filter (if any), analog filter, PA ramping time, etc. So according to the agreement we have, transient time is defined, so part of the group delay is already included. |
| Ericsson | Agree assuming that group delay is defined as not including the transient time part. |
| Huawei | Perhaps this needs a little clarification, the long group delay needs to be de-embedded from the ramp profile I think this measn. IN princklple I thin ok but better wording needed. |
| Qualcomm  | It needs to be clarified that the group delay and the long delay are decoupled.  |
| Nokia, Nokia Shanghai Bell | OK with option 1. |
| ZTE | We think these two concepts need to be distinguished. The term “long group delay” can be somewhat misleading. |

Sub topic 2-8

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | Prefer to leave it to implementation and deployment. So option 2. |
| Ericsson | In general nothing special is required, apart from that the timing for the long delay repeater transition time should be at the output port, whereas for the normal repeater the timing is agreed to be based on input port timing. We may need to discuss whether this timing is referenced in the core spec or only in the conformance. |
| Huawei | Not sure what new interfaces would be needed? Maybe some new definitions, these can be considered when submitted. |
| Qualcomm | No strong opinion but we prefer to discuss this at a later stage if needed.  |
| Nokia, Nokia Shanghai Bell | Don’t see needs for introduction of new definitions and interfaces.  |
| ZTE | We understand that the interface related issue may be out of the scope of RAN4, but since we have previously defined the repeater's architecture diagram, which does not seem to reflect the special structure of the distributed repeater, some modifications may be required. |

Sub topic 2-9

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | We prefer to use the diagram in R4-2203943. The diagram is copied from IAB spec and aligns with BS spec better. |
| Ericsson | Probably the existing diagram as passed by CATT is better, but we would be grateful if the proponent of R4-2205968 could clarify what advantage that diagram could have. The “usual” diagram may not quite work in real life, because if there is no input then the repeater will not be at the ON level during the ON period, but I guess that is understood, or a note could be added that it is assumed in the figure that an input signal is present during the ON period. |
| Huawei | In general the diagram above is ok, the issues we see that we tried to address are:1. As repeater has 2 paths that operate in opposition to each other (UL and DL) its clearer to see that during in DL repeater is ON for DL and OFF for UL timeslots. The CATT diagram does not show this as clearly
2. The ON power level requirement is not a threshold as indicated in the CATT diagram it’s a window
3. Some text is needed to make it clear that the input signal is changing, the diagram alone is not sufficient – this is the case for any option but text needs to be approved with the diagram.
4. There are pro’s and cons to a generic diagram vs separate diagrams for UL and DL. As power levels are not necessarily the same for UL and DL our view is this is made clearer with separate diagrams and separate y axis (UL power and DL power) but a generic diagram is ok as long as the relationship between the levels on the diagram and the specification levels are clear.

We are ok with either as starting point as long as the diagram is clear and correct. |
| Qualcomm | To converge, we can include Huawei’s comments in CATT’ diagram and further discuss.  |
| Nokia, Nokia Shanghai Bell | We are ok o include diagram, however some further alignment on diagram need to be agreed.  |
| ZTE | We are OK to include the diagram but the two diagrams may need some convergence. |
| NEC | We are ok to include the diagram. We prefer CATT diagram as a starting point. |

 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** |
| [**R4-2203943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203943.zip) | Nokia, Nokia Shanghai Bell: Typo in 7.10.2.3 ‘repeaer’. |
| 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#2-1** | Most companies pointed out that this issue is related to testing and should be discussed in the conformance phase. It was also pointed out by several companies that group delay does not need to be known.*Tentative agreements:* Postpone the discussion to the conformance phase. *Recommendations for 2nd round:* Confirm above agreement. |
| **Sub-topic#2-2** | Most companies expressed the opinion that a single EVM test(test needed to check that repeater meets the EVM requirement) would also be enough to check the switching time accuracy and there would be no need for any additional test.*Tentative agreements:*A single EVM test is needed to check the timing accuracy and that EVM requirements are met.*Candidate options:**Recommendations for 2nd round:* Continue the discussion in the 2nd round to check if above agreement can be confirmed or the entire discussion should be postponed to the conformance phase. |
| **Sub-topic#2-3** | Most companies agree with Option 1, the symbol before the transition should also be checked for EVM compliance.*Tentative agreements:* EVM requirement should include the symbol just before the transition (as is the case for the BS requirement).*Recommendations for 2nd round:* Continue discussion to see if above agreement can be confirmed . |
| **Sub-topic#2-4** | Several companies commented that the proposal is not clear and some issues/questions were raised. Consensus seems to be that there is no need for any special requirement for the symbol before any transition and the general EVM requirement can be applied. *Tentative agreements:* No additional EVM requirement for symbols before the transitions. No special handling during the test for the symbol before transitions.*Recommendations for 2nd round:* Continue the discussion to see if above tentative agreement can be confirmed above agreement. |
| **Sub-topic#2-5** | Opinions on this issue are very diverse, with some companies even questioning the need for such definitions. *Recommendations for 2nd round:* Continue the discussion in the 2nd round to try and make some further progress on whether there is any consensus to have a definition. |
| **Sub-topic#2-6** | All companies agreed with Option 1.*Tentative agreements:* Option 1: The extended group delay and deployment restrictions are indicated by vendor declaration. *Candidate options:**Recommendations for 2nd round:* Conform above agreement. also check whether anything is needed to be captured in the core specifications. |
| **Sub-topic#2-7** | Companies seem to agree that for the repeaters with a long group delay, the group delay is additional to the transient times and this is accounted for in testing. The proposal needs some clarifications.*Recommendations for 2nd round:* Discuss further in the 2nd round what clarifications are needed to reach further agreements on the handling of the long delay repeater |
| **Sub-topic#2-8** | Most companies commented that they prefer to leave this to implementation and not add anything new to the specs.*Tentative agreements:* Do not introduce any special definitions or interfaces for the long delay repeater. *Recommendations for 2nd round:* Discuss whether the above agreement can be confirmed and whether any other clarification is needed. |
| **Sub-topic#2-9** | Companies agreed that a diagram is needed, it seems the CATT proposal can be taken as a starting point and might need some additions to improve it.*Tentative agreements:* Agree that a diagram will be introduced *Candidate options:**Recommendations for 2nd round:* Confirm above agreement and continue discussion on what changes/additions should be made to the diagram in R4-2203943 |

### 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”.*

Continue the 2nd round discussion in a WF on TDD Repeater Switching

# Topic #3: Others

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2205108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205108.zip) | ZTE Corporation | **Proposal 1: RAN4 should discuss whether the type 2-O repeater have output intermodulation issue, otherwise we proposed to** **remove Clause 7.8: OTA output intermodulation.** |
|  |  |  |
|  |  |  |

## Open issues summary

*Details related to the drafting of the specifications are not yet agreed, there are some proposal to further progress the work.*

### Sub-topic 3-1

OTA Output intermodulation

**Issue 3-1: OTA Output Intermodulation**

* Proposals
	+ Option 1: Clause 7.8: “OTA Output Intermodulation” should be removed(requirement not needed)
	+ Option 2: Clause 7.8: “OTA Output Intermodulation” should be kept(requirement not needed)
* Recommended WF
	+ TBA

Please state your preference and arguments

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CATT | There’s already agreement that * No need to define output IMD requirements for FR2.

In R4-2108632. So support option 1. |
| Ericsson | Support option 1 for FR2 |
| Huawei | Option 1 ok |
| Qualcomm | Ok with option 1.  |
| Nokia, Nokia Shanghai Bell | OK with option 1.  |
| ZTE | Option 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** |
| [**R4-2203942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203942.zip) | Huawei: In a couple of places (e.g. 4.3.1) it refers to transceivers (i.e. a full complement of transceivers) the repeater does not really have transceivers as such? They are amplifiers? Is this the correct term to use.Similarly the diagrams refer to transmitter and receiver interface – I am not sure these are really correct terms in a repeater spec ( in 36.106 transmitter is used a few times with respect to the output signal, receiver and transceiver are not used at all), so perhaps transmitter is ok but receiver is probably not appropriate. |
|  |
|  |
| [**R4-2205105**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205105.zip) | CATT: May need to be updated according to the agreements in this meeting. |
| Ericsson: References to “channel bandwidth” and “BWChannel” should be changed to passband.The sentence stating that the requirement only applies to downlink should be removed following the agreements. |
|  |
| [**R4-2205128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205128.zip) | CATT: Pass band is missing. Some are not needed for repeater, such as PCMAX, Ncells. Many“BS” exist. It seems NR repeater is more powerful than LTE repeater, so we’re not sure if some concepts like *channel edge, operating band* edge will be reused. Some discussion may be needed. |
| Ericsson: Need to remove BS RF bandwidth, BS channel bandwidth etc. and add passband. No need for carrier aggregation definition needed. No need for highest, lowest carrier. For EIRP, TRP etc. Need to remove carrier reference somehow. Remove references to channel bandwidth. Lots of symbols and abbreviations need changing or are redundant (referring to e.g. channel bandwidth, or simply will not be used anywhere in the specification).The proposal overlaps with R4-2205974. R4-2205974 actually provides a good overview of which definitions and symbols are needed. |
| Huawei: This is difficult as it can be chicken and egg, do we start with a big list and remove the ones we don’t need or add the ones we use as we go? My view is add the list (in square brackets maybe) and then allow rapporteur (or editor?) clean it up once the TS is compiled. If modifications are suggested in other TP’s (like R402205974) and approved they can be merged when the TP’s are implemented. |

## 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#3-1** | Companies agreed that the clause 7.8 should be removed, the spec editor can take this into account.*Candidate options:**Recommendations for 2nd round:* NO need for further discussion, spec editor should take into account this discussion and remove clause 7.8 from the skeleton. |

### 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**  |
| [**R4-2203942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203942.zip) | To be revised based on comments from 1st round |
| [**R4-2205105**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205105.zip) | To be revised based on comments from 1st round |
| [**R4-2205128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205128.zip) | To be revised based on comments from 1st round |

## 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 TDD Repeater Switching | Qualcomm | Capture agreements and further discussion for Topic#2 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| [**R4-2203942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203942.zip) | TP for TS 38.106：Clause 4 general | CATT | To be revised |  |
| [**R4-2203943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203943.zip) | TP for TS 38.106：ON/OFF mask | CATT | To be revised |  |
| [**R4-2205105**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205105.zip) | TP to TS 38.106 clause 6.8 | ZTE | To be revised |  |
| [**R4-2205128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205128.zip) | TP to TS 38.106 for Sections 1,2, and | Qualcomm | To be revised |  |

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** |
| R4-2207279 | TP for TS 38.106：Clause 4 general | CATT | Agreeable |  |
| R4-2207280 | TP for TS 38.106：ON/OFF mask | CATT | Agreeable |  |
| R4-2207281 | TP to TS 38.106 clause 6.8 | ZTE | Agreeable |  |
| R4-2207282 | TP to TS 38.106 for Sections 1,2, and | Qualcomm | Agreeable |  |

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| CATT | Huiping Shan | shanhuiping@catt.cn |

Note:

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