**3GPP TSG-RAN WG4 Meeting # 100-e R4-210xxxx**

**Electronic Meeting, 16th – 27th August, 2021**

**Agenda item:** 9.5.1

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [100-e][308] 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:
	+ System parameters
	+ Definition of repeater classes and types
	+ UL/DL switching requirement for TDD
	+ Handling of the conformance specs
	+ Specification Skeleton
* 2nd round: TBA

# Topic #1: System Parameters

*Several system parameters are discussed in this section*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111915 | CATT | **Proposal 1: The name of the links between repeater and BS/UE follow E-UTRA repeater specification that downlink and uplink are used. The requirements are defined for downlink and uplink.****Proposal 2: There are separate clauses in the repeater’s spec for channel raster and sync raster which refer BS and UE specification.** |
| R4-2113665 | Nokia | **Proposal 1: For repeater type 1-C, the implementation options used for BS type 1-C (to define the multi-band requirement) could be used.****Proposal 2: It makes sense to specify the requirements assuming that the same implementation option is used for the access and backhaul sides of a repeater.****Observation 1: The agreed pass band definition does not clearly state whether each of those individual pass bands belong to the same operating band or not. As a result, one could think the individual pass bands would locate in the same or different operating bands.****Proposal 3: When the pass bands are located in different operating bands, the requirement defined for each operating band could be used for the respective pass band. That is, if the requirements for each operating band are different, then that of the pass band would also be different.**If a repeater could have more than one pass band, it would be essential to define some parameters to characterize the repeater pass bands. For example, similar to the sub-block gap $W\_{gap}$ in contiguous and non-contiguous carrier aggregation.**Proposal 4: Additional parameters would need to be defined to characterize multiple pass bands of a repeater.****Proposal 5: It would be good to consider whether requirements need to differ in cases where a repeater has two pass bands which are located either within two different operating bands or within the same band.** |

## Open issues summary

### Sub-topic 1-1

Definition/naming for UE to repeater link and repeater to BS link

**Issue 1-1: Naming of links between repeater/BS and UE/repeater**

* Proposals
	+ Option 1: The name of the links between repeater and BS/UE follow E-UTRA repeater specification that downlink and uplink are used. The requirements are defined for downlink and uplink.
	+ Option 2: Other proposals
* Recommended WF
	+ Option 1

If option 2 is preferred then please also present an alternative proposal to be considered.

### Sub-topic 1-2

Need for channel raster/sync raster in repeater specs

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

**Issue 1-2: Channel and sync raster**

* Proposals
	+ Option 1: Both channel raster and sync raster should be included in the repeater specifications
	+ Option 2: Only channel raster is needed in the repeater specifications
	+ Option 3: Neither is needed in the repeater specifications
* Recommended WF
	+ Option 1

If other options are preferred, please state the arguments for the chosen option

### Sub-topic 1-3

Multi-band requirements for type 1-C

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

**Issue 1-3: Multi-band requirements for type 1-C**

* Proposals
	+ Option 1: Proposal 1: For repeater type 1-C, the implementation options used for BS type 1-C (to define the multi-band requirement) could be used.
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If other options are preferred, please state the arguments for the chosen option

### Sub-topic 1-4

Assumptions on repeater implementation for requirements definition

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

**Issue 1-4: Implementation assumptions for repeaters**

* Proposals
	+ Option 1: specify the requirements assuming that the same implementation option is used for the access and backhaul sides of a repeater.
	+ Option 2: Specify the requirements assuming different implementations for access and backhaul are possible
	+ Option 3: Other options
* Recommended WF
	+ Option 1

If other options are preferred, please state the arguments for the chosen option

### Sub-topic 1-5

Requirements for repeaters with pass bands in different operating bands

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

**Issue 1-5: Requirements with pass bands in different bands**

* Proposals
	+ Option 1: The requirement defined for each operating band could be used for the respective pass band. That is, if the requirements for each operating band are different, then that of the pass band would also be different
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If other options are preferred, please state the arguments for the chosen option

### Sub-topic 1-6

Parameters to characterize multiple pass bands

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

**Issue 1-6: Parameters for multiple pass bands repeaters**

* Proposals
	+ Option 1: Additional parameters would need to be defined to characterize multiple pass bands of a repeater (e.g. gap between passbands)
	+ Option 2: Nothing is needed, just independent requirements for each pass band
* Recommended WF
	+ Option 1

If Option 1 is preferred, please also propose other possible parameters. If Option 2 is preferred, please state the arguments

### Sub-topic 1-7

Requirements for repeaters with multiple pass bands

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

**Issue 1-7: Requirements with multiple pass bands**

* Proposals
	+ Option 1: Requirements need to differ in cases where a repeater has two pass bands which are located either within two different operating bands or within the same band.
	+ Option 2: Requirements can be the same
* Recommended WF
	+ Option 1

Please state your preference and arguments.

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

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| **Company** | **Comments** |
| Ericsson | We are fine with using the terms DL and UL. Note that there are 4 groups of requirements; DL TX, UL TX, DL RX (i.e. Input intermodulation), Ul RX (i.e. input intermodulation) |
| CATT | Support the recommended WF. |

Sub topic 1-2

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| **Company** | **Comments** |
| Ericsson | We do not see it as essential to include references to channel and sync raster; designers of repeaters that read SSB will presumably check the UE/BS specs anyhow and will need to check other specs too (e.g. RRC). We don’t have any objection to including either or both though (as references to the BS spec) |
| CATT | Support option 1 but as said in our paper, just referring BS spec may be ok. |

Sub topic 1-3

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| **Company** | **Comments** |
| Ericsson | Option 1 is OK; this was thought through for the BS. |

Sub topic 1-4

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| **Company** | **Comments** |
| Ericsson | Either option is feasible. Apart from the need to make two declarations we would like to clarify is there actually any increase in complexity if option 2 would be adopted? (It would add implementation flexibility) |

Sub topic 1-5

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| **Company** | **Comments** |
| Ericsson | Agree |

Sub topic 1-6

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| **Company** | **Comments** |
| Ericsson | There is a need to define a sub-block gap in the same manner as a multi-carrier BS. Requirements such as CACLR, ACS etc. should apply within sub-block gaps as appropriate. |

Sub topic 1-7

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| **Company** | **Comments** |
| Ericsson | Exceptions for spurious emissions and OOB blocking requirements for one band are needed within other bands transmitter/received from the same multi-band connector (in the same way as the BS spec) |

### 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** |
| 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.*

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| --- | --- |
| **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: Repeater Class/Type

The discussion on the definition of the repeater classes and types has been ongoing for a few meetings. In the previous meeting the following agreements were reached:

* At least 2 DL classes for FR1
* Introduce FR2 classes if requirements are different between classes, otherwise not
* Introduce at least 2 UL classes for FR1
* For FR2, either introduce 2 UL classes or limit the repeater power to the maximum UE power class
* Tentative agreement to decouple DL and UL TX classes. Further check if RX requirements might differ between classes
* Introduce types 1-C and 2-O. Further discuss 1-H/O.

In this meeting there are several proposals on which classes to define.

The discussion should be concluded in this meeting such that discussion on the actual requirements can conclude on time for the WI to be finalized as scheduled.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2111916**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111916.zip) | CATT | **Proposal 1: The FR1 DL output power levels corresponding to NR BS WA, MR and LA can be defined. The home class can also be considered if the requirements can be discussed and concluded.****Proposal 2: FR1 UL output power levels corresponding to NR BS MR and LA can be defined.****Proposal 3: Revisit the last meeting’s agreement for FR2 UL class and agree that no class is defined for both FR2 DL and UL.****Proposal 4: Power class is used to differentiate the output power levels and emission requirements. No repeater class definition exists in the spec.****Proposal 5: Type 1-H and type 1-O are not defined for NR repeater in R17, they can be defined in future release if there’s demand from market.** |
| [**R4-2112197**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112197.zip) | CMCC | **Proposal 1: FR2 repeater DL classes are still necessary because there is differentiation in DL related requirements among scenarios. For example, absolute ACLR requirements are different among classes.****Observation 1: 90dB maximum gain assumption is reasonable for WA scenario. The received signal at UE after repeater is below the maximum receiving power and also UL receive power is larger than sensitivity with output power less than max output power.****Proposal 2: for both FR1 and FR2 NR repeater, classification is suggested the same as NR BS spec to support WA, MR and LA repeater DL access link with the same deployment scenarios for each class. The same criteria and exactly the same parameter of NR BS classification will be applied for repeater DL access link with modification of how to describe the minimum distance or the coupling loss.****Proposal 3: for FR1 repeater, home class is also suggested characterized by the requirements as E-UTRA spec.** **Proposal 4: it is suggested to define two classes for UL backhaul link, one of which is LA-like scenario with maximum output power less than any UE power class and the other is MR-like scenario without any upper limits for FR1 and FR2.**** Medium Range repeater UL backhaul are characterised by requirements derived from Micro Cell and/or Macro Cell scenarios.**** Local Area repeater UL backhaul are characterised by requirements derived from Pico Cell and /or Micro Cell scenarios.****Observation 1: the potential interference issue introduced by repeater with higher output power than any UE class may be resolved by smart repeater by some intelligent mechanism.** |
| [**R4-2112764**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112764.zip) | NTT DOCOMO, INC. | **Observation 1: The class definition for FR2 UL was based on the idea of unplanned/planned.****Observation 2: Some countries and/or regions where the regulation does not allow the output power of PC1, it might not be able to use the NR repeater unplanned which has the same output power with PC1.****Proposal 1: RAN4 introduce additional class for FR2 UL, which shall not exceed the output power of any UE Power Classes i.e. not to exceed 23dBm.****Proposal 2: RAN4 adopt following idea on how to define UL class:*** **Planned (WA): The output power has no limit.**
* **Semi-unplanned (MR): The output power shall not exceed UE Power Class 1.**
* **Fully-unplanned (LA): The output power shall not exceed any UE Power Classes (23dBm).**
 |
| [**R4-2113204**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113204.zip) | ZTE Corporation | **Observation 1: Many stakeholders are eager to enhance outdoor coverage with low costs, but the utilization of repeater may impact the network from multiple aspects.****Proposal 1: Introduce Medium Range class for both FR1/FR2 repeater, and specify the maximum output power limits. The specific value may need further evaluation.** |
| [**R4-2113363**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113363.zip) | Ericsson | **Proposal 1: BS class definitions (Macro, Micro, Pico) are applied for repeaters****Proposal 2: Discuss whether to omit the statement about minimum distance from repeater class definitions.****Proposal 3: Create LA, MR, WA repeater classes.****Proposal 4: Either limit the repeater output power to the maximum UE power class or create 2 UL repeater classes similar to the IAB classes.** |
| [**R4-2113666**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113666.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: Two possible options for DL (access) FR1 could be**** *Option 1: WA and LA  WA deployment to serve MR requirements*
* *Option 2: WA and LA  WA to serve for MR requirements*
* *Option 3: WA and MR  MR deployment to serve LA requirements*

***Proposal 1: For DL (access) FR1, we propose to have WA and LA repeater classes.******Observation 2: BS and IAB specifications have categorized the radiated requirements (e.g., ACLR and CACLR) for DL and UL FR2 separately, based on the deployment scenarios and the IAB or BS types.******Observation 3: For FR2 type 2-O repeaters, there is no* *upper limit for the rated carrier TRP output power.******Observation 4: There are no radiated requirements categorizations for IAB-DU FR2 MR deployment scenario* [2]*.******Proposal 2: For DL (access) FR2, we propose to have LA and WA repeater classes.******Observation 5: The UL class selection for FR1 and FR2 could be dependent on what classes have been selected for the DL FR1 and FR2, respectively.******Observation 6: There is no MR class for IAB-MT for both FR1 and FR2.******Proposal 3: For UL (access) FR1, we propose to have LA and WA repeater classes.******Observation 7: In case of UL IAB-MT FR2, the ACLR/CACLR requirements for LA and WA classes are different.******Proposal 4: For UL (access) FR2, we propose to have LA and WA repeater classes.******Proposal 5: For DL (access link) and UL (backhaul link), we propose to define the classes as shown in Table 1.******Table 1: Possible classes for access and backhaul links for FR1 and FR2***

|  |  |  |
| --- | --- | --- |
| ***Frequency range*** | ***Access link (DL)*** | ***Backhaul link (UL)*** |
| ***FR1*** | ***WA, LA*** | ***WA, LA*** |
| ***FR2*** | ***WA, LA*** | ***WA, LA*** |

***Proposal 6: It is meaningful to have operator deployed and controlled repeaters wherever it is possible; at least such operator-controlled deployments should be used for WA class repeaters.*** |
| [**R4-2114229**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114229.zip) | Huawei | For repeater type 1-C, UE side classes are defined as indicated below:- Wide Area repeaters on the UE side are characterised by requirements derived from Macro Cell scenarios with a repeater to UE minimum coupling loss equal to 70 dB.- Local Area repeaters on the UE side are characterised by requirements derived from Pico Cell scenarios with a repeater to UE minimum coupling loss equal to 45 dB.For repeater type 1-C, BS side classes are defined as indicated below:- Wide Area repeaters on the BS side are characterised by requirements derived from Macro Cell and/or Micro Cell scenarios.- Local Area repeaters on the BS side are characterised by requirements derived from Pico Cell and /or Micro Cell scenarios.We also have discussed the necessity for a 1-H repeater class and do not think it is required. |
| [**R4-2114481**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114481.zip) | Qualcomm Incorporated | **Proposal 1: RAN4 should develop WA, LA, and home repeater class FR1 specs.****Proposal 2: RAN4 should include repeater requirements for FR2-2****Proposal 3: We should consider indoor hotspot, dense urban, urban micro, urban macro, rural, and factory hall deployments in developing repeater classes.** |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1

General repeater classes definition*:*

It has not yet been agree how to characterize the different repeater classes or whether just maximum output power is enough*:*

**Issue 2-1: Repeater class characterization**

* Proposals
	+ Option 1: Power class is used to differentiate the output power levels and emission requirements. No repeater class definition exists in the spec.
	+ Option 2: Deployment scenario is used to differentiate repeater classes
	+ Option 3: Similar to BS power classes(based on MCL)
	+ Option 4: Other definition/differentiation for classes
* Recommended WF
	+ TBA

Please state your preference and arguments for the choice

### Sub-topic 2-2

*Repeater class for FR1 DL(access link)*

**Issue 2-2: Classes for FR1 DL**

* Proposals
	+ Option 1: Introduce WA, MR, LA
	+ Option 2: Introduce WA, MR, LA and home class
	+ Option 3: WA and LA
	+ Option 4: WA, LA and home class
* Recommended WF
	+ Option 2

Option 2 is the most comprehensive. If other option is preferred, please state arguments why some classes are not needed.

### Sub-topic 2-3

*Repeater class for FR2 DL(access link)*

**Issue 2-3: Classes for FR2 DL**

* Proposals
	+ Option 1: Introduce WA, MR and LA
	+ Option 2: WA and LA
	+ Option 3: no class defined
* Recommended WF
	+ Option 1

Option 1 is the most comprehensive. If other option is preferred, please state arguments why some classes are not needed.

### Sub-topic 2-4

*Repeater class for FR1 UL(backhaul link)*

**Issue 2-4: Classes for FR1 UL**

* Proposals
	+ Option 1: 2 classes: LA like with maximum output power less than any UE and MR like without upper limit
	+ Option 2: 2 output power classes: upper limit same as UE(e.g. LA) and one without upper limit that is well planned by operator (e.g. WA)
	+ Option 3: Other option
* Recommended WF
	+ Option 2

Option 2 seems to cover most needs. If another option is preferred, please state arguments and proposal for power limits

### Sub-topic 2-5

 *Repeater class for FR2 UL(backhaul link)*

**Issue 2-5: Classes for FR2 UL**

* Proposals
	+ Option 1: 2 classes: WA and LA
	+ Option 2: No class defined
	+ Option 3: 2 classes: LA and MR
	+ Option 4: 3 classes: Planned(WA)- no power limit, Semi-unplanned (MR) – upper limit same as UE PC 1 and Fully-unplanned(LA) – output power same as UE PC3/5
* Recommended WF
	+ Option 4

Option 4 is proposed, if other options are better then please state the arguments and what would be the requirement differentiator

### Sub-topic 2-6

*Handling of FR2-2*

**Issue 2-6: Repeaters for FR2-2**

* Proposals
	+ Option 1: RAN4 should include repeater requirements for FR2-2
	+ Option 2: RAN4 should not included repeater requirements for FR2-2 in the current WI, it can be discussed in the future
* Recommended WF
	+ TBA

Please state your preference or aguments

### Sub-topic 2-7

*If FR2-2 will be included, what classes should be introduced for FR2-2*

**Issue 2-7: Classes for FR2-2**

* Proposals
	+ Option 1: Maintain the same classes as FR2
	+ Option 2: consider indoor hotspot, dense urban, urban micro, urban macro, rural, and factory hall
	+ Option 3: Further discuss in the next meeting how these
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

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| **Company** | **Comments** |
| Ericsson | We have some preference for option 2. The reason is that the downlink power limits for BS have been derived based on the corresponding deployment scenarios. Stating that the requirements are power classes would imply that the power class can be deployed in any deployment scenario. This is true for UEs (which can roam between different scenarios), but for BS the power limits are linked to scenarios. For the BS specs, we do not believe that the classes are based on MCL; rather the other way around the requirements are based on deployment scenarios and MCL is recorded as one of the parameters of the scenario.The definition of the deployment scenarios is, we believe sufficiently flexible for describing repeater deployments. |
| CATT | Option 1 is from our company. We still think it’s reasonable. Power class or power level can be used to differentiate the requirements. There’s no repeater class for UTRA and E-UTRA repeater and we’re not confident on how to define the repeater classes. Inventing repeater class in NR may bring some misleading. The deployment consideration for repeater is different with BS/IAB, such as tunnel. There’s another reason that BS/IAB usually transmit the declared maximum output power which is related to deployment scenarios. But repeater’s output power is decided by the input signal and gain, even maximum gain is used, when the input signal is 10 dB lower, the output power will also be 10 dB lower thus the coverage is smaller. |

Sub topic 2-2

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| **Company** | **Comments** |
| Ericsson | We think that the 3 existing classes can be defined to give flexibility (option 1). Regarding option 2; our understanding is that the power limit is an upper limit, not a target (actual power supported is declared) and there would be no other requirement differences for a “home” scenario. So a “home” deployment could be served by repeaters declared with lower power than the maximum limit for an LA class and conforming to LA requirements.Regarding option 3; if this would be adopted it would imply that either medium range is not supported, or there is no need for a power limit for medium range. In our view, if there would be a strong desire to limit to two classes then MR and LA may be more appropriate to avoid that repeaters with unlimited DL power are inadvertently deployed in medium range scenarios. |
| CATT | We’re ok with the power levels for WA, MR, LA and home class (if it can be agreed). Whether the power levels are defined for repeater class or power class depends on the discussion for 2-1. |

Sub topic 2-3

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| **Company** | **Comments** |
| Ericsson | We are OK for option 1, or in case there would be no difference in the requirements option 3. If the only difference in requirements is the absolute ACLR level then option 1 is not any more complex than option 2 but is clear that all of the scenarios can be supported. |
| CATT | Currently we still slightly prefer option 3. As FR2 power may be declared so not sure if power class can be defined. But if ACLR can’t be defined, there may be no requirements need to be differentiated, then no class or even power class may be ok for FR2. |

Sub topic 2-4

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are OK for option 1 and option 2. Note that option 2 is effectively taking the responsibility for ensuring co-existence in the UL from 3GPP and into the hands of the deploying operator (3GPP specs would not guarantee co-existence), but this is already the practice for IAB and using directional antennas + avoiding co-located equipment is achievable for FR2 and FR1 AAS. |
| CATT | Prefer option 1. From power levels perspective, both option 1 and option 2 may be ok. But from how the requirements are differentiated, we support option 1 to reuse the possible BS requirements for the corresponding output power levels. For option 2, some clarification is needed on how to define the requirements for different power levels. |

Sub topic 2-5

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| **Company** | **Comments** |
| Ericsson | Either no class, but maximum UL power limit, or 2 classes with a limit on one class (like IAB) or option 4 are all fine. Same comment as FR1; the class with no upper limit is not guaranteeing co-existence in the 3GPP specifications but instead relies on intelligent deployment taking into account other operator BS. |
| CATT | Currently support option 2 if no requirements will be differentiated. The problem for option 4 is that UE EIRP requirement is very different with BS, for example spherical coverage, not sure the benefit of option 4. |

Sub topic 2-6

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| **Company** | **Comments** |
| Ericsson | We are not against covering FR2-2 in principle. However, procedurally there is not yet an FR2-2 spec, and we should not create a dependency between WI so for this reason the WI should not agree to include the results of another Rel-17 WI. |
| CATT | Support option 2, BS requirements for FR2-2 is not decided yet. And we don’t think FR2-2 is urgent for repeater. |

Sub topic 2-7

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| **Company** | **Comments** |
| Ericsson | See comment about about FR2-2. There has not yet been any discussion on BS and UE classes for this FR. Presumably at least the DL classes could be the same, but as of now making an agreement would be risking to diverge from the approach used for BS. |
| CATT | Depends on the agreement for 2-6. We think FR2-2 discussion can be postponed to future release. |

### 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.*

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| --- | --- |
| **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”.*

# Topic #3: 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** |
| [**R4-2111917**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111917.zip) | CATT | **Proposal 1: The TDD repeater requirements can be defined as EVM and OFF power level for both DL and UL.****Proposal 2: The DL OFF power level is measured at the UL transmission period + UE transmit period length \*2. The UL OFF power level is measured at the DL transmission period + BS transmit period length \*2.****Proposal 3: TDD switch timing accuracy is the name of the requirement.****Proposal 4: Dynamic range for the TDD time accuracy requirement is defined, [35] dB range as CCSA TD-LTE is considered.****Proposal 5: Different DL/UL configuration capability can be merged to the TDD time accuracy requirement.****Proposal 6: No group delay requirement is defined for NR TDD repeater.** |
| [**R4-2112196**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112196.zip) | CMCC | **Proposal 1: maximum output power could be tested together with TDD switching requirements****Proposal 2: fig 4 is suggested as the schematic diagram of TDD switching related requirements.** **Proposal 3: two methods for TDD switching related requirements definition are listed as below. TDD switching related requirements include group delay, TDD switching period, power ramp down and power ramp up transition period.*** **Option 1: only list the schematic diagram as in fig4 in the spec without any specific basic limits of TDD switching related requirements.**
* **Option 2: define basic limits for at least one part of TDD switching related requirements including group delay, TDD switching period, power ramp down and power ramp up transition period.**

**Observation 1: before defining TDD requirements, we should find out whether current RF requirements e.g. EVM could already make sure repeater amplify corresponding signal in advance before it receives and terminate its gain amplification after signals passed through repeater without introducing cross link interference.** |
| [**R4-2113207**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113207.zip) | ZTE Corporation | **Proposal 1: Introduce Cell Phase Synchronization Accuracy requirements for TDD repeater, the value could be set to 3µs as the baseline. How to measure this requirement is FFS.**  |
| [**R4-2113362**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113362.zip) | Ericsson | **Proposal 1: Define the switching time requirement in the same manner for both directions****Proposal 2: The switching time requirement is 10us for FR1 and 3us for FR2****Proposal 3: Discuss further whether gain or power level should be the requirement metric for TDD OFF power****Proposal 4: No need to set a requirement or test relating to synchronization of DL and UL switching****Proposal 5: RAN4 should discuss further whether the OFF level should be defined as an absolute power level or a minimum gain****Proposal 6: Define the requirement and test as applicable with a continuously applied stimulus signal. Transition time is the time take to transition between maximum output power and minimum power (or gain).****Proposal 7: Do not create a group delay requirement** |
| [**R4-2113667**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113667.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.****Observation 5: The available gap between DL TX and UL TX will be the RX/TX switching gap on the backhaul link reduced by the group delay of the repeater and the ramp-down/-up periods of the DL/UL TX power.****Observation 6: Agreed baseline for repeater switching sufficiently considers both DL and UL TX signals.****Observation 7: As indicated in the baseline switching diagram, the expected range of the guard period between DL and UL TX should be known.****Observation 8: The actual group delay of the repeater implementation should be known for the network planning with repeater deployments as too long group delay limits the applicable deployments and network configurations.****Proposal 1: RAN4 to confirm the diagram in the WF as the basis for the repeater TDD switching requirements so that UL and DL will not be treated independently.****Proposal 2: Open issues related to gain switching, stimulus signal and whether the requirements can be tested with power/EVM measurements, to be discussed in the conformance part.****Proposal 3: There is no need to specify requirement for the group delay.****Proposal 4: Requirements for the repeater TX OFF/ON and ON/OFF times can be based on the base station requirements.** |
| [**R4-2113984**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113984.zip) | Qualcomm CDMA Technologies | **Proposal 1. To further quantify the TDD swtiching requirements, an updated diagram for TDD repeater operation is suggested in Figure 1. The guard period should account for the ramping periods as well as the switching intervals.****Proposal 2. The guard period will depend on the switching delays. RAN4 should discuss further what values of the switching times should be considered.****Proposal 3. Stimulus signal should be adopted to measure the switching gain. More analysis is required to specify switching requirements while keeping in mind the impact of the introduction of this stimulus signal on conformance testing. TE vendors should confirm the feasibility of such test in conducted and radiated setups.****Proposal 4. Group delay requirement should capture the different delay components. To simplify the process, RAN4 can assume that the repeater should switch X seconds after the end of UL/DL transmission and this X should be based on the group delay. RAN4 can further discuss what this value should be.****Proposal 5 RAN4 should continue to discuss conformance-related issues, such as port mapping between Tx and Rx within the repeater, declaration of output power, off power and EVM, and switching time upper limits.** |
| [**R4-2114228**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114228.zip) | Huawei | **Proposal 1:** Use 2 diagrams (similar to figures 2.1-1 and 2.1-2) for the timing accuracy definition**Figure 2.1-1. Downlink Gain ON/OFF Template****Figure 2.1-2. Uplink Gain ON/OFF Template****Proposal 2:** Add definitions for the 2 gain states; Rated gain and zero gain**Rated gain:** forward gain for either UL or DL based on the installed gain setting**Zero gain:** forward gain for either UL or DL in the OFF state**Proposal 3**: Name of the requirement is switching accuracy  |

## Open issues summary

The definition of the switching requirements is still opened, many details are still to be agreed.

### Sub-topic 3-1

*Requirement naming:*

**Issue 3-1: Requirement naming**

* Proposals
	+ Option 1: Name of the requirement is TDD switching accuracy
	+ Option 2: TDD switch timing accuracy
	+ Option 3: Other name
* Recommended WF
	+ Option 1

*If another option is preferred, please provide a concrete proposal*

### Sub-topic 3-2

*Diagram to be used to define the requirement*

**Issue 3-2: Diagram for requirement definition**

* Proposals
	+ Option 1: Fig. 4 in R4-2112196 (all requirements in a single diagram)
	+ Option 2: Use 2 diagrams (similar to figures 2.1-1 and 2.1-2 or Figure 1 in [R4-2111917](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111917.zip)) for the timing accuracy definition
	+ Option 3: Other
* Recommended WF
	+ Option 1

Option 1 should be clear enough and more compact. If Option 3 is preferred, please provide another proposal

### Sub-topic 3-3

*Requirement for group delay*

*Most companies stated a preference not to define a group delay requirement, however, it is not clear how to define a complete switching time requirement without having a group delay requirement*

**Issue 3-3: Group delay requirement**

* Proposals
	+ Option 1: Define a maximum group delay requirement
	+ Option 2: Do not define a maximum group delay requirement, manufacturer to declare it for the test. Overall switch delay will be group delay + power ramp up/ramp down(discussed in Issue 3-4)
	+ Option 3: Do not define a specific group delay requirement, define an overall switching delay requirement that would comprise both group delay and power ramp up/ramp down(discussed in Issue 3-4)
	+ Option 4: Do not define any group delay, implicitly check in the conformance test that switching happens after entire UL/DL signal is forwarded
	+ Option 5: Other options
* Recommended WF
	+ TBA

Please state your preferred options and arguments for the choice. If Option 5 is sought, please provide alternate proposal.

### Sub-topic 3-4

 *Switching time on/off requirement – power ramp up and ramp down*

**Issue 3-4: Switching time on/off requirement**

* Proposals
	+ Option 1: The switching time requirement is 10us for FR1 and 3us for FR2
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If option 2 is preferred, please provide an alternate proposal

### Sub-topic 3-5

*Definition for rated gain and zero gain*

**Issue 3-5: Rated gain and zero gain definition**

* Proposals
	+ Option 1: Add definitions for the 2 gain states; Rated gain and zero gain:
		- * Rated gain: forward gain for either UL or DL based on the installed gain setting
			* Zero gain: forward gain for either UL or DL in the OFF state
	+ Option 2: Definition is not needed
	+ Option 3: Other definition
* Recommended WF
	+ Option 1

Please provide arguments for the choice and alternative proposal for Option 3.

### Sub-topic 3-6

 *Requirement for Cell Phase Synchronization Accuracy*

**Issue 3-6: Cell Phase Synchronization Accuracy**

* Proposals
	+ Option 1: Introduce Cell Phase Synchronization Accuracy requirements, take 3μs as baseline.
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If option 2 is preferred, please provide an alternate proposal

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | The term “accuracy” is a bit inexact; it can refer to power level, positioning etc. How about “TDD transition time” like in the other specs ? |
| CATT | Maybe it could be “TDD switching timing accuracy”? |

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We do not fully follow why the diagram used in the BS/UE specs to depict transition time cannot be used (apart from the fact that on/off power probably needs to be replaced by on/off gain). |
| CATT | We would prefer Figure 1 in [R4-2111917](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111917.zip) or Figure 1 in R4-213984. Actually, both of them use the idea from CCSA TD-LTE repeater requirements. CCSA and R4-213984 used one diagram. [R4-2111917](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111917.zip) separated DL and UL. We think both of them can be ok if the requirements and test can be described clearly. There can be some seperated test such as off power, and there can be some combined test such as EVM and power. So theoretically both can works, although separating them may be easier to be understood. |
| Keysight | Clarification question to folks in this discussion. Please help me to understand this requirement.Is this requirement to define time period of DL TX power and UL Tx power (detail seems TBD) ramp up and down timing and verifying time gap (repeater gain off period) between these two (DL TX and UL Tx) is one of intention of this requirementORThis requirement is to verify power ramp up and down (detail seems TBD) of each DL TX burst and UL TX burst as these defined in BS/UE conformance spec. this probably implies DL Tx and UL Tx can be measured independently. |

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We do not see the need to define a group delay requirement; in fact it may constrain implementation in some cases. Also, group delay should not be confused with simultaneous switching. As suggested, the conformance testing will implicitly test that the switching does not cut off DL/UL forwarding or cause oscillations. |
| CATT | We prefer option 4. |

Sub topic 3-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are OK for this. It could be put in [] if companies want time to check further. |
| CATT | We would prefer no requirement for the ON/OFF. |

Sub topic 3-5

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are generally OK with option 1, although instead of “zero gain” it may be better to use the term “minimum gain”. |
| CATT | Support option 2 if there’s no test related to the definitions. |

Sub topic 3-6

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We do not see the need or possibility to make such a requirement for a repeater, since the repeater simply amplifies other signals and does not create signals itself. As long as the BS transmitters meet cell phase sync then there will not be interference. If the repeater does not properly synchronize then it may (i) amplify too long -> but the input signal will have finished in time so no interference or (ii) not start amplifying until too late -> but then it will fail to meet other requirements such as EVM. |
| CATT | We don’t think Cell Phase Synchronization Accuracy is applicable to repeater. Our understanding is that a repeater is a transparent node to amplify the signals so there’s no cell synchronization concept for a repeater. |

### 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”.*

# Topic #4: Others

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2112234**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112234.zip) | Qualcomm Incorporated | **Proposal:****Introduce two new specifications for the repeater conformance testing as below:**38.1xx – NR; Repeater conformance testing – Part 1: Conducted conformance testing38.1xx – NR; Repeater conformance testing – Part 2: Radiated conformance testing |
| [**R4-2112187**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112187.zip) | CMCC | The structure of TS 38.106 is outlined in detail below:Draft outline of TS 38.1061 Scope2 References3 Definitions of terms, symbols and abbreviations3.1 Terms3.2 Symbols3.3 Abbreviations4 General4.1 Relationship with other core specifications4.2 Relationship between Minimum Requirements and Test Requirements4.3 Conducted and radiated requirement reference points4.4 Repeater classes4.5 Regional requirements4.6 Applicability of requirements5 Operating bands and channel arrangement5.1 General5.2 Operating bands5.3 Pass band6 Conducted transmitter characteristics6.1 General6.2 Repeater output power6.3 Frequency stability6.4 Out of band gain6.5 Unwanted emissions6.6 Error Vector Magnitude6.7 Input intermodulation6.8 Output intermodulation6.9 Adjacent Channel Rejection Ratio (ACRR) 6. 10 ON/OFF time mask7 Conducted receiver characteristics8 Radiated transmitter characteristics8.1 General8.2 Repeater output power8.3 OTA frequency stability8.4 OTA out of band gain8.5 OTA unwanted emissions8.6 OTA Error Vector Magnitude8.7 OTA input intermodulation8.8 OTA output intermodulation8.9 OTA Adjacent Channel Rejection Ratio (ACRR) 8.10 ON/OFF time mask9 Radiated receiver characteristicsAnnex A (normative): Environmental requirements for the Repeater equipmentAnnex B (informative): Change history |
| [**R4-2112188**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112188.zip) | CMCC | Document containing the formal proposed TS skeleton |
| [**R4-2113668**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113668.zip) | Nokia, Nokia Shanghai Bell | **Observation 1: The frame/slot/symbol timing accuracy should consider the available switching times of UL/DL signals, which need to be taken into account in how the switching time requirement is set.****Observation 2. Repeater synchronization to the received signal enables suitable timing for ramping up/down of the RX/TX chain but the timing of the TX signals are under the control of serving gNB.** **Proposal 1: Possible further discussion on CLI due to high power UL transmissions should take place together with discussion on other associated RF requirements, such as maximum output power and unwanted emissions.** |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1

*Handling of the conformance specifications*

**Issue 4-1: Handling of conformance specs**

* Proposals
	+ Option 1: Introduce two new specifications for the repeater conformance testing as below:
		- * 38.1xx – NR; Repeater conformance testing – Part 1: Conducted conformance testing
			* 38.1xx – NR; Repeater conformance testing – Part 2: Radiated conformance testing
	+ Option 2: Other options
* Recommended WF
	+ Option 1

If option 2 is preferred, please provide an alternate proposal

### Sub-topic 4-2

*TS 38.106 skeleton*

**Issue 2-2: Specification skeleton**

* Recommended WF
	+ As proposed in R4-2112187

Please provide any comments on the proposed skeleton and whether any addition/changes are needed

### Sub-topic 4-3

*Repeaters and handling of CLI*

**Issue 4-3: Repeaters and CLI**

* Proposals
	+ Option 1: Possible further discussion on CLI due to high power UL transmissions should take place together with discussion on other associated RF requirements, such as maximum output power and unwanted emissions.
	+ Option 2: No need to consider CLI during the current work
* Recommended WF
	+ Option 1

If option 2 is preferred, please provide argument why this is not needed

## Companies views’ collection for 1st round

### Open issues

Sub topic 4-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1 is OK. |
| CATT | Support option 1. The spec may be -1 and -2. |

Sub topic 4-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We do not see a need for a section on “relationship to other core specifications” as it is not really clear what content there would need to be. We do not see a need for sections on receiver characteristics at present |
| CATT | Generally the skeleton is good except that some of the clauses may need to be updated according to the agreement, for example ON/OFF mask, ACRR, TDD switching timing requirements, etc. |

Sub topic 4-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | It is indeed true that high power UL transmissions could cause co-existence issues, but this is not a cross link interference question (the link is still the uplink). For the IAB specification, the solution is that the 3GPP spec does not guarantee co-existence and the operator needs to do so. Whatever the solution for repeaters, we think that this is an UL only question and not CLI. CLI is an independent topic that is not related to repeaters. |
| CATT  | Support option 2. In our understanding, CLI is a big topic which cann’t be solved easily only in the RF repeater topic. And as Ericsson said, it’s not related directly to repeater but to the whole network deployment. |

### 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** |
| R4-2112188 | 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** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

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

## 2nd round

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

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| [Keysight] | Takao Miyake | takao\_miyake@keysight |

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)