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

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

**Agenda item:** 8.11.1

**Source:** Moderator (Qualcomm)

**Title:** Email discussion summary for [98-bis-e][ 310] 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
  + Repeater support/operation for TDD systems
  + Other topics such as specification skeletons
* 2nd round: TBA

# Topic #1: System Parameters

This section discusses different system parameters such as multi band support, whether to simply reuse the parameters already defined for base stations and UEs, etc.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104614**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104614.zip) | CMCC | **Proposal 1: NR repeater should support multi-band and the** **Tx/Rx RF core requirements for single band shall apply separately to each supported operating band unless otherwise stated.** |
| [**R4-2104667**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104667.zip) | Ericsson | **Observation 1: To avoid amplification of signals in neighbor operators’ carriers, a repeater would either need to implement configuration specific analogue filters or digital filtering.**  **Observation 2: If a repeater amplifies in neighbor operators’ carriers, it may in some cases be beneficial to the neighbor operator, but it may also cause degradations in neighbor operator networks.**  **Observation 3: Narrow beamwidths may provide spatial selectivity and reduce the impact of amplification on neighbor operator carriers as long as operators are not co-located.**  **Proposal 1: RAN4 discuss the impact of amplification on neighbor operator carriers within the operating band on 5G performance of the neighbors and repeater architectures.**  **Proposal 2: If the passband is assumed to potentially contain other operator’s carriers, consider a requirement on repeater emissions within the rest of the passband when only one carrier is transmitted/amplified by the repeater.** |
| [**R4-2106323**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106323.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: The required system parameters specified in [R4-2103882], [38.104], and [38.101-1] are comprehensive and sufficient, and a subset of these can be utilized as system parameters for NR repeaters as well.***  ***Observation 2: Main discussion for system parameters for repeaters is whether it is sufficient to refer to other specifications or is it practical to spell out the content also in repeater specification.*** |
| [**R4-2106348**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106348.zip) | NTT DOCOMO, INC. | **Observation 1: Multi-band supporting repeater is expected to be widely used.**  **Proposal 1: RAN4 define the requirements for multi-band supporting repeater.**  **Proposal 2: RAN4 clarify the scope of the supporting multi-band combination FDD-FDD, FDD-TDD, and TDD-TDD.**  **Proposal 3: RAN4 should consider the feasibility of using different TDD pattern simultaneously in a NR repeater supporting multi-bands.**  **Proposal 4: If RAN4 conclude that having different TDD pattern simultaneously in the multi-band supporting repeater is not feasible, RAN4 consider the requirements for multi-band TDD repeater in terms of using the same TDD pattern.** |

## Open issues summary

The following topics are discussed in the 1st round:

* multi-band support
* specifications for multi band support
* referencing or explicit specifications
* impact on systems in neighbour channels
* requirements to protect neighbour channels

### Sub-topic 1-1

Multi-band support for repeaters is proposed to be taken into consideration.

**Issue 1-1: Multi-band support**

* Proposals
  + Option 1: Repeaters specifications should cover multi-band support
  + Option 2: Requirements developed only for repeaters supporting a single band
* Recommended WF
  + Option 1

### Sub-topic 1-2

If multi-band support for repeaters is considered, the specification impact has to be assessed.

**Issue 1-2: Multi-band support related requirements**

* Proposals
  + Option 1: Tx/Rx RF core requirements for single band shall apply separately to each supported operating band unless otherwise stated.
  + Option 2: requirements have to be discussed/specified based on the bands which are supported together
* Recommended WF
  + Option 1

### Sub-topic 1-3

Repeater operation might cause problems in adjacent channels if signals in neighbor carriers are also amplified. Is there a need to discuss the impact and develop requirements to address this problem?

**Issue 1-3: Impact of Repeater on neighbouring channels**

* Proposals
  + Option 1: Issue needs to be discussed and requirements on amplification in adjacent channels are needed
  + Option 2: This is not a problem, no requirement is needed
* Recommended WF
  + Option 1

### Sub-topic 1-4

If Option 1 is agreed for Sub-topic 1-4 then which requirements are needed?

**Issue 1-4: Requirements for amplification/emissions in neighboring channels**

* Proposals
  + Option 1: ACRR
  + Option 2: Any other requirements?
* Recommended WF
  + TBA

Please provide examples of other requirements if Option 2 is chosen

### Sub-topic 1-5

Repeater specifications will re-use many requirements defined for the base stations (38.104) and UEs(38.101-1, -2), it has to be discussed whether the repeater spec should use referencing as much as possible or requirements should be explicitly included in 38.106.

**Issue 1-5: Repeater Specification Drafting**

* Proposals
  + Option 1: Reference as much as possible other existing specifications (38.104, 38.101-1&38.101-2)
  + Option 2: Define requirements explicitly
* Recommended WF
  + Option 1

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

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| **Company** | **Comments** |
| XXX |  |
| CMCC | We prefer option 1, repeater specification should cover multi-band support |
| Ericsson | We are OK to consider multi-band support. However, as is the case for the BS specs we would like to point out that multi-band requirements are dependent on the architecture:   * If the repeater supports 2 or more bands using *separate* active electronics (and potentially separate connectors), then single band requirements should be applied to each band * If the repeater supports 2 or more bands that are repeated using *common* electronics/PA then multi-band requirements should apply.   Note that our understanding of FDD/TDD combinations would be that the first scenario would apply; it would not be possible to do FDD and TDD using the same active components. |
| ZTE | Fine with option 1. |
| Pivotal | Agree with Ericsson, should not restrict architecture based on multi-band specification. |
| AT&T | We are OK with the recommended WF to use Option 1. |
| CATT | Ok with option 1. |
| NEC | OK with option 1. |
| Huawei | OK with multi-band but needs same clarifications as BS i.e. common RF HW. |
| Nokia, Nokia Shanghai Bell | Option 1 could be considered for FR1, with the aim to see if similar approach as BS multi-band requirement can work for repeaters. Some study is needed if this approach can work.  Multi-band requirements do not exist for FR2 base stations so it seems reasonable to leave them out-of-scope also for repeaters. |
| Docomo | OK with Option 1. |
| Qualomm | Option 1 |
| CommScope | OK with option 1 |

Sub topic 1-2

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | If the bands are covered using *separate* active electronics then single band requirements apply to each band.  If the bands are covered with *common* active electronics then single band requirements apply, but with exceptions for emissions and blocking requirements for the other covered bands (as in the BS spec). |
| ZTE | As mentioned by Ericsson, this is related whether there are common active RF component sharing among different bands. |
| Pivotal | Similar view to Ericsson and ZTE |
| AT&T | We are OK with the recommended WF as it allows to cover any exceptions as noted by Ericsson based on the “unless otherwise stated” statement. |
| CATT | Agree with Ericsson and ZTE. |
| NEC | Agree with Ericsson, etc. |
| Huawei | As stated the requirements should be similar to BS (as stated above) |
| Nokia, Nokia Shanghai Bell | Option 2 is needed here, and starting point could be similar to multi-band requirements defined for base stations, though some study is needed is same approach can be applied here.  Option 1 does not work as one operating band might fall in the unwanted emission domain of another band, i.e. some side conditions are needed, at least for the case that multiple bands share same measurement connector. |
| Docomo | Agree with Ericsson and ZTE |
| Qualcomm | Option 1. the case of supporting multiple bands with same components should go into “unless otherwise stated” |
| CommScope | Agree with Ericsson, et al. |

Sub topic 1-3

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | There may be adjacent channels that are within the receiver passband. In this case, noise and interference will be amplified for these channels (for example, if there is a source of interference in the adjacent channel near to the repeater then the repeater will amplify the interference). This may be difficult to avoid for some repeater implementations, but it should be discussed whether amplification on adjacent operators carriers within the passband could cause significant co-existence issues.  Also, if there is another operators equipment close to the repeater, then the repeater will amplify the other operators signal, which may cause ACS degradation to the receivers belonging to the operator that has deployed the repeaters.  For adjacent channels that occur outside of the repeater passband, requirements on emissions and rejection should apply. |
| AT&T | We agree with the recommended WF as well as Ericsson’s observations above. |
| Pivotal | Requirements should be left to implementation unless there is a significant impact to adjacent operator carriers. Agree with Ericsson. |
| CATT | Out of band gain requirement solves the concern? |
| NEC | Agree with the WF |
| Huawei | Continue to discuss is ok, but how will discussion be resolved? The location of the repeater and victim/adjacent networks is statistical in nature and any degradation will be statistical. Such problems are solved by simulations but are we really suggesting that here? |
| Nokia, Nokia Shanghai Bell | It is important to differentiate here whether the adjacent channels are within the same operating band. To our understanding LTE FDD repeaters do not have requirements covering amplification other operator signals at adjacent channels. Given that the WID scope remains only within RAN4, it is also difficult to enable solutions where passband bandwidth could be dynamically changed or where the repeater could easily even know what channel bandwidth is being used. |
| CableLabs | Option 1. Also agreed with the statement above that the adjacent channel requirements should be discussed for intra-band and inter-band separately. |
| Qualcomm | Option 1. |
| CommScope | Agree with WF. |

Sub topic 1-4

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Option 2, ACLR equivalent requirements including ACRR, out of band gain, absolute ACLR requirement and OBUE |
| Ericsson | ACRR is currently defined outside of the passband. It can mitigate re-amplification of signals and interference outside of the passband. The rejection ratio actually should depend on the expected MCL and power of the interferers.  Unless re-defined to also apply to adjacent carriers inside the passband then ACRR does not provide any protection to other operators whose carriers are inside the repeater passband. |
| ZTE | Similar view as CMCC |
| AT&T | We should look to the LTE repeater specification for guidance on requirements in adjacent channels. However, we agree with Ericsson that ACRR would not provide protection for adjacent carriers inside the repeater passband and we should consider any necessary modifications or additional requirements to cover protection of adjacent carriers inside the repeater passband. |
| CATT | Similar with CMCC, it can be discussed in the RF requirement discussion. |
| NEC | Similar view with CMCC. |
| Huawei | The current passband definition allows for one or several passbands, presumably several passbands would be necessary if operator owns non-consecutive spectrum. Are we considering the case when a repeater is deployed and operates in a channel which is not owned by the operator deploying the repeater (as Ericsson comment suggests)? Otherwise we have out of band gain, OBUE and ACRR in existing repeater requirements, do we need to revisit the derivation of these requirements, if so what has changed in the starting assumptions? |
| Nokia, Nokia Shanghai Bell | ACRR requirement, as specified in 36.106, is applied at the border of repeater passband. As such there is no issue in using ACRR, but definitely clarifications are needed how passband is defined, i.e. is passband based on manufacturer declared frequency range the repeater can support or could there be some finer granularity. |
| CableLabs | Besides transmitter characteristics listed above, receiver characteristics should be discussed as well, including P\_REFSENSE, ACS, blocking, etc. |
| Qualcomm | This should be further discussed in the RF requirements. Passband has to be clarified. |
| CommScope | Agree with AT&Ts comments. |

Sub topic 1-5

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | It is more clean to write the requirements explicitly (option 2) |
| ZTE | No strong opinions if requirement could be defined clearly. |
| AT&T | We share the same opinion as ZTE. We need to utilize learnings from the past when developing the LTE repeater specification and the NR IAB specification and apply as necessary to the development of the NR repeater specification. |
| Pivotal | Agree with Ericsson (option 2) |
| CATT | Option 2 is preferred because there’re not many requirements being reused and many new requirements are needed. |
| NEC | Option 1 in principle, but needs changes and additions. |
| Huawei | Not against referencing but most of the requirements are very different to BS (or UE) requirements, the only one that is almost the same is spurious emissions and if this is the case maybe it is easier to write all the requirements explicitly as referencing only 1 would require effort for reader for not so much gain (in terms of document size) |
| Nokia, Nokia Shanghai Bell | Option 1 seems reasonable, but there may be many understandings on what is “as much as possible”. For us, it seems reasonable that some rather stable sections as system parameters could be referenced.  On the other hand, actual Tx and Rx requirements might be preferable to write out explicitly so that changes in UE and BS requirements do not accidently become applicable also to repeaters. This can also be prevented by following the drafting rules and referencing specific clauses only using versioned references. |
| Qualcomm | Option 1, but only apply to sections that are fully common. |
| CommScope | Option 2 is probably best, that way any later changes in the reference documents will be isolated from the repeater specifications. |

### 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.*

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|  | **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

This section discussed the introduction of different repeater classes and types.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2104611](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104611.zip)** | CMCC | **Observation 1: In China, DL repeater has been classified into three classes, wide area, medium range and local area while no class definition for UL.**  **Observation 2: Wide area and medium range NR repeater are necessary to provide better coverage with much less cost, especially for FR2.**  **Observation 3: NR repeater may be deployed inside the high-speed train to provide blanket inside coverage considering large penetrate loss of carriages. In this scenario, home class rather than the local area class would be much feasible.**  **Observation 4: there are two approaches to definition DL repeater classes:**   * **Option 1: no class definition for DL** * **Option 2: four classes including WA, MR, LA and home class. WA, MR and LA could reuse the same definition as NR BS and the home class could refer to LTE BS definition, characterized by requirements derived from femto cell.**   **Proposal 1: both of above approaches are suggested for DL repeater classes definition.**  **Proposal 2: it is noted if RAN4 finally agrees no class classification, some requirements need further check to estimate whether they are still applicable for all the NR repeaters. For example, co-location spurious emission requirement may not be applicable for repeater with less output power.**  **Proposal 3: it is suggested to refer to UE spec with no UL class classification for repeater.** |
| [**R4-2104668**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104668.zip) | Ericsson | **Proposal 1: At least for FR1, introduce classification of repeaters as wide area, medium range or local area in the same manner as BS.** |
| [**R4-2104793**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104793.zip) | CATT | **Proposal: NR repeater class is not defined.**  **Observation: If FR1 radiated requirements will be defined, NR repeater type needs to defined.** |
| [**R4-2104987**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104987.zip) | NEC | **Proposal: To define two classes for repeater requirements and not to distinguish DL and UL for repeater class definition.** |
| [**R4-2106324**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106324.zip) | Nokia, Nokia Shanghai Bell | *Observation 1: Two separate classes are needed to organize the RF requirements of backhaul (R-BH) and access (R-AC) links of an NR repeater.*  ***Proposal 1: NR repeater classes can be defined as LA, MR, and WA, similar to IAB.***  ***Proposal 2: The relationship between the IAB MT and DU parts with the R-BH and R-AC for different NR repeater classes can be modelled as shown in Table 1.***   |  |  |  | | --- | --- | --- | | ***Repeater class*** | ***Access link (R-AC)*** | ***Backhaul link (R-BH)*** | | ***LA*** | ***IAB-DU LA*** | ***IAB-MT LA*** | | ***MR*** | ***IAB-DU MR*** | ***IAB-MT WA*** | | ***WA*** | ***IAB-DU WA*** | ***IAB-MT WA*** | | ***Table 1: Relationship between IAB MT/DU with R-AC and R-BH links*** | | |   ***Proposal 3: Further study is needed to decide whether NR repeater types can be defined in a similar way as IAB. That is, for FR1 type 1-H, and for FR2 type 2-O by incorporating conducted and radiated requirements.*** |
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## Open issues summary

The following topics are discussed in the 1st round:

* need for different classes for DL (access link)
* if different classes are needed, how many classes to define
* need for different classes for UL?
* need for introduction of different repeater types similar to base station
* repeater types to be introduced

### Sub-topic 2-1

Introduction of multiple repeater classes for DL (access link)

**Issue 2-1: Repeater Classes for DL (access link)**

* Proposals
  + Option 1: Introduce multiple classes
  + Option 2: No need for multiple classes
* Recommended WF
  + Option 1

### Sub-topic 2-2

If multiple classes are needed, there will be a need to discuss how many classes should be introduced

**Issue 2-2: Number of Repeater Classes for DL (access link)**

* Proposals
  + Option 1: 4 classes (WA, MR, LA and home class)
  + Option 2: 3 classes (WA, MR, LA)
  + Option 3: other options
* Recommended WF
  + TBA

If option 3 is preferred, number of classes and arguments should be presented.

### Sub-topic 2-3

Introduction of multiple repeater classes for UL (backhaul link)

**Issue 2-3: Repeater Classes for UL (backhaul link)**

* Proposals
  + Option 1: No need for multiple classes because power is capped as for UE
  + Option 2: Multiple classes are needed
* Recommended WF
  + Option 1

### Sub-topic 2-4

It is proposed to introduce different types as for base stations to differentiate the way the specifications are defined

**Issue 2-4: Repeater Types**

* Proposals
  + Option 1: Introduce multiple types similar to base station
  + Option 2: No need for different types
* Recommended WF
  + Option 1

### Sub-topic 2-5

If multiple types are introduced, it has to be discussed and agreed which types should be introduced

**Issue 2-5: Repeater Types**

* Proposals
  + Option 1: Introduce same types as base station depending on what will be defined(e.g. type 1-C, type 1-H, type 1-O, type 2-O)
  + Option 2: Other options
* Recommended WF
  + Option 1

If option 2 is preferred, please provide alternative proposals on how to differentiate the requirements.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | To protect heterogeneous network co-existence, classes with DL power limits are needed. |
| ZTE | Fine with Option 1 |
| AT&T | OK with the recommended WF. |
| Pivotal | Prefer option 2 |
| CATT | Our understanding is that there could be two power levels, but that power level may not be the same as BS because the deployment request and scenario are not the same. The benefit of definition of repeater power class is to make the requirements clearer. Ok with power class definition if all of the companies support it. |
| NEC | Fine with option 1. |
| Huawei | It seems at least there is the need for different output power repeaters, however it’s still not clear that repeaters will be deployed in the same was as BS and as BS class is effectively a deployment description (with an associated set of RF requirements) there is a risk of confusing 2 different things if we use BS classes to define repeaters. We also discuss in out pater (R4-2107106) which is not listed above that repeater is essentially a gain device with a physical limit in the maximum gain it can achieve and ultimately this will limit the output power, repeaters are used to extend the cell when signal are small but if the gain is limited then achieving large output power is not possible. If we have repeater classes then the definitions need to consider those and not just use the BS type definitions. |
| Nokia, Nokia Shanghai Bell | We prefer option 1: It makes sense to have classes as different output powers can be used to cater for different use cases. With a single class, it is challenging to categorize requirements suitable for the needs of different deployment scenarios. |
| Docomo | OK with the recommended WF. |
| CableLabs | Option 1. |
| CommScope | A two-tiered classification (low power, high power), as defined for LTE repeaters, is sufficient. |

Sub topic 2-2

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Option 1, one example for home class scenario is that this kind of repeater would be deployed into high-speed train scenario with very low output power |
| Ericsson | Our current view is that 3 classes are needed (option 2). We are open to discuss/explore the possibility of fewer classes. |
| ZTE | Fine with option 1, however for NR BS, only 3 class has been defined yet, maybe referring to LTE home BS? |
| AT&T | Prefer to take Option 2 as the starting point. |
| CATT | We think two classes may be sufficient. Repeater can’t improve signal quality, only can decrease SNR especially for UL. So extending a WA coverage to another WA coverage is not reasonable. And if repeater’s output power is as large as WA BS, it will bring interference to other cell. Open to discuss if there’re more technical analysis. |
| NEC | Option 3, two classes. For wide area coverage with unlimited output power, and for local area with limited output power. |
| Huawei | Tend to agree that wide area may not be very useful, we can start with 3 but we should justify each with a deployment scenario description. If that scenario turns out to make no sense we can remove it. |
| Nokia, Nokia Shanghai Bell | Option 2 is a good starting point. It also appears that classes can be independent backhaul and access links. One example where this is required is indoor-outdoor repeater, which could apply low output power indoors while providing high power link outdoors. |
| Docomo | We are OK with Option 2 as the starting point. |
| CommScope | Option 3 - LA/MR/WA classification is not needed. A two-tiered classification (low power, high power), as defined for LTE repeaters, is sufficient. |

Sub topic 2-3

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Option 1, UL output power upper limits should be higher than any UE power class |
| Ericsson | For the scenario discussed by CMCC of a repeater from outside to inside of a train carriage, power levels may differ in each direction. This may necessitate differentiation of class (or at least power limit) for DL and UL.  If the power is limited to the largest UE power class for the band, then no UL classes are needed. |
| ZTE | For UL, it should be guaranteed that BS RX cannot be blocked due to higher repeater output power, we need more discussion on that. |
| AT&T | Repeaters with higher output power upper limits than UEs should be further considered. |
| Pivotal | Option 1, UE power caps are sufficient |
| CATT | Prefer option 2. Repeaters can receive multiple UE’s UL and retransmit the signals. So not sure if the repeater’s backhaul link output power is less than UE power. But usually UE ouput power is smaller than BS and only small number of UEs are in the coverage of repeater. It’s expected that backhaul link power is smaller than access link power. One way to solve the issue is to define the same power class for both directions and leave the exact output power level to implementation. |
| Huawei | As classes are deployment specific and repeater will be deployed with UL and DL in the same place and the same deployment conditions then surely the repeater will have a single class applied to both links? Of course the UL may not have as many (or any) class dependent requirements, I think that is more what we are discussing here rather than the class? |
| Nokia, Nokia Shanghai Bell | Option 2 seems reasonable. For example, different classes may apply on FDD and TDD repeaters. The objectives in work item description (RP-202927) state that    “It is assumed that the TDD repeater meets both BS and UE emission requirements (or the more stringent absolute level in dBm) in all slots.  The following constraint may be considered for TDD repeaters, as needed, to contain the workload associated with this project:   * TX EIRP/TRP/power of Repeater not exceeding any UE power class defined in the band“     Therefore, it appears FDD repeaters may have more opportunities to support high power UL transmissions. |
| CableLabs | Option 2 |
| CommScope | Option 1 – there is no need for multiple classes. |

Sub topic 2-4

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| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | We think that OTA testing is needed for FR2 and conducted testing sufficient for FR1.  We do not see any need for a “hybrid” class for FR1 since there will not be an EIS requirement and we do not see any need for an EIRP requirement (no EIRP requirement because the repeater does not do beam steering and hence no need to set a requirement on the ability of the repeater to achieve EIRP in different steering directions like the BS). |
| ZTE | Option 1 is fine for us. |
| CATT | It depends on if FR1 will define radiated requirements. |
| NEC | Same view as Ericsson. |
| Huawei | Possibly 1-O and 1-H are not both needed. If you have antennas as part of the definition then as isolation is one of the most important parameters it makes sense to test as a 1-O, although minimizing OTA testing if you have a conducted interface could simplify testing where the isolation is not such an issue (emissions, switch time,..) certainly the test defined as OTA for a repeater 1-H might be different to those defined for BS 1-H but maybe it’s worth keeping. |
| Nokia, Nokia Shanghai Bell | Option 1: At least a repeater type conforming to conducted requirements is needed in FR1 and another type conforming to radiated requirements in FR2. |
| Qualcomm | Option 1. at least conducted requirements for FR1 and FR2 are needed |
| CommScope | Option 1 – similar types can be defined, however the donor and mobile side may have different types |

Sub topic 2-5

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK for us |
| Ericsson | Option 2. No need to mention types explicitly. (If really desired, 1-C and 2-O) |
| ZTE | For 1-H /1-O, more considerations are needed from cost, IAB node could be another alternatives for deployment. |
| AT&T | This can be handled in a similar way as IAB with a linkage to existing BS classes. |
| CATT | Also not sure of 1-H and 1-O. |
| NEC | Same view as Ericsson |
| Huawei | On balance I think there are advantages in keeping 1-H and 1-O for now anyway (see above). So option 1 is ok. |
|  | Option 2: In principle type 1-H covers also type 1-C. Additionally, it is not clear whether there is additional benefit in specifying type 1-O. It should be also noted that work item description defines that FR1 FDD repeater testing is conducted, so likely type 1-O would need to be defined only for TDD repeaters. Therefore, at least 1-C or 1-H for FR1 and type 2-O are needed. |
| Qualcomm | At least 1-C and 2-O are needed |
| CommScope | Option 2 – no need to define explicit types |

### 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 #3: Repeaters in TDD

This section discussion several issues related to support and operation of repeaters in TDD systems.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104616**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104616.zip) | CMCC | **Proposal 1: for timing accuracy, the same method as TDD UTRA repeater could be reused by defining DL/UL ramp on/off time.**  **Observation 1: SNR assumption are different for different deployment scenario when calculate REFSENSE.**  **Proposal 2: 5dB NF is suggested for all repeaters.**  **Observation 2: it’s hard to define a uniform REFSENSE requirement, which is variable and related to the practical deployment scenarios.**  **Proposal 3: NF is the equivalent requirements as REFSENSE for TDD to make sure repeater could decode synchronization signalling.** |
| [**R4-2104676**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104676.zip) | Ericsson | **Observation 1: If the same approach is follows as for BS, then there would be no requirement on synchronization for a repeater (but the specifications would be drafted with the assumption that synchronization is achieved).**  **Observation 2: UE DL synchronization is tested implicitly**  **Observation 3: There is no need to decide which of the options 1-4 is used**  **Observation 4: For the test, the repeater could be (pre-) configured if applicable.**  **Observation 5: Dynamic TDD can be operated as long as the repeater can detect the pattern from existing Uu signalling.**  **Observation 6: Dynamic TDD operation may cause severe inter-operator interference in outdoor scenarios.**  **Observation 7: UL timing can be adjusted by timing advance at the UE**  **Observation 8: Repeater group delay will impact throughput and capacity**  **Observation 9: There is no need for a requirement on group delay**  **Proposal 1: No need for a requirement relating to synchronization**  **Proposal 2: No need to agree on 3GPP on how the repeater detects the DL/UL pattern**  **Proposal 3: No need for a requirement on maximum group delay** |
| [**R4-2104700**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104700.zip) | Sony | **Observation 1: whether or not dynamic TDD is supported can impact the solution on how the repeater becomes aware of the UL/DL split:**   * **If dynamic TDD is supported, the same mechanism as indicate the dynamic TDD can be used by repeaters to gain awareness of the UL/DL split.** * **If dynamic TDD is not supported, then option 1 (via the cell broadcast information) or option 4 (via pre-configuration) can be supported, since they entail the least complexity and guarantee inter-operability of communication nodes.**   **Observation 2: It is beneficial for the flexibility of scheduling as well as the specification forward compatibility point of view to consider the dynamic TDD for smart repeater.**  **Observation 3: The TDD repeater can switch autonomously to the UL if it can figure out the end of DL transmission.**  **Observation 4: It is possible to specify a predefined switch time during the guard period for repeater to switch from DL to UL.**  **Observation 5: Indicating the maximum TA may involve dedicated signaling design and need further study.**  **Proposal 1: RAN4 may assume that the necessary dynamic UL/DL split information is made available to the repeater by signaling, or by some other means to be determined.**  **Proposal 2. If signaling is supported by TDD NR repeaters, set , i.e., the repeater TA is set to the maximum of the TAs configured to the UEs being served by the cell.** |
| [**R4-2104704**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104704.zip) | Qualcomm Incorporated | **Proposal 1. Baseline assumption for synchronization should be based on synchronization signals broadcast by the gNB.**  **Proposal 2. Baseline assumption for the knowledge of UL/DL split should be that it is acquired from the cell broadcast information.**  **Observation 1. No support for dynamic TDD for repeaters will lead to reduce the system coverage/capacity.**  **Proposal 3. Introduce a broadcast message with UL/DL configuration for the flexible slots to enable repeater support of dynamic TDD.**  **Proposal 4. Introduce a group delay requirement.**  **Observation 2. There is no need for the repeater to have any knowledge of UL transmission timing.**  **Proposal 5. Introduce requirements for DL to UL/UL to DL switching delay.** |
| [**R4-2104794**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104794.zip) | CATT | **Proposal 1: All of the possible implementation architectures are allowed for TDD repeater.**  **Observation: UE specific semi-static or flexible TDD slot configuration can’t be supported by repeater.**  **Proposal 2: Cell-specific semi-static or dynamic TDD slot configuration can be defined mandatory or optional based on declaration.**  **Proposal 3: Cell specific semi-static TDD slot configuration should be supported as mandatory requirement.**  **Proposal 4: Cell specific dynamic TDD slot configuration can be defined as optional requirement.**  **Proposal 5: Group delay requirement is not defined for NR repeater in 3GPP.**  **Proposal 6: UL timing requirement is not defined for repeater. The performance can be tested by TDD UL/DL pattern test.** |
| [**R4-2106325**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106325.zip) | Nokia, Nokia Shanghai Bell | **Observation 1. There are multiple implementation options for frame/slot/symbol synchronization of the repeater, but the assumptions of the implementation are out of scope of the Rel.17 WI.**  **Observation 2. The frame/slot/symbol timing accuracy requirement should consider the available switching times of UL/DL signals.**  **Observation 3. Base station may configure UL/DL resource with SFI which causes further requirements for a repeater to follow the UL/DL patterns.**  **Proposal 1. RAN4 to consider UL/DL signal timing within a repeater in practical deployment scenarios when determining the inaccuracy that will be tolerated for frame/slot/symbol timing.**  **Proposal 2. RAN4 should discuss to what degree Rel.17 repeaters would support semi-static and dynamic configurations of the UL/DL resources.** |
| [**R4-2106349**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106349.zip) | NTT DOCOMO, INC. | **Knowledge of UL/DL split:**  **Observation 1: In the case of Stand Alone, the repeater can know the TDD split by** **reading the cell broadcast information (SIB) coming from the gNB separately without any demodulation process to the signal to be transmitted to the UE.**  **Observation 2: Regarding Non-Stand Alone, the cell broadcast information (SIB) cannot be transmitted to the NR repeater.**  **Observation 3: Option 2 to 4 seems to be outside the scope of standardization discussion.**  **Proposal 1: RAN4 discuss how repeater to know TDD split based on Option 1, with considering NR repeater cannot get the cell broadcast information in the case of NSA.**  **Group delay:**  **Observation 4: The size of the acceptable delay on the NW side decreases as the supported SCS becomes larger.**  **Proposal 2: RAN4 define the requirements for the delay for FR1 and FR2.** |
| [**R4-2106603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106603.zip) | ZTE Corporation | **Observation 1: without explicit DL-UL pattern information or with static DL-UL pattern only at repeater, the deployment scenario should be limited;** |
| [**R4-2107107**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107107.zip) | Huawei | **Observation 1:** A TDD switch requirement is necessary.  **Observation 2:** The UTRA TDD timing requirement does not include information on how synchronization is achieved, however the test method implies its from the RF burst pattern.  **Observation 3:** There is no need to specify how the timing information is generated.  **Observation 4:** The test set up should be suitable for the timing recovery method  **Observation 5:** Dynamic TDD networks require high isolation between different nodes to operate, which can require careful planning, this is not compatible with using repeaters. Repeaters should not be used in dynamic TDD networks. |

## Open issues summary

The following topics are discussed in the 1st round:

* need for explicit synchronization requirement
* need to explicitly specify synchronization source
* group delay requirements
* DL/UL, UL/DL switch delay requirement
* dynamic TDD support
* how to support dynamic TDD if needed
* need to consider NSA

### Sub-topic 3-1

Whether there is a need for an explicit synchronization requirement (and accuracy) is discussed in multiple contributions

**Issue 3-1: Need for Synchronization Requirement**

* Proposals
  + Option 1: Yes, there should be an explicit synchronization requirement
  + Option 2: No, there is no need for an explicit synchronization requirement
  + Option 3: No, it will be implicitly captured in other requirements or tests
* Recommended WF
  + Option 3

### Sub-topic 3-2

Some contributions discussed the synchronization source and whether this should explicitly captured in the specifications.

**Issue 3-2: Synchronization Source**

* Proposals
  + Option 1: Synchronization source should be explicitly captured in the specs
  + Option 2: There is no need to explicitly capture any synchronization source
  + Option 3: There is no need to explicitly capture any synchronization source but default assumption is that synchronization is acquired from cell synchronization signals (test method can imply it is acquired from cell sync signals)
* Recommended WF
  + Option 3

### Sub-topic 3-3

Multiple contribution discuss the need to specify a group delay requirement

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

* Proposals
  + Option 1: Group delay requirement is needed, further discussion should happen in the RF requirements discussion
  + Option 2: No need for a group delay requirement
* Recommended WF
  + Option 1

### Sub-topic 3-4

Multiple contributions discuss the need to have a TDD switching requirement (DL-UL and UL-DL)

**Issue 3-4: TDD Switching Requirement**

* Proposals
  + Option 1: Switching requirement is needed
  + Option 2: Switching requirement is not needed
* Recommended WF
  + Option 1

### Sub-topic 3-5

Multiple contributions discuss the support of dynamic TDD and different possibilities to support it.

**Issue 3-5: Dynamic TDD Support**

* Proposals
  + Option 1: No need to support any dynamic TDD
  + Option 2: Dynamic TDD is supported only based on current cell broadcast information
  + Option 3: Dynamic TDD is supported and broadcast signaling for semi-static configurations(e.g. UL/DL definition of flexible slots) can be introduced
  + Option 4: Support dynamic TDD, discuss other options on how to enable support
* Recommended WF
  + TBA

### Sub-topic 3-6

One contribution is discussing the need for NSA support to detect the UL/DL split that requires further discussion/clarification.

**Issue 3-6 : NSA Support**

* Proposals
  + Option 1: Explicit support for NSA is needed
  + Option 2: no explicit support is needed, channels used in NSA are expected to also support SA and broadcast SIBs
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Option 1, more clarification of synchronization requirement is required.  From my understanding, this requirement is to regulate the synchronization between TDD repeater and gNB for both DL and UL. For DL these requirements require repeaters to amplify and forward received DL signal with appreciated gain according to the trigger of DL synchronization signal. Besides, repeaters also stop the amplification and forwarding in time when it’s not the time for DL. For UL these same requirements still apply that repeater amplify/ forward the received UL signal and stop these activities according to the UL synchronization source.  If so, the same approach as UTRA repeater in 25.116 could be reused to define synchronization requirements by DL/UL ramp on/off time. The DL/UL gain versus time should meet the specified synchronization mask. The beginning and ending of DL burst should be calculated according to the trigger given by synchronization signal generator to regulate DL synchronization performance while UL gain mask is used to regulate UL synchronization by the same approach. |
| Ericsson | Option 2. The requirements should assume synchronization, but similar to other network equipment there is not a need for an explicit requirement. The means of acquiring synchronization may differ in different repeater implementations. |
| ZTE | Option 2 similar as other network requirement. In addition, what’s the exact definition here for sync requirements here? |
| AT&T | OK with Option 2 given the understanding that repeaters would be under the same assumptions on meeting required synchronization similar to wired BS or IAB nodes. |
| Pivotal | Option 2. Similar view to Ericsson. |
| CATT | Option 2. |
| NEC | Option 2 |
| Huawei | I think this has already been agreed in GTW, but we are ok with option 2, the assumption of timing is captured in the on/off mask requirement. |
| Nokia, Nokia Shanghai Bell | We prefer option 2. |
| Docomo | Option 2. |
| CableLabs | Option 2. The repeater TDD transmitted signal should meet the 38.133 synchronization requirements. |
| CommScope | Option 2 |

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK, cell synchronization signal is regarded as the default assumption especially used in the testing method. |
| Ericsson | Option 2. Synchronization should be assumed in the requirements. No need to assume or mandate how the synchronization is achieved. We do not follow what difference any default assumption would make to the requirements. |
| ZTE | Go with option 3 means UE specific dynamic TDD would be precluded. |
| AT&T | Option 2 or Option 3 seem to be equivalent. In practice, the exact methods of obtaining synchronization may be implementation/deployment dependent. |
| Pivotal | Option 2. Similar view to Ericsson. |
| CATT | There should be some assumption, how to write the spec depends on the assumption. |
| NEC | Option 2. Test method should be discussed later. |
| Huawei | Again we are ok with agreement in GTW, no test source is explicitly defined but the cell synch is available during test of the ON/OFF mask. |
| Nokia, Nokia Shanghai Bell | We prefer option 2. Option 3 is not ok as synchronization can be also based on other implementation specific methods. |
| Docomo | We are ok with agreement in GTW. |
| CommScope | Option 2. It will usually be the cell sync signals, but if some other method is devised that allow the other performance requirements to be met, it should not be excluded. |

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK, group delay is the total time delay produced by repeater including traveling time, processing time and Rx-Tx switching time. The recommended value is smaller than DL-UL GP but larger than CP. |
| Ericsson | A group delay requirement may constrain some kinds of implementation where e.g. the repeater converts to the digital domain and performs some filtering/processing or where there is some distance between the repeater antennas. The impact of group delay is a need for a longer guard period. This is not an emissions/regulatory issue and our view is that it is preferable not to create any minimum requirement, since a requirement would either constrain some implementations or be relaxed for simple implementations. Option 2. |
| ZTE | From our understanding, at least some feasible value should be provided to check whether there are additional network implementation needed. |
| Pivotal | Option 2. Repeater implementation options may be heavily impacted by a non-regulatory requirement, so group delay should not have an explicit requirement. |
| CATT | Option 2. Ok with some technical analysis similar with LTE repeater, but don’t think there will be a requirement. |
| NEC | Support option 2. |
| Huawei | Clearly there should be some upper limit on delay but this is probably provided by the ON/OFF mask. This controls the gain not the delay, but if the delay was to great the signal would not be within the ON period and hence would fail a number of other tests (EBVM for example) |
| Nokia, Nokia Shanghai Bell | Group delay is related to the synchronization and TDD switching time, i.e. the repeater cannot have such a long delay which would cause the repeater transmissions to cause cross-link interference in the network. GD can be assumed to be small and identical for both directions. Thus, do not see any additional RF requirements specifically for group delay. |
| Docomo | OK with Option 2. |
| CommScope | Option 2. Different applications will have different requirements, and different delays can be accommodated depending on the donor base station configuration. |

Sub topic 3-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK. TDD switching between DL and UL is required.  The same approach as synchronization requirement is suggested. DL and UL gains versus time should meet the specified mask. The starting point of DL burst at repeater is triggered by gNB synchronization DL signaling and time offset in terms of repeater clocks is allowed as DL synchronization requirements. And the ending point of DL burst and following starting point of UL burst at repeater is used to regulate DL-UL switching time. Furthermore, the ending point of UL burst and following starting point of another DL burst is used to regulate UL-DL switching time. The GP should be taken into consideration. |
| Ericsson | A TDD switching requirement is feasible and useful. Testability may need some careful consideration though, in particular in OTA. Option 1. |
| ZTE | To define switching requirement as other TDD equipment is fine for us. |
| AT&T | Agree with the WF. |
| Pivotal | Option 2 |
| CATT | General ok. The details need more discussion. |
| NEC | Ok with the WF. |
| Huawei | OK with WF |
| Nokia, Nokia Shanghai Bell | On-off and off-on time masks can be defined and would guarantee UL-DL switching functionality. When it comes to details of the masks, the UE switching times in TS 38.211 section 4.2.3 need to be taken into account. |
| Docomo | OK with WF. |
| CommScope | Option 2 – Usually switching will be needed, but there may be certain implementations where it is not needed (if TX/RX isolation is provided by means other than switching). Other performance requirements will determine if a non-switching implementation is feasible (like EVM). |

Sub topic 3-5

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | We support dynamic TDD. And we don’t have strong views on how to achieve it. Option 2, 3,4 are all OK for us. |
| Ericsson | It is outside of the scope of the WI to create additional Uu signaling or procedures to support dynamic TDD. Hence option 2 works, but we do not see that it has any impact on the RAN4 requirements.  In many deployment scenarios, dynamic TDD will lead to an unacceptable level of inter-operator interference. For secnarios where there is isolation between operators, our understanding is option 2 can be supported with no impact to the repeater specification. |
| ZTE | If UE specific dynamic TDD cannot be enabled, then this should be clearly captured in WID, otherwise it will be misleading to practical deployment. |
| AT&T | At least Option 2 should be feasible to support. Any additional signaling or procedures would require additional study and may need RAN1/RAN2 involvement. |
| Pivotal | Option 1. As noted by Ericsson, additional signaling/procedures are outside the scope of this WI. |
| CATT | UE specific dynamic TDD can’t be supported as repeater can read the information for UE. Cell specific dynamic TDD can be optional for some powerful repeater, but agree with Ericsson that it need some views from operators if it’s practical from deployment point of view. |
| Huawei | Again this was discussed in GTW and we are ok with the agreements made |
| Nokia, Nokia Shanghai Bell | We prefer option 1. |
| CommScope | Option 1 – Support of dynamic TDD could be optionally supported (as in option 2), but not required. |

Sub topic 3-6

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | The support of NSA is suggested. At this very early stage, more study is required to verify whether/how to differentiate requirements for NSA and SA before the conclusion of explicit support or implicit support. |
| Ericsson | We do not think that this question has any impact on the RAN4 repeater requirements. |
| ZTE | Similar view as Ericsson |
| AT&T | RAN4 may need to first clarify which signaling is needed and then it may be up to RAN1/RAN2 to determine whether NSA support is needed in certain cases. |
| Pivotal | This only has an impact if additional signaling is introduced, which is outside the scope of this WI. |
| CATT | Would like to understand the impact of requirements. |
| NEC | Similar view as Ericsson. |
| Nokia, Nokia Shanghai Bell | Explicit support for NSA is not needed, but we think it is also not suitable to base the operation of a simple analog repeater in assumption that it can read SIBs. It is sufficient to agree that there is no RAN4 impact. |
| Docomo | The intention of this question was to raise the issue that if the repeater only considers SIB for TDD synchronization, then it needs to consider the case such as that NR repeater only amplifies the NR bands belonging to the SCG in the EN-DC. Since it has already been agreed that the way to achieve synchronization depends on the implementation, there are no impact on RAN4 repeater requirements. |
| Qualcomm | Nothing is needed for NSA support. |
| CommScoep | Similar view as Ericsson. |

### 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

This section discusses other issues such as the skeleton of the new repeaters specifications, updated work plan, isolation requirements, OTA requirements for FR1, support for configurable bandwidth.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2104596**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104596.zip) | CMCC | Proposal of structure(skeleton) for TS 38.106 (core specifications) |
| [**R4-2104597**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104597.zip) | CMCC | Skeleton of TS 38.106 as proposed in R4-2104596 |
| [**R4-2104673**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104673.zip) | Ericsson | **Proposal 1: Requirements at output connectors should only apply during times at which the signal from the connectors is expected to be radiated.**  **Proposal 2: Do not add OTA requirements for FR1.** |
| [**R4-2106326**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106326.zip) | Nokia, Nokia Shanghai Bell | ***Observation 1: Deployment scenarios impact the applicable implementation aspects of the NR repeaters.***  ***Proposal 1: The isolation requirement between antenna access and backhaul antenna arrays is implementation aspect and does not need to be standardized.***  ***Proposal 2: Repeater specification needs to be designed to be flexible to allow different implementation options.*** |
| [**R4-2106920**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2106920.zip) | Qualcomm Incorporated | **Observation 1: Lack of bandwidth configurability for repeaters would incur a large cost on the operator deployments.**  **Proposal: Introduce a broadcast message containing the bandwidth that the repeater should be configured to.** |
| [**R4-2104614**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104614.zip) | CMCC | **Proposal 2: as no clear motivation for network signalling has been proposed, pre-configuration and customer-based design for pass band are suggested without any network signalling.** |
| [**R4-2107212**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107212.zip) | Qualcomm Incorporated | Updated work plan |
| [**R4-2107213**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2107213.zip) | Qualcomm Incorporated | Skeleton of TS 38.106 |

## Open issues summary

The following issues are discussed in the 1st round:

* specification skeleton
* updated work plan
* OTA requirements for FR1
* Isolation requirement
* configurable bandwidth

### Sub-topic 4-1

A new TS will be introduced for repeaters, some papers are proposing the skeleton for this TS

**Issue 4-1: Repeaters Specification Skeleton**

* Specification skeleton proposed in R4-2104596, R4-2104597 and R4-2107213
* Recommended WF
  + Please provide comments on the proposed skeleton and whether this can be endorsed

### Sub-topic 4-2

An updated work plan is proposed in R4-2107212 taking into the account the revisions in RAN#91e

**Issue 4-2: Updated work plan**

* Proposals
  + Option 1: Endorse updated work plan in R4-2107212
* Recommended WF
  + Option 1.

Please provide any comments if changes are needed

### Sub-topic 4-3

One contribution discussed the need for an isolation requirement between the repeater’s interfaces.

**Issue 4-3: Isolation requirement**

* Proposals
  + Option 1: No need to defined any isolation requirement between the repeater’s interfaces
  + Option 2: Isolation requirement between the repeater’s interfaces is needed
* Recommended WF
  + Option 1

### Sub-topic 4-4

The need for OTA requirements in FR1 was discussed in R4-2104673 and it is proposed not to introduce such requirements

**Issue 4-4: OTA Requirements for FR1**

* Proposals
  + Option 1: Do not introduce any OTA requirements for FR1
  + Option 2: OTA requirements for FR1 are needed
* Recommended WF
  + Option 1

### Sub-topic 4-5

Some contributions are discussing the necessity to have a configurable passband and proposals are contradicting.

**Issue 4-5: Configurable passband**

* Proposals
  + Option 1: Support for configurable passband is needed, some signaling should be introduced
  + Option 2: Support for configurable passband is not needed (proprietary methods are not precluded but nothing is introduced in the specifications)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 4-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Specification skeleton proposed in R4-2104596, R4-2104597 is preferred. For R4-2107213, a little confused about how to differentiated OTA and conducted requirements? It seems it doesn’t explicitly differentiate OTA and conducted requirement. |
| Ericsson | We should make a list of which requirements will be created for FR1 and for FR2 before making a skeleton. It is not clear whether all of the requirements are applicable for both OTA and conducted, or whether there are any other requirements right now.  It is not obvious that sections on “channel arrangement”, “channel bandwidth” etc. are needed for a repeater.  We do not see a need for a section on performance requirements.  We should agree the skeleton first before including text.  We need to discuss whether to create a single specification for FR1 and FR2, or 2 specifications, or “-1, -2” specifications. |
| CMCC2 | To Ericsson:  1. “channel arrangement”, “channel bandwidth” are included in 36.106 LTE repeater spec,  2. It is not our intention to define performance requirements for repeater. As we said in our discussion paper, the idea is to align the spec structure with BS and IAB. It can be marked as “void” if no requirements are introduced.  3. In our TS skeleton, no text is added.  It was discussed in last meeting that a single spec for conducted and radiated requirements would be created. We also prefer to create one spec, similar as BS spec. |
| Huawei | R4-2104597 is the better starting point  We also see no need for performance requirements, if we know they are not needed its better to not include than have void sections in a new spec.  The ON/OFF timing seems to be missing  For OTA requirement we may want to include requirement/testing for max gain/oscillation which currently is done for conducted repeaters as part of the installation process but for a system with antennas can be part of conformance. |
| Nokia, Nokia Shanghai Bell | It is useful to have a starting point for TS skeleton, but at this point of time we should also be still open to further modifications as the discussion on requirements is still very much open. We prefer the CMCC proposal in R4-2104597 as it differentiates between conducted and radiated requirements. However, we think clauses for performance requirements do not need to be reserved. Also the classification to transmit and receive requirements may not be necessary, as by definition both functions are always operational in the repeater. |
| CommScope | Generally support the skeletons; however, several points in this discussion should be decided first. |

Sub topic 4-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | There seems to be some time related mis-alignment in the work plan. Further check is suggested. For example, RAN4 #99 e-meeting is not hold in April 2021 but in May 2021 and it’s RAN #92 meeting after RAN4 #99e meeting not RAN #93e meeting. |
| Ericsson | The dates do not line up with the meeting numbers. It appears as if the WP proposes to complete the core CRs and TS in the May meeting; we think such a timeline is not feasible. |
| Nokia, Nokia Shanghai Bell | It seems that the workplan has mismatch between the meeting numbers and times, also when it comes to numbers of RAN plenary meetings. It would be also useful to clarify that while conformance testing discussions are included here the actual performance part and definition of conformance tests will start only after core part is completed, i.e. after Q4-2021. |

Sub topic 4-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Recommended WF is OK to us. Isolation requirement is suggested to be based on implementation. |
| Ericsson | Option 1; we do not see a need to define a requirement explicitly. Oscillations etc. will show up when testing other requirements if the isolation is not sufficient. |
| Pivotal | Option 1. This should be left to implementation and will show in testing through oscillations, EVM, etc. |
| CATT | We’re also not sure about this requirement and how to test it. |
| Huawei | For existing repeaters there is a procedure to measure the coupling loss between antennas and set the maximum repeater gain based on this measurement. It’s clear that for conducted interface this is unavoidable, but it is not possible in the field installation for an OTA system and could also be included in the OTA test. Currently the installation advice recommends 15dB margin, clearly the requirements of “not oscillating” during other tests does not satisfy this it just shows the margin is >0dB. Considering deployment conditions may not be as ideal as those in a test chamber then is this sufficient? It’s one of the most important characteristics of the repeater so we should perhaps consider further if some requirement on feedback gain margin is needed. |
| Nokia, Nokia Shanghai Bell | Option 1 |
| Qualcomm | Option 1. Question to Huawei would be how to decide on the margin that’s needed? |
| CommScope | Option 1- Other requirements with drive how much isolation is needed. |

Sub topic 4-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Both option 1 and option 2 are OK for us |
| Ericsson | Our preference is not to include OTA requirements. The scope of the WI is repeaters without active beamforming and it is not expected that repeaters with many active TX and no connectors would be used for FR1. The conformance work for OTA will be somewhat complex as there are no reference test procedures from BS or UE, and the assessments will differ between FR1 and FR2. So we think there is little gain from FR1 OTA, and effort should be focused on FR2 OTA conformance. (Option 1) |
| ZTE | The necessity to have OTA requirement needs more discussions, especially considering this should be low cost equipment, if with large AAS arrary without connectors available, then IAB could also be one alternative to be deployed |
| Pivotal | Option 1 |
| CATT | Need more discussion. |
| Huawei | This overlaps somewhat with the earlier discussion on BS types (issue 2-4), not having OTA requirements means we would not include type 1-H and 1-O (which we previously supported). However not having OTA option would simplify testing for FR1 and if its assumed there are fixed direction antennas then maybe OTA requirements are not necessary. |
| CommScope | Needs more discussion – beamforming is unlikely, but integrated antennas may be used. |

Sub topic 4-5

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| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| CMCC | Nowadays, it’s a global trend to re-farm 2G/3G/4G spectrum into 5G spectrum. Therefore, practical channel BW for NR repeater may be variable with the process of spectrum re-farming. Therefore, configurable passband is suggested. |
| Ericsson | Uu signalling should not be introduced as it would impact other WG. Then if the passband can be configured by other means, that is fine, but the conformance spec should include test configurations for the worst case (like the BS conformance spec). |
| ZTE | Understand the motivation to have configurable passband, however to include Uu signalling might need RAN-P decision/ |
| Pivotal | Option 2, similar view as ZTE |
| Huawei | We should not assume any configuration of the repeater by the on air interface (as discussed many times this is outside scope), but configuration by installation or other means can be considered, clearly a means to declare the capability and ensure the worst cases are tested would need to be derived. |
| Nokia, Nokia Shanghai Bell | Option 2 |
| Qualcomm | Option 1. This is needed to have more flexibility. however, should be proposed in plenary and discussed. |
| Samsung | No specification impact is anticipated to support configurable passband if purely by implementation. Then no decision needed regarding necessity on this feature. However, if signaling outside RAN4 needed to enable this, it should be decided in RAN-P. |
| CommScope | Option 2 – There should be no configuration of the repeater BW by the air interface; however, the repeater HW could support a user configurable BW. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | 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