**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.5.4, 8.5.4.1, 8.5.4.2.1.

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for RAN4#94e\_#82\_NR\_IAB\_RF\_Tx

**Document for:** Information

# Introduction

IAB Requirements have been discussed for a few meetings but very few agreements have been reached. The requirements for IAB-DU are somewhat simpler to manage as they will mostly re-use the BS requirements in 38.104. The IAB-MT requirements are more complex/controversial as the IAB-MT is mostly behaving like a UE but it is a network node.

The most important topic for which progress is of most importance is the definition of IAB-MT classes as this influences the definition of many other requirements that are class dependent.

This e-mail discussion will target all IAB Tx requirements with an emphasis on IAB-MT Tx requirements since these are more complicated.

List of topics for the 1st round of discussion are:

* 1st round:
  + Definition of IAB-MT classes
  + IAB-MT Tx Power
  + IAB Tx Signal Quality
  + IAB-MT Beam Correspondence
  + IAB-MT Rx-Tx Switching time
  + IAB-MT Unwanted Emissions
  + Other IAB-DU Tx Requirements
* 2nd round: TBA

# Topic #1: Definition of IAB-MT classes

Definition of IAB-MT classes has been discused for a few meetings. It is not yet decided whether multiple classes would be defined and what would be the differentiator.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001868 | Ericsson | **Proposal-1: Only study the IAB MT and IAB DU belong to the same class scenario.**  **Proposal-2: Assume that wide area and medium range IABs are planned and local area IABs are unplanned.** |
| R4-2001283 | Qualcomm | **Proposal 1: differentiate IAB-MT classes only based on dynamic range. Maximum or minimum power limits will not be introduced for IAB-MT**  **Proposal 2: define IAB-MT class 1 targeting planned deployment scenarios and characterized by a transmitter dynamic range of 20dB**  **Proposal 3: define IAB-MT class 2 targeting unplanned deployment scenarios and characterized by a transmitter dynamic range of 30dB** |
| R4-1001709 | Huawei | **Observation 1:** The BS “class” terminology (wide area, medium range, local area) is more suitable than the UE numbering system as it relevant to the IAB node deployment.  **Observation 2:** EIRP may be a better figure to specify for IAB-MT as an upper power limit with as it does not require an antenna gain limit  **Observation 3:** a simple link budget using Uma LOS PL2 indicates a macro power of 57dBm EIRP and a micro power of 47dBm EIRP is needed.  **Implied proposals:**  For IAB\_MT type 2-O, IAB-MT classes are defined as indicated below:  - Wide Area IAB-MT nodes are characterised by requirements derived from Macro Cell scenarios with a IAB-DU to IAB-MT minimum distance along the ground equal to [113] m.  - Medium Range IAB-MT nodes are characterised by requirements derived from Micro Cell scenarios with a IAB-DU to IAB-MT minimum distance along the ground equal to [20] m.  - [Local Area IAB-MT nodes are characterised by requirements derived from Micro Cell scenarios with a IAB-DU to IAB-MT minimum distance along the ground equal to 2 m.]  It’s clear that these numbers are suitable for the scenarios studied so far in the IAB WI but should not be finalised before there is the opportunity to add additional scenarios.  Using these definitions reasonable max power levels would be:  Wide area maximum EIRP - no limit (although we have been assuming 57dBm)  Medium range maximum EIRP ≤ 47dBm  Local area maximum EIRP ≤ FFS (not yet studied is it needed?) |
| R4-2001436 | Nokia | **Proposal 3: No output power based classes or categories shall be defined for IAB-MT.**  **Proposal 4: IAB-MT and IAB-DU radiated power capabilities shall be declared independent of each other. Same applies for output power.** |
| R4-2000276 | Samsung | **Proposal: Define 2 IAB-MT classes as below:**   |  |  | | --- | --- | | **IAB-MT power class** | **TRP upper limit** | | I(higher power capability) | No upper limit | | II(lower power capability) | <30dBm | |

## Open issues summary

Introduction of one or multiple classes and what would the differentiator be. Most companies are proposing to define multiple classes(2 or 3) with differentiation based on Tx power, dynamic range or distance from the parent.

### Sub-topic 1-1

Introduction of multiple classes:

**Issue 1: Introduction of MT classes**

* Proposals
  + Option 1: Do not introduce any class
  + Option 2: Introduce 2 classes
  + Option 3: Introduce 3 classes
* Recommended WF
  + Introduce 2 classes

### Sub-topic 1-2

How to differentiate between classes:

**Issue 1: What is the MT class differentiator**

* Proposals
  + Option 1: Distance from donor node (minimum/maximum)
  + Option 2: Power dynamic range
  + Option 3: Max Tx power(TRP or EIRP)
* Recommended WF
  + Differentiate classes based on minimum distance from donor node

### Sub-topic 1-3

Which requirements would be class dependent should also be discussed:

**Issue 1: Which requirements would be class dependent if 2 classes are defined**

* Proposals – multiple options can be introduced at the same time
  + Option 1: Max Tx power(it is possible not to have max Tx power for at least one class
  + Option 2: Dynamic range
  + Option 3: ACLR and/or ACS?
  + Option 4: other requirements?
* Recommended WF

Option 1 and 2 – different distances will imply different deployment scenarios and different power needs.

### Sub-topic 1-4

Under the assumption that multiple classes are defined, should there be a 1-1 matching between the MT class and the DU class or not? It is assume that the DU will follow the BS classes currently defined.

**Issue 1: Should MT classes and DU classes have a 1-1 matching or is any combination allowed?**

* Proposals
  + Option 1: Yes, any combination is allowed.
  + Option 2: No, IAB-MT and IAB-DU classes should have a 1-1 matching.
* Recommended WF

Option 1 – will allow for more flexibility to address different deployment scenarios.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 1-1: support to introduce 3 power class, WA, MR, LA as from maximum transimission power perspective, IAB DU and MT should have the same capability. FFS is how to define the maximum EIRP for each power class, as there are no IAB DU power limits definition specified for FR2 NR, therefore the the specific power limit could be FFS.  Sub topic 1-2: combination of option 1 and option 3,   1. First of all, power class with specific power level are definitely necessary as IAB MT should report it to its parent IAB DU via capability report for scheduling, otherwise parent IAB has no idea on actual tranmission power of its child node and remaing power it could transmit. 2. Mini distance between IAB DU and MT. In the past, MCL or mini distance between BS and UE is based on the practical deployement scenario instead of requirements or performance, indeed this is coming from UTRA spec and reuse it for E-UTRA and NR spec, Based on the MCL or mini distance between BS and UE, then we define the relative requirements ,e.g. UE maximum input power for FR1 [45dBm{BS transmission power}-70{MCL}=-25dBm], high boundary of RSRP report table as far as I can remember, however the logic for IAB MT has been reversed, as we agree not to define maximum input power for IAB MT in the last Reno meeting, meanwhile IAB MT maximum input power are expected to not exceed its IBB power levels otherwise it will exceed its RX dynamic range requirement [Note IBB is mainly used to specify the RX dynamic range requirement if no maximum input power is defined], therefore we should use the IAB DU maximum allowed transmission power for each deployment scenario and its child IAB MT IBB requirement to derive the mini distance or MCL.   In short, powe class for IAB MT should be specified for network uplink scheduling and it’s better for IAB MT to follow the IAB DU power limits, but the problem is that no power limits for FR2 are defined; Indeed this requirement should be based on the excessive SLS on co-channel interference analysis to avoid lower BS class creating high interference to higher BS class from system level, that’s also why for MR, LA, Home eNB power limits are defined in the 3G and 4G.  New mini distance for parent IAB DU and child IAB MT should be specified for its RX capability as we defined its requirement firstly instead of based on the practical deployment, I think it’s also reasonable to have such assumption as mini distance between IAB DU and MT can be carefully planned insteaof randomly dropped like legacy mobile UE.  Examples are shown as following:  IAB MT class 1: {power class 1and mini distance 1 between IAB DU and MT}  IAB MT class 2: {power class 2 and mini distance 2 between IAB DU and MT}  IAB MT class 3: {power class 3 and mini distance 3 between IAB DU and MT}  Note: IAB MT mini distance should be moved to IAB DU class definition where mini distance between parent IAB DU and child IAB MT are added together with mini distance between IAB DU and legacy UE.  Sub topic 1-3: support only option 1 as ACLR/ACS or TX dynamic range requirement are defined independently with BS class, therefore we think option 1 is reasonable option.  Sub topic 1-4: support option 1 and IAB MT power class should follow IAB DU power class considering its practical capability. In addition, IAB MT will not cause more interference as IAB DU as power control might be enabled to remove its actual transmission power. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #2: IAB-MT Tx Power

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000277 | Samsung | **Proposal 1**: The dynamic range can be defined to link with ACLR.  **Proposal 2**: It may not necessary to define ACLR and dynamic range as power class dependent requirement for IAB-MT. |
| R4-2001432 | Nokia | **Proposal 6: Adopt 20 dBm as minimum output power for IAB-MT with the side condition of channel being fully allocated.** |
| R4-2000965 | Qualcomm | **Tx Power**  Based on the agreements in [1], the Tx power requirements for IAB-MT will follow the BS framework of using manufacturer’s declaration. These requirements will depend on the outcome of the IAB-MT class discussions. The structure of the requirements should be similar to what will be used for the IAB-DU.  **Output power dynamics**  The UE requirements for output power dynamics are comprised of minimum output power, Tx off power, On/Off time mask and power control. We discuss them separately below:  Minimum Output Power  The minimum output power requirement for the IAB-MT is still under discussion (also if it will be defined or not). If this is defined, it should apply to all the Tx beams of the IAB-MT.  Tx off power  The Tx off power requirement is defined such that UL interference is minimized, as such, the current UE requirement in 38.101 should be re-used.  On/Off time mask  The on/off time mask requirement ensures that UL performance is not compromised, hence, the current UE requirements should be re-used.  Power control  The IAB-MT introduction into the network should minimize the impact over existing gNBs, as such, the best approach would be to re-use the UE requirements. For the OTA requirements in [3], the requirement should apply to the set of beam peak directions as discussed in Section 2.2. |
| R4-2000619 | CATT | **Observation 1: If IAB-MT follows the UE power control requirements, there’s no problem for the system performance.**  **Observation 2: IAB-MT can easily meet UE power control requirements.**  **Observation 3: IAB-MT power control requirements can be considered to be simplified compared with UE requirements.**  How to simplify the requirements needs discussion in RAN4. We slightly prefer no power control requirements for IAB-MT. |
| R4-2001436 | Nokia | **Proposal 2: IAB-MT shall declare its output power similar to BS type 2-O. BS EIRP and TRP accuracy requirements can be re-used. No requirement is set for extreme conditions.**  **Proposal 3: No output power based classes or categories shall be defined for IAB-MT.**  **Proposal 4: IAB-MT and IAB-DU radiated power capabilities shall be declared independent of each other. Same applies for output power.**  **Proposal 5: In addition to minimum output power, power control requirements as a function of RB allocation shall be specified. Allowed tolerances shall be greater than currently allowed for BS type 2-O.**  **Proposal 6: If OTA transmit OFF power requirement is needed, the BS requirement is adopted, i.e. maximum TRP during Tx OFF period is -36 dBm.** |
| R4-2001707 | Huawei | **Proposal 2:** Use the BS TX OFF levels for the IAB-MT  **Proposal 3:** Use the BS timing values for both IAB-DU and IAB-MT. |
| R4-2001866 | Ericsson | **Observation-1: The radio channel change by the slow fading could be compensated by power control. The magnitude to consider is between 4 dB to 8 dB.**  **Observation-2: IAB MT dynamic range is limited to provide fast switching between IAB MT and IAB DU for shared transceiver architecture.**  **Observation-3: IAB MT dynamic range is further limited to to support the FDM/SDM operation.**  **Proposal-1: IAB MT dynamic range suggest to be around [5] dB.**  **Proposal-2: Min TX power can be derived with declared maximum carrier TRP power and IAB MT dynamic range and thus there is no need to define the min TX power.** |
| R4-2001867 | Ericsson | **Observation-1: BS can transmit at uplink time slot with maximum TRP assuming a minimum distance with neighbour NR BS of at least 50m to 80m and assuming an ACIR of 28 dB, from regulator perspective.**  **Observation-2: The IAB-MT Tx maximum power could be set similar as the IAB-DU Tx maximum power with the similar conditions in [4] is met.**  **Proposal-1: IAB MT upper limit of output power can be set the same with IAB DU upper limit of output power on the condition of minimum physical separation distance and good ACIR.**  **Proposal-2: IAB maximum output power could be adjusted/limited to protect the neighbour BS service.**  **Proposal-3: Send a LS to RAN2 to request the additional signalling on the power limitation of the IAB MT in R16 to protect neighbour BS receiver.**  **Proposal-4: No upper limit on output power on the IAB MT for FR2.** |
| R4-2001872 | Ericsson | **Observation#1: The IAB is installed in a fixed location, the initial transmit power level setting could be fixed irrespective the RSRP estimation accuracy.**  **Observation#2: The initial power control tolerance relates to the IAB MT transmit power accuracy, which in turn could depend on the IAB MT declared transmit accuracy for different power level.**  **Proposal-1: Not specify the absolute PC tolerance requirement.**  **Proposal-2: due to the limited dynamic range of IAB MT, there is no need on the requirement of relative PC tolerance.**  **Proposal-3: Aggregate PC tolerance scenario not apply to IAB node.** |
| R4-2001283 | Qualcomm | **Proposal 2: define IAB-MT class 1 targeting planned deployment scenarios and characterized by a transmitter dynamic range of 20dB**  **Proposal 3: define IAB-MT class 2 targeting unplanned deployment scenarios and characterized by a transmitter dynamic range of 30dB** |
|  |  |  |
|  |  |  |

## 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

**IAB-MT Tx power definition**

All companies seem to agree that the IAB-MT Tx power definition will follow the BS framework in which the power is declared by the manufacturer. For FR2, the beam pairs will be declared similar in the same way as the BS framework.

**Issue 2-1: IAB-MT Tx power definition**

* Proposals
  + Option 1: Through manufacturer declaration using same framework as BS Tx power declaration
* Recommended WF
  + Agree option 1

### Sub-topic 2-2

**Tx Power Dynamic range definition**

For the dynamic range definition there are multiple proposals, ranging from no requirement to having requirements of up to 20dB or 30dB depending on the MT class.

**Issue 2-2: Tx power Dynamic range definition**

* Proposals
  + Option 1: Introduce dynamic range requirement linked to ACLR
  + Option 2: Introduce different dynamic range requirement depending on the MT class
  + Option 3: introduce fixed value of dynamic range (e.g. 5dB as proposed by Ericsson)
* Recommended WF
  + Agree option 2, the values are FFS. Values can be discussed based on target deployment. Different deployment scenarios (e.g. macro vs. “small cell”) would have different channels to parent(LOS vs. NLOS, different shadowing and fading profiles)

### Sub-topic 2-3

**IAB-MT Power Control requirements**

The proposals for power control requirement range from no requirement to re-using the UE requirements with some options of relaxing the UE requirements.

**Issue 2-3: IAB-MT Power Control requirements**

* Proposals
  + Option 1: Do not define any requirement
  + Option 2: Re-use UE requirements
  + Option 3: Take UE requirements as baseline with further simplification (e.g. no aggregate requirement)
* Recommended WF
  + Agree option 2: this would have the least impact to existing infrastructure

### Sub-topic 2-4

**IAB-MT Tx off power**

The proposals on this topic suggest re-using the BS requirements or the UE requirements. BS requirements assume that BS will not cause any self desense while the UE requirements also consider interference to other UEs that could be close by. A requirement is needed to define an on/off time mask.

**Issue 2-4: IAB-MT Tx off power**

* Proposals
  + Option 1: Re-use the BS Tx off power
  + Option 2: Re-use the UE Tx off power
* Recommended WF
  + Agree option 1 – it is unlikely there will be many IAB nodes in close proximity so a relaxed requirement compared to UEs should not cause a rise in overall interference in the system

### Sub-topic 2-5

**IAB MT On-off transient period(time mask)**

The proposals are to either re-use the UE time mask or the BS time mask.

**Issue 2-1: IAB-MT on-off transient period(time mask)**

* Proposals
  + Option 1: Re-use the BS time mask
  + Option 2: Re-use the UE time mask
* Recommended WF
  + Agree option 2

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 2-1: partially agree with option 1 and it’s better to have clear defintion of IAB MT power class, otherwise how to signalling to parent IAB DU and how to the scheduling from CU . Even though for declaration, then it is still necessary for parent IAB DU to know that actual power of child IAB MT.  Sub topic 2-2: agree with option 2 and values could be FFS.  Sub topic 2-3: agree with option 2 to reuse UE requirement as power control accuracy is new to BS and need BS to do muliple power calibration at different power levels I think.  Sub topic 2-4: agree with option 1 to reuse BS OFF power requirement, however frankly speaking it my need some more discussion as FR2 NR BS OFF power is based on 100m dist separation, however for IAB MTs or IAB DUs, 100m is not good deployment as IAB DU/MT is almost at the center of cell center and cell edge, at least in HetNet IAB network, it is not good typical scenarios. Maybe we need to align with BS class mini distance discussion.  Sub topic 2-5: both are fine us, as the transient time is mainly depent on transmitter OFF/ON time, PA ramping up time and PLL settling time, from hardware perspective, it’s the same capability for IAB DU and IAB MT. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #3: IAB Tx Signal Quality

IAB Tx signal quality requirements comprise of frequency error, transmit signal quality(EVM), In-band emissions(IBE) and carrier leakage. In previous meetings there were some agreements on frequency error(re-use absolute requirements for IAB-DU) but some companies wanted to re-open the discussion and further study the requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000618 | CATT | **Observation 1: IAB-MT should compensate the Doppler frequency shift if the IAB is mobile IAB.**  **Observation 2: Two implementations choices can be considered for the clock system of mobile IAB-DU.**  **Observation 3: DU and MT use independent clock systems is the correct implementation.**  **Proposal 1: IAB-MT frequency error requirement is the relative frequency error with the parent IAB.**  **Proposal 2: IAB-DU frequency error requirement should follow BS requirements of different classes.**  **Proposal 3: IAB-MT frequency error requirement should follow UE requirement to be ± 0.1 PPM.** |
| R4-2000965 | Qualcomm | **Transmitted signal quality**  The transmit signal quality requirements are comprised of frequency error and EVM.  Frequency error  Whether the UE requirements will be adopted or an absolute frequency error requirement will be allowed is still under discussion. The OTA requirements applicability should follow the BS framework as discussed in Section 2.2.  EVM  The UE requirements should be re-used and applicability should follow the BS framework as discussed in Section 2.2. |
| R4-2000975 | ZTE | **Observation 1: absolute frequency error for IAB DU and relative frequency error for IAB MT will reuslt in different RF testing setup enviroment.**  **Observation 2: if IAB MT reuse the IAB DU’s reference clock and are targeted to meet the UE relative frequency error 0.1ppm, then absolute frequency error for IAB DU will be maintained within 0.05ppm regardless of different BS class.** |
| R4-2000278 | Samsung | It is still proposed to define as +/- 0.1ppm as relative frequency error for IAB-MT. It may not be necessary to constrain the implementation flexibility. However, as comprise, we can consider both relative and absolute frequency error for IAB-MT. IAB-MT can declare regarding which requirement to be supported. And testability aspect can be discussed separately after core spec completion.  **EVM**  It is suggested to consider QPSK, 16QAM and 64QAM EVM requirement for IAB-MT in FR2. And for EVM itself the requirement the values are the same between IAB-MT and IAB-DU. Hence the same EVM level in percentage for each modulation scheme should be applied for IAB-MT. Regarding the test power condition on EVM for 16QAM and 64QAM IAB-MT could be based on declaration as well. |
| R4-2001434 | Nokia | **Observation 1: If an absolute frequency error would be specified, it would need to be such that the frequency received at the gNB would not deviate more than 4300 Hz from the gNB DL frequency, as otherwise there is a great risk impacting base station demodulation performance.**  **Observation 2: To avoid impact for gNB demodulation performance, IAB-MT absolute frequency error would need to be +/- 0.0075 ppm, which is roughly 6.7 times less than most stringent base station requirement. This is not a reasonable target.**  **Proposal 1: Confirm the original agreement of IAB-MT frequency error being +/- 0.1ppm relative to the DL frequency it receives.**  **Proposal 2: +/- 0.1 ppm frequency error limit will apply for both IAB-MT and IAB-DU, while for IAB-DU it shall be an absolute frequency error requirement.** |
| R4-2001436 | Nokia | **Proposal 7: UE requirements shall be adopted for frequency error and modulation quality. No requirement shall be specified for time alignment error.** |
| R4-2001869 | Ericsson | **Proposal-1: Reuse the item 1 and 2 for relative level of generic mask.**  **Proposal-2: the absolute level could to be removed.**  **Observation #1: There will be x dB PSD difference between IAB MT and DU carrier for shared transceiver if IAB MT and DU were configured with different # of carrier.**  **Observation #2: IAB MT LO leakage power only relative to the maximum transmitted PSD of IAB DU/MT.**  **Proposal-3: LO leakage power should be specified relative to IAB MT output power when IAB MT is configured with the maximum declared power.**  **Proposal-4: the additional suppression due to the uncorrelated LO signal can be implementation specific and so the correlation characteristic of LO signal discussion can be skipped.** |
| R4-2001871 | Ericsson | **Proposal-1: IAB DU frequency error requirement should follow the BS requirement for different BS classes.**  **Proposal-2: Align with RAN1 agreement that IAB parent shall be used as a synchronization source.**  **Proposal-3: IAB MT frequency error should be set as the same with IAB DU frequency error which is related to the IAB DU class.**  **Observation-1: IAB MT frequency error requirement can be set as** ±0.05 **PPM for FR1.**  **Observation-2: IAB MT frequency error requirement can be set as** ±0.05 **PPM for FR2 assuming the similar baseband performance (SSS/PSS) can be achieved for FR2 compared with FR1.** |

## Open issues summary

### Sub-topic 3-1

**IAB-MT Frequency error**

Submitted papers present 2 options, re-use the UE requirements(error relative to signal from parent) or absolute accuracy or introduce an absolute requirement since the IAB-DU will probably re-use an absolute requirement from BS. Analysis in R4-2001434 shows that an absolute requirement for the IAB-MT would lead to very stringent requirement.

**Issue 3-1: IAB-MT Frequency Error definition**

* Proposals
  + Option 1: Adopt UE requirements – 0.1ppm relative to DL(signal from parent)
  + Option 2: Adopt absolute requirement
  + Option 3: Define 2 requirements, one requirement relative to DL(re-use UE requirement) and one absolute requirement, MT has to meet one of them
* Recommended WF
  + Adapt option 2 as baseline, addition of an absolute requirement can be further discussed based on more analysis on impact to existing BS

### Sub-topic 3-2

**IAB-DU Frequency error**

Submitted papers disuss whether an absolute requirement is needed or a relative requirement to parent node could also be used. The argument for the relative requirement is that IAB nodes need to have relatively tight synchronization to the parent node, however, there is no qualitative analysis shown. In previous meetings it was agreed to use an absolute requirement because a relative requirement would cause a large frequency error in case of multiple hops.

**Issue 3-2: IAB-DU Frequency Error definition**

* Proposals
  + Option 1: Adopt relative requirements to DL (signal from parent)
  + Option 2: Adopt absolute requirement, same as BS
* Recommended WF
  + Adapt option 2 as baseline, further discuss whether a relative requirement can be introduced under certain conditions

### Sub-topic 3-3

**IAB-MT EVM**

EVM requirements are the same for UE and BS, hence re-using these numbers is straighforwards.

**Issue 3-3: IAB-MT EVM**

* Proposals
  + Option 1: Adopt UE requirements for all modulations currently defined
* Recommended WF
  + Agree Option 1

### Sub-topic 3-4

**IAB-MT IBE**

Papers treating these topics suggest either re-using the UE requirements or re-using the requirements with some modifications because the IAB-MT is not expected to transmit at low power.

**Issue 3-4: IAB-MT IBE definition**

* Proposals
  + Option 1: Adopt UE requirements as they are in 101-1 and 101-2
  + Option 2: Adopt UE requirements with simplifications as proposed in R4-2001869
* Recommended WF
  + Adopt Option 2 – simplified requirement should cover the expected working point of IAB-MTs

### Sub-topic 3-5

**IAB-MT Carrier Leakage**

There is only 1 contribution(R4-2001869)explicitly discussing the carrier leakage proposing to define the requirements as below:

**Issue 3-5: IAB-MT Carrier leakage definition**

* Proposals
  + Option 1: LO leakage power should be specified relative to IAB MT output power when IAB MT is configured with the maximum declared power.
* Recommended WF
  + Adopt Option 1, actual level to be specified to be discussed

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 3-1: support option 1 as this is aligned with RAN1 assumption parent node work as sync source.  Sub topic 3-2: support option 2 to reuse the BS requirement.  Sub topic 3-3: agree with option 1 and should further consider MPR is allowed or not for IAB MT as this is not allowed for QPSK/16QAM for FR2 BS. Meanwhile detailed EVM measurement in Annex is also different for IAB DU and IAB MT, as there are sync signal [ssb,csi-rs]provided for IAB DU testing and for IAB MT, we think some sync signal should be provided.  Sub topic 3-4: no strong view on that requirement  Sub topic 3-5: as same as IBE requirement. |

### 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 |
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## 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:* |

*Suggestion on WF/LS assignment*

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### CRs/TPs

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

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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)

## Summary on 2nd round (if applicable)

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

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

# Topic #4 IAB-MT Beam Correspondence

Beam correspondence has been discussed mainly in the previous meeting, it was agreed not to define any requirement for the IAB-DU(similar to BS) and there were 2 options left for the IAB-MT:

**1.** MT declares UL EIRP range in different directions, MT picks UL beam based on received DL signals(reference signal) and has to meet EIRP in the direction it received from with TBD accuracy relative to declared EIRP capability in that direction

Functionality to be tested:

1. MT detects best DL beam with some accuracy

2. MT applies detected direction to the UL Tx beam

3. MT needs to transmit UL beam in the direction applied form step 2.

Accuracy would have to be derived based on combined accuracy/error from all 3 steps

**2.** MT declares UL EIRP and EIS range in different directions, functionality that MT can pick the right UL direction based on DL signals is assumed to be implicit if MT meets UL EIRP and EIS in the declared directions

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000980 | ZTE | **Observation: there are no BC requriement defined for FR1 NR UE.**  **Proposal: to adopt the option 2 for IAB MT BC requirement.** |
| R4-2000901 | CMCC | Proposal: introduce beam correspondence requirements for IAB MT, whether it is mandatory in all cases can be further studied. |
| R4-2001281 | Qualcomm | **Proposal 1: define beam correspondence requirement for IAB-MT**  **Proposal 2: beam correspondence requirement is tested along the declared beam peak directions of the IAB-MT. Manufacturer claimed EIRP level in those same directions shall be met with an accuracy of [±TBD]** **dB** |
| R4-2001187 | Ericsson | **Observation 3: The beam correspondence requirement is only applicable for handheld UEs which need to use UL beam sweeping to meet spherical coverage.**  **Observation 4: The beam correspondence requirement is not applicable for fixed UEs.**  **Observation 5: The basestation coverage depends on the intended cell shape and is declared by the manufacturer.**  **Observation 6: The basestation must provide the declared power in a tested direction (within the declared coverage range) without any kind of DL beam sweeping.**  **Observation 7: Existing RF requirements verify that the BS is able to direct a beam in an intended direction and receive a beam in an intended direction.**  **Proposal 1: Do not introduce a beam correspondence requirement for IAB.** |
| R4-2001434 | Nokia | **Proposal 1: Beam correspondence requirement is adopted to IAB-Node RF core specification by adapting the IAB-MT OTA radiated output power requirement with different accuracy compared to current BS RF requirements.**  **Proposal 2: IAB-MT shall be capable of obtaining beam correspondence both based on SSB-only and CSI-RS only.**  **Observation 1: While conformance test details shall be left for performance part, it seems reasonable to consider how to ensure that IAB-MT used the configured DL reference signal for beam correspondence.** |
| R4-2001706 | Huawei | **Observation 1:** The IAB-MT node has directional antenna as such will have no spherical coverage requirement, so both the spherical coverage aspect and the beam correspondence metric are not suitable (in current form) for IAB\_MT  **Observation 2**: BS EIRP accuracy requirement therefore offers a better level of beam power accuracy in a specified direction than the UE beam correspondence specification.  **Observation 3:** the directional EIS minimum sensitivity requirement demonstrate the BS is capable of finding the direction of the incoming signal.  **Observation 4:** The ability to set the transmitter direction based on the RX direction is not an RF requirement.  **Proposal 1:** No beam correspondence requirement is needed for IAB\_MT the BS RF requirements are sufficient. |

## Open issues summary

The open issues are whether to define an explicity BC requirement for the IAB-MT, and if yes, what should the requirement be.

### Sub-topic 4-1

**IAB-MT Beam correspondence requirement definition**

Multiple papers discuss the definition of the requirements with proposals ranging from defining a requirement to not defining any requirement. Papers proposing to define a requirement do not have any concrete proposals on how to define the requirement.

**Issue 1-1: IAB-MT Beam correspondence requirement definition**

* Proposals
  + Option 1: Do not define any requirement
  + Option 2: Define explicit requirement for beam correspondence on the IAB-MT
  + Option 3: Do not define any concrete requirement, it will be implicitly tested by IAB-MT meeting the declared EIRP by picking the transmit direction/beam based on the received signal direction
* Recommended WF
  + Adopt Option 3, this will ensure that desired functionality is tested. FFS how to include this in the specifications

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 4-1: support option 1 to not define any BC requirement for IAB MT as there are almost no rational to have beam sweeping from it’s parent IAB DU as this is almost fixed network. |

### 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** |
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## 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:* |

*Suggestion on WF/LS assignment*

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### CRs/TPs

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

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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)

## Summary on 2nd round (if applicable)

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

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

# Topic #5: IAB-MT Rx-Tx Switching time

asfd

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001433 | Nokia | **Observation 1: RAN1 has developed a framework on how the switching time between MT and DU can vary and how it is reported to the parent node.**  **Proposal 1: Minimum requirements shall not be specified for switching time between IAB-MT and IAB-DU.** |
| R4-2000976 | ZTE | **Proposal 1: RAN4 should firstly discuss whether in-band IAB and out of band IAB should be both supported in Rel-16.**  **Proposal 2: in-band IAB could be prioritized to be supported in Rel-16.**  **Proposal 3: IAB DU and MT is supposed to support the same channel bandwidth.**  **Proposal 4: RAN4 should discuss MIMO layer adaption between IAB DU and MT.**  **Proposal 5: not to define switching delay in IAB RF part and define the switching delay in RRM part.** |
| R4-2001870 | Ericsson | **Proposal-1: There is no need to define additional latency requirements between the DU to MT switching.** |

## Open issues summary

The open issue is whether the IAB-DU to IAB-MT switching delay should be defined or not

### Sub-topic 1-1

**IAB-DU to IAB-MT swicthing delay requirement**

Contributions submitted on this topic propose not to define any RF requirement for the switching delay.

**Issue 5-1: IAB-DU to IAB-MT switching delay requirement definition**

* Proposals
  + Option 1: Do not define any RF requirement
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 5-1: support option 1 to not define any RF requirement. the maximum switching timing between IAB DU MT is less than the guard period beteen DL and UL, therefore we think 3 symbols in FR2 might be sufficient which has already included in RAN1 agreement.  FR1 needs some further analysis at least from RAN4 internally. |

### 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** |
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## 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:* |

*Suggestion on WF/LS assignment*

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### CRs/TPs

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

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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)

## Summary on 2nd round (if applicable)

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

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

# Topic #6: IAB-MT Unwanted Emissions

asfd

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000965 | Qualcomm | **Unwanted emissions**  The UE unwanted emissions are comprised of the occupied BW, out of band emissions and spurious emissions.  Occupied BW  The occupied BW requirement is the same for UE and BS and is defined as a directional requirement. The IAB-MT requirement should be the same and follow the applicability as discussed in Section 2.2.  Out of band emissions  UE out of band emissions are comprised of SEM and ACLR. The SEM should follow the UE requirements. The ACLR will be defined based on the outcome of the co-existence study. These requirements are defined as TRP.  Spurious emissions  Spurious emissions should re-use the UE requirements. These requirements are also defined as TRP. |
| R4-2001436 | Nokia | **Proposal 8: Adopt an OBUE requirement with levels matching PC1 UE requirement, i.e. -5 dBm/MHz closest to the transmission and at offsets greater than 10% of contiguous transmission BW -13 dBm/MHz.**  **Proposal 9: Adopt absolute ACLR requirement of -20 dBm/MHz.**  **Proposal 10: Adopt 1.5 GHz OBUE boundary similar to BS type 2-O.** |
| R4-2000279 | Samsung | **Proposal 1**: OBW requirement can be the same for IAB-MT and IAB-DU.  **Proposal 3**: UE emission level can be applied for IAB-MT for operating band emission and spurious emission. |

## Open issues summary

The definition of the unwanted emissions requirements(OWB, out of band emissions, spurious emissions) is still open. The discussion revolves around whether the UE emission levels should be re-used or the BS type of emission limits should be used.

### Sub-topic 6-1

**IAB-MT Unwanted emissions**

The unwanted emissions requiremetns are comprised of: Occupied Bandwith, Out of band emisisons and Spurious emissions. The IAB-MT will behave more like a UE in the network and will transmit and recieve at the same time as a UE.

**Issue 2-1: Definition of IAB-MT Unwanted emissions**

* Proposals
  + Option 1: Re-use the UE emissions
  + Option 2: Re-use the Bs emissions
* Recommended WF
  + Adopt Option 1: Re-use the UE emissions

Re-using the UE emissions should be the simplest solution from a regulatory and practical point of view since the IAB-MT will behave like a UE in the network.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 6-1: option 1 to reuse the UE in-band emission requiement is more relaxed and it’s fine to adopt that.  Here one example for n258 with 400MHz, comparing with 30dBm [typical WA BS with 5-7dBm per RF chain within analog antenna array] BS and UE mask, then mask for BS and UE is the same, only difference is additional mask defined for BS is between 2\*BW from carrier edge and band edge+1.5GHz.    If we further look at the Cat B spurious emission requirement from FR2 NR BS [down to -25dBm] and NS\_201 for 23.6-24GHz, [-8dBm for 200MHz ], indeed it’s the same issue for protecting EESS band, for IAB MT with A-MPR, therefore lower spurious emission could be achieved. However for BS, only fitler atteunation is considered for -25dBm spurious emission.  If A-MPR is also allowed for IAB MT, then maybe follow the FR2 UE additional spurious emisison is fine, otherwise it’s better to follow the BS Cat B spurious emission requirement. |

### 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 |
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## 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:* |

*Suggestion on WF/LS assignment*

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### CRs/TPs

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

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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)

## Summary on 2nd round (if applicable)

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

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

# Topic #7: Other IAB-DU Tx Requirements

IAB-DU Tx requirements have not been discussed extensively because the IAB-DU serves the functionalaty of the BS and should behave just like a BS such that the fact that it is an IAB node is transparent to UEs. Hence, most of the BS requirements will be re-used for the IAB-DU

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001436 | Nokia | **Proposal 1: Re-use BS type 2-O transmitter requirements for IAB-DU for all transmitter requirements in FR2.** |
| R4-2000964 | Qualcomm | |  |  | | --- | --- | | **RF Requirement** | **IAB-DU** | | Radiated transmit power – only OTA | Import from BS specs | | IAB output power | Import from BS specs | | Output power dynamics | Import from BS specs | | Transmit ON/OFF power | Import from BS specs | | Transmitted signal quality – Frequency Error | Under discussion, see below | | Transmitted signal quality – EVM | Import from BS specs | | Transmitted signal quality – TAE | Import from BS if CA is defined | | Unwanted emissions | Import from BS specs | | Transmitter intermodulation | Import from BS specs | | OTA sensitivity level | Import from BS specs | | Reference sensitivity level | Import from BS specs | | In-band selectivity and blocking | Import from BS specs | | OTA out-of-band blocking | Import from BS specs | | OTA receiver spurious emissions | Import from BS specs | | OTA receiver intermodulation | Import from BS specs | | OTA in-channel selectivity | Import from BS specs | | Beam correspondence | Not needed as agreed in [1] | |
| R4-2000900 | CMCC | Paper proposes to re-use all the BS conducted requirements for the IAB-DU for FR1 with the exception of on/off power transient that should be based on UE specs and power control that is FFS.  For the radiated spec(type 1-O or type 1-H) it is proposed to re-use the BS radiated requirements |

## Open issues summary

The IAB-DU Tx requirements are still open, the proposals are to re-use the BS specs with a few exceptions.

### Sub-topic 7-1

**Definition of IAB-DU Tx requirements other than frequency error**

Apart from the frequency error requirement that was discussed separately, all other requirements can be re-used from the BS specs. It is not clear why it was proposed in R4-2000900 to use the UE specs for the on/off power transient when the BS specs can also be re-used

**Issue 7-1: Definition of IAB-DU Tx requirements other than frequency error**

* Proposals
  + Option 1: Re-use the BS requirements
* Recommended WF
  + Adopt Option 1

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 7-1: support option 1 for IAB DU reuse BS requirement. |

### 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 |
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## 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:* |

*Suggestion on WF/LS assignment*

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### CRs/TPs

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

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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)

## Summary on 2nd round (if applicable)

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

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