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

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

**Agenda item:** 8.5.2

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for RAN4#94e\_ #81\_NR\_IAB\_Co-existence

**Document for:** Information

# Introduction

The topic area covered in this document is NR IAB Co-existence. The main technical topics covered are requirements for

* IAB-MT ACS
* IAB-MT ACLR and IAB-MT minimum output power
* IAB-MT in-band blocking

The discussion additionally covers capturing coexistence study assumptions and results.

Candidate target of email discussion for 1st round

* Agree IAB-MT ACS
* Agree the way to capture co-existence assumptions and results
* Find the way forward for other requirements

Assuming the 1st discussion round reaches its targets, second round can concentrate on TPs to TR and TS, and additionally to WF documents, if needed. Guidance for second round will be provided after the first round is finished.

# Topic #1: IAB-MT ACS

This topic covers IAB-MT ACS requirement, including wanted and interferer signal levels for both FR1 and FR2.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000282 | Samsung | **Observation 1:** Previously agreed ACS [23.5]dB same as BS for <37 GHz  ACS [22.5]dB same as BS above >37 GHz which were sent to ITU WP5D were rounded up to integers and are 24 dB and 23 dB in rel-15 specifcation.  **Proposal 1:** IAB-MT ACS of 24 dB for 24.24 – 33.4 GHz  **Proposal 2:** IAB-MT ACS of 23 dB for 37 – 52.6 GHz  **Proposal 3:** Wanted signal level is REFSENS+[14dB]  **Proposal 4:** Interference signal level is REFSENS+[36.5] for 24.24 – 33.4 GHz  **Proposal 5:** Interference signal level is REFSENS+[35.5] for 37 – 52.6 GHz |
| R4-2001873 | Ericsson | **Observation-1:** The R16 IAB WI need be hardware prepared for FDM/SDM operation which means the ACS for IAB MT and IAB DU shall to be same.  **Proposal-1:** The ACS requirement should be based on BS spec.  **Proposal-2:** the additional reference channel with PDSCH should be specified in additionally  **Proposal-3:** use the BS type ACS for IAB MT on FR1. |
| R4-2001435 | Nokia, Nokia Shanghai Bell | **Proposal 5:** ACS for IAB-MT shall be   * 23.5 dB for frequencies 24.25 – 29.5 GHz and * 22.5 dB for frequencies 37 – 40 GHz |

## Open issues summary

To facilitate the discussion the sub-topics are separated between FR1 and FR2. Additionally, in the proposals there was clear alignment for ACS value in FR2 whereas for there is no alignment for wanted signal level. Therefore, discussion for ACS value and wanted signal are separated.

In FR1 only a single proposal to re-use BS requirements was made, and therefore discussion can concentrate on whether this proposal can be agreed.

### Sub-topic 2-1 IAB-MT ACS value in FR2

In this sub-topic IAB-MT ACS value is discussed. All companies are aligned with the earlier agreed [23.5] for 28 GHz region and [22.5] dB for 39 GHz region. However, it has been observed that in rel-15 specification these values have been rounded upwards to integer values. Therefore, same approach is the recommended WF here.

**Issue 2-1: IAB-MT ACS value in FR2**

All company proposals are close to each other, only discrepancy is whether the ACS value is rounded to an integer value

* Recommended WF

Agree the following values, where ACS is rounded to an integer

* IAB-MT ACS of 24 dB for 24.24 – 33.4 GHz
* IAB-MT ACS of 23 dB for 37 – 52.6 GHz

### Sub-topic 2-2 IAB-MT ACS relationship with sensitivity in FR2

In this sub-topic the wanted signal power level for ACS in FR2 is discussed. Two main options can be seen from the contributions, either re-using the UE or BS signal level. The proposals are in square brackets as there is a relationship to receiver sensitivity which has not been agreed yet.

**Issue 2-2: Wanted signal power level for ACS**

* Proposals
  + Option 1: [REFSENS + 6 dB]
  + Option 2: [REFSENS + 14 dB]
* Recommended WF
  + Agree option 1
  + Additionally there was a proposal to specify PDSCH reference channel. Moderator recommendation is to leave this to reference sensitivity discussion.

### Sub-topic 2-3 IAB-MT ACS value and wanted signal power level for FR1

In this sub-topic ACS value and wanted signal power for FR1 is discussed. Only a single company has a proposal for IAB-MT ACS for FR1. Therefore, the discussion can concentrate on whether the proposal can be agreed.

**Issue 2-3: IAB-MT ACS value and wanted signal power level for FR1**

* Proposals
  + Re-use BS ACS for OTA requirements, i.e. 45 dB with wanted signal level at [refsens + 6 dB]
* Recommended WF
  + Agree the proposal for both OTA and conducted requirements.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 2-1: need to consider together with IBB as this are related requirements, ususally IBB interference power leve is 9dB higher than ACS interfernece power level. As observed in the R4-2000978 with 40m separation between parent IAB DU and child IAB MT in layout 1, the maximum input power of wanted signal could be much higher than IBB power levels, if there are no maximum input power for IAB MT defined and limited IBB power levels, then mini distance between parent IAB DU and child IAB MT should be carefully designed, otherwise this will misleading the network deployment.  Sub topic 2-2: agree with option 1: +6dB degradation for IAB MT REFSENS for ACS requirement  Sub topic 2-3: the same comments as sub-topic 2-1. this need more discussion on IAB MT class or IAB DU class with child IAB MT. |
| Samsung: | Sub topic 2-1: support option 1  Sub topic 2-2: prefer option 2, the co-channel interference observed by IAB-MT reception would be higher than gNB. Hence the test condition should be consider lager delta offset to REFSENS compared with gNB.  Sub topic 2-3: it seems RAN4 have tentative agreement on FR1 ACS as 33dB captured in R4-1913052. Even though this is marked as yellow for further check, there are two companies provide the simulation results show that with 33dB ACS there is no co-existence issue for IAB-MT as victim. |
| Ericsson | Sub topic 2-1: Proposal is ok, as following the LS is ok and should follow the rel-15 BS spec.  Sub topic 2-2: Option 1 is ok, it is also ok to discuss Reference channel in REFSENS:  Sub topic 2-3: Proposal is ok. |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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# Topic #2: IAB-MT ACLR and minimum power

In this topic IAB-MT ACLR and minimum power is discussed for both FR1 and FR2.

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000972 | ZTE Corporation | **Observation:** ACIR 35dBc could meet both cell average and cell edge 5% throughput loss.  **Proposal 1:** define FR1 IAB MT ACLR as 30dBc; **Proposal 2:** define FR1 IAB MT min output power as 10Db in TRP. |
| R4-2000973 | ZTE Corporation | **Proposal 1:** IAB MT min output power as 10dBm in TRP.  **Proposal 2:** ACLR=17dBc for 24.25-33.4GHz and ACLR=16dBc for 37-52.6GHz. |
| R4-2001432 | Nokia, Nokia Shanghai Bell | **Observation 1:** Co-existence performance can be guaranteed in layout 2 with 16 Db power control range and 16 dBc ACLR.  **Proposal 5:** Adopt 17 dBc as IAB-MT ACLR minimum requirement.  **Proposal 6:** Adopt 20 dBm as minimum output power for IAB-MT. |
| R4-2001280 | Qualcomm Incorporated | **Observation 1:** 20Db IAB-MT ACLR is required for the case of -20dBm minimum output power at IAB-MT  **Observation 2:** 24dB IAB-MT ACLR is required for the case of -10dBm minimum output power at IAB-MT  **Observation 3:** ACLR requirement shall be coupled with proper minimum output power to guarantee appropriate functioning of the IAB system  **Observation 4:** Necessary minimum output power depends on the target deployment scenario and shall be guaranteed by the dynamic range of the IAB-MT transmitter  **Proposal 1:** define 24dB IAB-MT ACLR requirement in FR2 |
| R4-2001865 | Ericsson | **Observation-1:** From co-existing perspective, IAB MT reuse the same ACLR with IAB DU will give advantage on the regulator acceptance.  **Observation-2:** Setting a different number of ACLR on IAB MT than BS will forbid the IAB MT operate on downlink time slot which significantly reduce the IAB deployment flexibility.  **Proposal-1:** choose the ACLR to be the same with BS ACLR for both FR1 and FR2. |

## Open issues summary

To facilitate the discussion the sub-topics are separated between FR1 and FR2. In both FR1 and FR2 the proposals range from the ACLR values in UE requirements to the values in BS requirements, but in FR2 also a compromise between them is proposed.

### Sub-topic 2-1: IAB-MT ACLR and minimum output power in FR2

In this sub-topic IAB-MT ACLR and minimum output power in FR2 is discussed. The proposals from individual companies have a wide range and no option has a clear majority of supporting companies. As the proposals have such a wide range, willingness to compromise is needed to reach a decision.

**Issue 2-1: IAB-MT ACLR and minimum output power in FR2**

* Proposals
  + Option 1: 17 dBc with [10…20] dBm minimum power
  + Option 2: 28 dBc with TBD minimum output power
  + Option 3: 24 dBc with TBD minimum output power
* Recommended WF
  + As a compromise to move forward, agree option 3 and discuss what related minimum power is needed.

### Sub-topic 2-2 IAB-MT ACLR and minimum power in FR1

In this sub-topic IAB-MT ACLR and minimum output power in FR1 is discussed. Two proposals were made, one suggesting re-using ACLR from UE requirements and another re-using BS requirements.

**Issue 2-2: IAB-MT ACLR and minimum power in FR1**

* Proposals
  + Option 1: 30 dBc ACLR with 10 dBm minimum output power
  + Option 2: 45 dBc ACLR with TBD minimum output power
* Recommended WF
  + Discuss how to move forward

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 2-1: prefer 17dBc for FR2 IAB MT ACLR as much more beamforming gain and intreference mitigation could be achieved by the narrow beamwidth of IAB MT compared with legacy NR UE.  Sub topic 2-2: prefer 30dBc for FR1 IAB MT and similar comments as before. |
| Samsung | Sub topic 2-1/2-2: this relates to MT class discussion. |
| Ericsson | Sub topic 2-1: Option 2 is preferred as IAB MT can operate on downlink time slot and also FDM/SDM operation with access link. We think TX min power can be discussed with Tx dynamic range.  Sub topic 2-2: option 2 is ok for us, We think TX min power can be discussed with Tx dynamic range.  Also related to ACLR, ACLR absolute limit is needed. It related to the emission mask definition. |

### 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 |
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| YYY | Company A |
| Company B |
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# Topic #3: IAB-MT in-band blocking

In this topic IAB-MT in-band blocking is discussed for both FR1 and FR2. In FR1 there are two proposal, either not to specify the requirement or re-use BS requirements. In FR2 company proposal have a wide range from re-using current UE and BS requirements either as is or with increases interference power level. One proposal is to change to concept so that interference level is a fixed power level and not related to sensitivity. One proposal is also to not specify in-band blocking but leave the verification to Rx dynamic range.

As the proposals have such a wide range, willingness to compromise is needed to reach a decision.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000282 | Samsung | **Proposal 1:** Wanted signal level is REFSENS+[14dB]  **Proposal 2:** Interference signal level is REFSENS+[36.5] for 24.24 – 33.4 GHz  **Proposal 3:** Interference signal level is REFSENS+[35.5] for 37 – 52.6 GHz |
| R4-2000977 | ZTE Corporation | **Proposal 1:** to define the FR1 IAB MT receiver dynamic range requirement based on the wanted signal instead of IBB power level.  **Proposal 2:** to define two reference power level for IAB MT with higher SNR. |
| R4-2000978 | ZTE Corporation | **Proposal 1:** to define the FR2 IAB MT receiver dynamic range requirement based on the wanted signal instead of IBB power level.  **Proposal 2:** to define two reference power level for IAB MT with higher SNR. |
| R4-2001282 | Qualcomm Incorporated | **Observation 1:** The entity of the IAB-MT in-band blocking requirement depends on the distance between the deployed IAB network and the NR network  **Observation 2:** IAB-MT interference at LNA input of gNB receiver is smaller than -69dBm for at least 99.4% of the cases at all analysed distances.  **Proposal 1:** Define radiated in-band blocking requirement at IAB-MT as -45dBm |
| R4-2001432 | Nokia, Nokia Shanghai Bell | **Observation 2:** IAB-MT transmissions do not cause significant degradation to rel-15 gNB receiver performance with the used assumptions.  **Observation 3**: IAB-MT receiver need to be able to tolerate higher interferer levels than rel-15 gNB receiver.  **Proposal 1:** The blocking power evaluation is based on 99% point of the CDF.  **Proposal 2:** Compared to FR2 base station, IAB-MT in-band interferer power level is increased by 6 dB.  **Proposal 3:** The details of in-band blocking requirement are confirmed only after the requirement for reference sensitivity is agreed. |
| R4-2001873 | Ericsson | **Observation-2:** The blocker level for FR2 with 50 meter separation distance is equivalent to current OTA blocking level in BS spec for FR2.  **Observation-3:** The blocker level for FR1 with 40 meter separation distance is equivalent to current OTA blocking level in BS spec for FR1.  **Proposal-4:** Reuse the IAB DU in-band blocking for IAB MT on FR2.  **Proposal-5:** Reuse the IAB DU in-band blocking for IAB MT on FR1.  **Proposal-6:** recommended physical separation distance is 50m for FR2 and 40m for FR1. |

## Open issues summary

### Sub-topic 3-1 In-band blocking requirements in FR2

**Issue 3-1: In-band blocking requirement in FR2**

* Proposals
  + Option 1: Do not specify in-band blocking, impact to be covered by Rx dynamic range
  + Option 2: Based on UE requirements
  + Option 3: Based on BS requirements
  + Option 4: increase interference level compared to current requirements, including the possibility of fixed interference power level
    - Wanted signal level TBD
* Recommended WF
  + Agree in-band blocking requirement is required.
  + Agree conclusions from simulations are based on 99% point of CDF
  + Discuss how to move forward with the signal levels

### Sub-topic 3-2 In-band blocking in FR1

In this sub-topic in-band blocking in FR1 is discussed.

**Issue 3-2: In-band blocking in FR1**

* Proposals
  + Option 1: Do not specify in-band blocking, impact to be covered by Rx dynamic range
  + Option 2: Re-use BS requirements, i.e.
    - Wanted signal level is EISREFSENS + [6dB] for OTA requirements
    - Wanted signal level is REFSENS + [6dB] for conducted requirements
    - Interference signal level is (-43,-38,-35) - ΔOTAREFSENS dBm, depending on class for OTA requirements
    - Interference signal level is (-43,-38,-35) dBm, depending on class for conducted requirements
* Recommended WF
  + Agree option 2 with the possibility to select only a subset of the interference signal levels depending on the outcome of the power class discussion.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 3-1: it’s fine to define the IBB blocking requirement for FR2 IAB MT, as mentioned before mini distance between parent IAB DU and child IAB MT should also be part of discussion. The values should be further studied. As there are no maximum input power defined for IAB MT , then IAB MT ‘s RX dynamic range is limited by REFSENS and IBB blocking. If the maximum input power for wanted signal is the same as IBB power level and MT IBB powerl level is the same as IAB DU, considering 4.7dB noise floor increas due to ACS interfernece power levels and co-channel interference interference rise 0~5dB which is simulated during FR2 dynamic range requirement discussion, SNR for wanted signal could be EIS+33dBc-10\*log10(10^(4.7/10)+10^(5/10))-10\*log10(BW)-NF= -1+33-7.9=24.1dB which seems that 256QAM can still be supported.  Sub topic 3-2: similar comment can be applied for FR1 IAB MT, then maximum input power for FR1 IAB MT is -43dBm, then SNR for wanted signal could be -43dBm- (-101.7dB for 5MHz)-10\*log10(10^(4.7/10)+10^(20/10))=38.7dB where 20dB is considered in the Rx dynamic range intra-channel interference rise compared with noise floor.  ALL IN ALL, be careful to specify the IAB MT class or mini distance between parent IAB DU and child IAB MT. We cannot exceed that boundary set by IBB. |
| Samsung | Sub topic 3-1: our proposal on in-band blocking can be covered in option 4. Suggestion from our side is that both wanted signal and interference signal should be anchored with certain offset on REFSENS level. Regarding how to move on with interference level it should be cautious to make decision with 99% CDF, since the interference point to IAB reception with the same direction at extreme high level should be quite a corner case especially for fixed IAB. Our proposal is to verify the in band selectivity requirement on relative high wanted and interference condition for both ACS and in-band blocking. And the interference outside wanted channel within adjacent channel and IBB range can be flat. |
| Ericsson | Sub topic 3-1: Option 3 is preferred with additional min separation distance to other operator. 99% CDF point is ok for us.  Sub topic 3-2: Option 2 of reusing BS req is ok for us. |

### CRs/TPs comments collection

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

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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# Topic #4: Capturing co-existence study background and results

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

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001708 | Huawei | Proposes a TP capturing antenna assumptions to the TR |
| R4-2001025 | Ericsson | Proposes a TP capturing antenna assumptions to the TR |
| R4-2001432 | Nokia, Nokia Shanghai Bell | Proposes a TP capturing simulation assumptions and company results to the TR |

## Open issues summary

### Sub-topic 4-1 Capturing simulation assumptions and results

**Issue 4-1: Capturing simulation assumptions and results**

* Recommended WF
  + Collect comments on the TPs with the aim to merge the content of the submitted contributions and capture to the TR Section 4.3.2 can be used for comments to individual TPs.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| ZTE | Sub topic 4-1: propose to postpone the TP to next meeting until the agreement is clear and we have TP implemented in one shot. |
| Samsung | Sub topic 4-1: all such kind of background information definitely is needed for TR. However, at least according to our observation it seems the IAB node antenna assumption are not reflected explicitly or clearly in all TPs on antenna assumption. |
| Ericsson | We need capture the simulation assumption and result, this will depend on the consensus of TP comments below. |

### 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** |
| R4-2001708 | Ericsson: We suggest dividing into parameters part and model part. The model is reused for all parameter sets. Also, we need to describe how parameters are selected to secure that the model produces correct result. See out text proposal |
| Company B: |
|  |
| R4-2001025 | Company A: |
| Company B: |
|  |
| R4-2001432 | Ericsson: we see Nokia IBB result is similar with Ericsson result if we understand correct, so in the end, it may be good to capture the different IBB level in a Table or some simple observation in TP. |
| 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:* |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **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*

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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”* |