**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.

### Sub-topic 2-4 IAB-MT ACS and interference signal power level

**Issue 2-4: IAB-MT ACS and inteference signal power level for FR2**

* Proposals
  + Option 1: Re-use BS interference signal level
  + Option 2: Interference signal level is REFSENS+[36.5] for 24.24 – 33.4 GHz

Interference signal level is REFSENS+[35.5] for 37 – 52.6 GHz

* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | Sub topic 2-1: ok  Sub topic 2-2: proposal is ok, ACS should test filtering not power levels (blocking tests the high power capability) so to some extent level is not important as long as Rx is linear – so lower power is safer.  Sub topic 2-3: ok  Sub topic 2-4: Linked to sub-topic 2-1 and 2-2, if we use 23/24 and refsens +6dB then option 1 is correct |

### 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 |
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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

|  |  |  |
| --- | --- | --- |
| **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 EIRP.  **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. |
| R4-2001897 | Ericsson | The OTA ACLR absolute limit is specified in table 9.7.3.4-2.  **Table 9.7.3.4-2: *IAB MT type 2-O* ACLR absolute limit**   |  |  | | --- | --- | | **IAB class** | **ACLR absolute limit** | | Wide area IAB | -13 dBm/MHz | | Medium range IAB | -20 dBm/MHz | |

## 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.

**Issue 2-2: IAB-MT ACLR absolute limit in FR2**

* Proposals
  + Option 1: -13 dBm/MHz for wide area IAB
* Recommended WF

### 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | Sub-topic 2-1: The ACLR and the minimum power are linked so difficult to agree ACLR with a TBC for minimum power. We favour a higher minimum power and if this means higher ACLR value then that’s ok.  Sub-topic 2-2(new): This is discussed in Topic area #82 (topic #6) also I think. It should be consistent with the decision on OBUE – but this value is ok if that is the case.  Sub-topic 2-2: As with FR2 we favour tougher ACLR and higher minimum power. FR1 has not been discussed so much so far. Whilst it is important maybe we should focus on FR2 in emeeting? |

### 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 |
|  |

# 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** |
| Hauwei | Sub-topic 3-1: In-band blocking is necessary (assuming its higher level than ACS) so rule out option 1. As gain may vary it’s important that interferer is linked to antenna gain (rule out option 4) for BS this is the case for UE not, as antenna gain is in range of BS it makes more sense to use BS approach. BS and UE blocking levels are a few dB different (2.5), but the wanted power for UE is much greater (8dB) – assuming blocking comes from a 3rd order product the BS requirement is slightly tougher (2\*2.5<8). Whilst the blocking pdfs are not the same as BS, this seems however the best option to adopt.  Sub-topic 3-2: 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.*

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

# 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

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | 1432 and the antenna TP’s can be treated almost independently, depending on antenna papers need to ensure antenna info is not repeated.  Antenna papers: They contain same information but using different approach, either world work (obviously my choice is my own paper). If we use 1025 a few comments are: does not list the parameters only gives instructions how to handle them – maybe this is ok but needs to align with rest of content (maybe from 1432) but my preference is all the antenna stuff in one place. It does not clearly state the reliance on element aperture and element spacing which is important. The flow chart may be taking the instructions a step to far (this is TR for IAB after all), the same thing could be stated more simply in text or bullets I think.  1432 (comments on TP only) – simulation assumptions (have we not already agreed this? - its difficult to keep track as we have no official draft TR yet) are ok. Test results we usually capture individual company’s results in annexes rather than main body and just put a summary in the main body. The results are Nokia’s and are what they are but the text in between starts to summarize to a conclusion. Analysis should be presented once we have captured all company results and agreed a conclusion. Also I think we need to make ACIR and blocking simulations a bit more separate, this is blocking but it’s not clearly in its own section – again this may be easier when we have an approved draft. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2001708 | Company A: |
| Company B: |
|  |
| R4-2001025 | Company A: |
| Company B: |
|  |
| R4-2001432 | 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”* |