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

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

**Agenda item:** 12.2

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [98-bis-e][328] LS\_reply\_ITU-R

**Document for:** Information

# Introduction

This e-mail thread covers two ongoing LS exchanges with different ITU-R WPs:

1. At last RAN plenary RAN4 was tasked (RP-210789) to consider a test signal proposed by ITU-R WP 1C in R4-2100004.
2. At last RAN4, antenna parameters were sent in LS to ITU-R WP 5D. In R4-2106354 additional information is provided to better reflect base stations deployed in networks. The intention is to send the information to ITU-R WP 5D.

This thread is split up into two corresponding topics:

1. Test signal
2. Antenna model extension

# Topic #1: Test signal

In R4-2100004, ITU-R WP 1C request RAN4 to consider the feasibility to introduce a test signal to facilitate in-filed OTA testing of unwanted emission.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2106356 | Ericsson | The intention with this contribution is to initiate the discussion in RAN4 about the request from ITU-R. A collection of RAN4 aspects to consider before responding to ITU-R WP 1C is presented in the contribution. At the end on the contribution a draft LS is provided to stimulate the discussion. |

## Open issues summary

### Sub-topic 1-1

Sub-topic description: Collect more relevant technical information required to better understand the test signal concept to be able to analyze the RAN4 impact.

**Issue 1-1: RAN4 specific issues related to proposed test signal**

* Identify any additional information to be requested from ITU-R WP 1C by RAN4, in order to better understand the test signal
  + Comments are welcome
* Recommended WF
  + Collect questions and open issued in a draft LS response.

### Sub-topic 1-2

Sub-topic description: In relation to the request from WP1C, some alternative solutions relevant for measuring unwanted emission are proposed in R4-2106356. The intention with this sub-topic is to collect feedback and maybe even more alternative approaches.

**Issue 1-2: Alternative approaches**

* Proposals
  + Option 1: Normal operation
  + Option 2: Normal operation and fixed measurement location
  + Option 3: Proprietary test configuration
  + Option 4: Provoking traffic
* Recommended WF
  + Collect information in a draft LS response.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Sub topic 1-1: RAN4 can analyse technical aspects only from the point of view of doing measurements in controlled environment. RAN4 cannot analyse measurement uncertainties in the field. In addition to RAN1 impact, there would likely be impact also elsewhere to be able to enable/disable proposed test signal. It would be therefore better to send LS first to RAN plenary to clarify what would need to be done and what would be the impacted WGs/specifications, in case a dedicated test signal would in the end be seen as preferred option compared to the alternative approaches. RAN can forward the message to ITU-R WP 1C in June meeting.  Sub topic 1-2: Comments for alternative approaches:   * Option 1: Good approach to schedule measurement at peak traffic hours * Option 2: Represent well the normal operation * Option 3: Has similar issues identified earlier for test mode. By enabling a test mode, the BS normal network operation will be disrupted * Option 4: Good approach using test UEs to provoke BS to schedule full carriers   In addition, option 1, 2, 4 could even be combined, i.e. averaging over the peak hours could be performed while traffic is simultaneously being provoked.  ….  Others: Overall, we see the alternative approaches more preferable, given the issues and open items surrounding the test signal definition. |
| ZTE | Sub topic 1-1:  To design some dedicated signal for OTA testing in field, it’s better to avoid the impacts on other group, otherwise we cannot reply LS in June RAN-P meeting.  Sub topic 1-2:  Since BS scheduler algorithm is unknown in practice, to provoking BS to schedule full carrier is also unknown.  For normal operation, then there is no guarantee the full carrier scheduled. |
| Huawei | Sub topic 1-1: Questions about test signal. Is the test signal intended to be transmitted all the time or initiated by some sort of request? If it is on all the time then it may force BS to abandon any power saving modes as it has to be prepared to transmit full power at all times. Interference with systems based on random distribution of UE in aggressor and victim system may suffer additional interference due to any sort of non-random persistent interferer, is the intention that the test signal is consistent in all BS synchronously? What is the intended beam pattern for the test signal (high gain correlated – if so in which direction, or de-correlated).  Another question that’s comes to mind is, is this just an AAS problem, the measurement aspects certainly are tougher for AAS, but of the signal has no guaranteed full power signal, the worst case emission case will also not occur for non-AAS BS  Sub topic 1-2:  It seems unlikely that normal operation in option 1 or 2 would produce a worst case scenario – however it would give an idea of average emission levels, whilst not the same as the specified levels it may give an indication of possible interference issues? Vendor specific test modes may result in diverse solutions to the same problem and make it difficult to compare measurements from different vendors. Initiating a test may be carried out by vendor specific approach but the signal itself should perhaps be consistent across vendors, however due to the problems of measurement if the test were to be vendor specific it may allow manipulation of eh beam to allow for available measurement locations which of course will be different for each installation. Provoking traffic seems an interesting approach as it does not require a specific test interface (although maybe a test mode would be useful when the test UE is attached?). It is assumed that the wanted signal will be in the form of a beam pointed at the test UE, however that will only occur if the UE is in the BS beam steering range (close to the BS where LOS is possible the BS may not be able to tilt that far!). In which case the measurement location(s) will either be separate from the test UE or not in the main beam. Both options raise issues, if they are separate (especially if a drone for example is used) then the test UE will need to be synchronized to the measurement to ensure the measurement is take when traffic is directed at the UE. If the measurement UE is not in the main beam then estimate of beam roll off etc will greatly add to MU.  The discussion seems to be based around assumption that emissions close to carrier or harmonics are the main unwanted emissions to be measured and that they will be correlated to the wanted signal. If this is true then assumptions on beam gain based on the wanted signal can be made (although this will introduce significant MU). If this is the assumption then the test signal should be set so that unwanted emission are less likely to be pointing in different directions (i.e. single carrier, single beam, as multiple carriers/beams can result in 3rd order beams in different directions eve with correlated emissions) |
| Ericsson | Sub topic 1-1: At last RAN plenary RAN4 was tasked to look into a request from ITU-R WP 1C on a new test signal to facilitate a situation with full power allocated. A test signal is proposed to give full power condition. Full power allocation is required to verify TRP unwanted emission in lab and in field. The in-field area is new for RAN4 but related since parameters are defined in RAN4 and used also for in-field testing. The intension with the draft response LS was to provide to more information and also ask for more specific information to understand in-field testing and the proposed test signal. Introducing a test signal will have impact on RAN1 if the signal is standardized. From a RAN4 perspective that is important is to understand what conditions is needed to measure TRP emission in-field, e.g. test signal length and periodicity to be able to measure unwanted emission. To have a fruitful discussion with ITU-R, RAN4 should collect questions and technical background relevant for in-field testing. The intension is to send the information as an LS to ITU-R WP 1C.  Sub topic 1-2: In a unloaded network, it will be difficult to measure emission levels. Therefore, a situation with a loaded carrier is required. The test signal proposed by ITU-R facilitate a fully loaded carrier. But also, alternative approaches exist, such as provoking the base station to send data using all resources.  Comments on different approaches:  Option 1: When peak traffic occurs, the carrier will be fully loaded. The drawback with this approach is that the traffic can vary significantly, hence time is a limiting factor.  Option 2: Since TRP is an average in itself, this approach is promising. By letting the network operate and provide data to multiple UEs the emission can be tested. This approach requires that UEs are attached to the network and scheduled data.  Option 3: The test signal proposed by ITU-R is designed to be transparent and not disturb the traffic. If that’s possible we need to further analyze. Proprietary solution has the draw back that the regulator needs to ask for the test signal to be enabled during testing. The intension with the test signal proposed by ITU-R was to always be enabled.  Option 4: The approach to provoke traffic in a cell without scheduled UEs is beneficial and very useful measuring unwanted emission. A dummy test UE will request large portion of data to be downloaded, which will create a situation where all resources in the frequency domain is used. This approach gives the freedom to test unwanted emission without interaction with the operator.  The intension is to find a way for testing TRP unwanted emission in-field since it is vital for regulators in several countries. Typically, what is interesting is the emission close to the carrier and harmonics. For the harmonics, even if the signal is correlated and beamformed, it’s very difficult to say what gain the antenna have. That’s why regulators ask for input from RAN4 how the base station works and how emission can be measured properly. RAN4 have great experience of testing emission in in-door lab environments, which are essential for in-field testing too. |

### CRs/TPs comments collection

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

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | *Tentative agreements: None*  *Candidate options: None*  *Recommendations for 2nd round: We need a way forward to sort out how we continue the work related to the request from ITU-R WP 1C and the task from RAN plenary.* |
| **Sub-topic #1-2** | *Tentative agreements: There are some alternative approaches to also consider*  *Candidate options: None*  *Recommendations for 2nd round: If possible, capture some feedback in WF above* |

A way forward is required to give guidance for the next meeting.

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

## Discussion on 2nd round (if applicable)

# Topic #2: Antenna model extension

At last RAN4 meeting antenna parameters was provided in LS to ITU-R WP 5D in R4-2103104. The antenna parameters do not reflect AAS base stations deployed in networks. Therefore, additional information has been provided in R4-2106354 with the intention to send an additional LS to ITU-R WP 5D with information more relevant for sharing studies.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2106354 | Ericsson, Nokia, Qualcomm | Proposal 1: An extension to current antenna model is proposed to model antennas using sub-arrays  Proposal 2: A parameter set for an antenna using sub-arrays is proposed |

## Open issues summary

The current antenna model defined in TR 37.840 models only antennas with single element configurations. Now when ITU-R WP 5D is evaluating measurement results from real base stations there is a need to update the antenna model to better reflect AAS base station deployed in networks.

### Sub-topic 2-1

Sub-topic description: An antenna model extension is proposed in R4-2106354 to include the sub-array impact on the composite antenna pattern.

**Issue 2-1: Antenna model extension**

* Proposals
  + Extend the antenna model to support sub-array geometries
* Recommended WF
  + Send LS to ITU-R WP 5D with additional information relevant for AAS base station modelling

### Sub-topic 2-2

Sub-topic description: For sharing studies in ITU-R WP 5D relevant antenna parameters are required. A relevant and representable parameter set for wide area base station using sub-arrays have been presented.

**Issue 2-2: Antenna parameter set**

* Proposals
  + Option 1: Model the sub-array antenna characteristics using provided parameters in R4-2106354
* Recommended WF
  + Include parameters set in LS to WP 5D.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Sub topic 1-1: Support the proposal.  Sub topic 1-2: Support the proposal.  ….  Others: |
| Qualcomm | Sub-topic 1-1: We support the proposal.  Sub-topic 1-2: We support the proposal. |
| Spark | We support both proposals for sub topics 1-1 and 1-2. There will be an impact in 5D to revise ITU R M 2101 and this could be problematic.  The antenna arrays shown in R4 2106354 are cross pol arrays yet the antenna models are for co polarized elements. This may also be improved in M 2101.  Spark NZ will be happy to work with RAN 4 colleagues to do the above. |
| ZTE | Sub-array is still not considered for Weighting factor Wm,n and Vm,n, more discussions are needed.  In addition, it’s better to resolve FR2 antenna array with sub-array together instead of going with FR1 only. |
| Huawei | Sub topic 1-1:  We need more time to check the model extension and relevant aspects, e.g. FR1 co-existence.  Sub topic 1-2:  We need more time to check the proposed parameters. Meanwhile we have some comments for clarification. Compared to previous LS R4-2103104 we agreed in last meeting, the vertical coverage range and mechanical down-tilt have been updated, what is the justification? |
| Ericsson | Sub topic 1-1: We support the proposal  Sub-topic 1-2: We support the proposal  The antenna characteristics have been discussed in ITU-R WP5D for a long time. With the current 3GPP parameters it is now clear that the modelled antenna does not really reflect AAS base station deployed in networks. This issue is obvious when measured patterns are compared with modelled pattern based on 3GPP RAN4 assumptions.  The main issue is related to the fact that most of the FR1 AAS base stations deployed in networks are using sub-array antenna geometries to be able to optimize coverage within the sector. The antenna model described in TR 37.840 and M.2101 only support single element antenna geometries. Therefore, a model extension to the current model have been created. With parameters relevant for a sub-array equipped AAS base station the correct pattern can be modelled.  The beamforming weights for the elements in the sub-arrays currently supports uniform amplitudes and linear phase propagation, which very good reflect most products out there.  As we see it, there are no issue with FR2. The reason why is that measurement results and model have already been compared in ITU-R WP 5D. The conclusion was that the model and parameters matched measured patterns very well.  The justification for changing some parameters from last meeting was to adopt to the sub-array model extension. The mechanical tilt was absorbed into the pre-set sub-array down-tilt. Also, parameters were harmonized between different scenarios to better reflect how base stations are deployed. Therefore, parameters have been changed compared to last meeting. |
| CATT | Sub topic 1-1:  We have the same observation as ZTE that some parameters in Table 2-2 of R4-2106354 is not adapted for sub-array which is misleading. We are open for further discussion but sometime might be needed for companies to check the mentioned issue and implication with co-existence we already done. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1-1** | *Tentative agreements: Postpone LS response until next meeting, since companies request more time to further look into details of the antenna model.*  *Candidate options: None*  *Recommendations for 2nd round: Capture the antenna model in a WF for further consideration until next meeting.* |
| **Sub-topic#1-2** | *Tentative agreements: Postpone LS response until next meeting, since companies request more time to check the proposed parameters.*  *Candidate options: None*  *Recommendations for 2nd round: Capture the antenna parameters in a WF for further consideration until next meeting.* |

A way forward is required to capture the antenna model and corresponding parameters and open issues for further discussion at next meeting.

### CRs/TPs comments collection

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

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on OTA in-field testing and antenna model information to ITU-R | Ericsson |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2106356 | Draft LS on feedback on LS from ITU-R WP 1C related to in-field unwanted emission testing | Ericsson | Noted |  |
| R4-2106354 | Draft LS to ITU-R and CEPT on extension of IMT array antenna model to support sub-array structures | Ericsson, Nokia, Qualcomm | Noted |  |

## 2nd round

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

Notes:

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