**3GPP TSG-RAN WG4 Meeting #94-e [Draft] R4-2002493**

Online, 24 Feb - 06 Mar 2020

**Source:** Huawei

**Title:** [IAB] TP to TR 38.xxx Antenna assumptions

**Agenda Item:** 8.5.2

**Document for:** Approval

# Introduction

This is s resubmission of R4-1915999, in the last meeting (RAN4#93) this contribution to capture the antenna parameters was submitted and updated during the meeting, however it was requested more time to study the final version before approving.

This TP to the TR capture the information on the antenna assumptions used in the simulation assumptions.

Errors in the antenna gain assumptions used in the original NR work meant that the antenna directivity required normalization due to the incorrect element gain assumptions. These errors were corrected in the assumptions for IAB simulations but there was still some confusion as to the derivation of the numbers. As such it is worthwhile to capture the derivation in the TR

# Updates after 1st round

R4-2001708 and R4-2001025 both cover same topic, papers are merged.

Specific comments

**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

**Action:** This is perhaps a metter of style? the way the tables are presented is the way they were captured in the original WF, it also seems that majority of companies prefer this layout. I will leave table format as is.

**Qualcomm:** Typo in Table 6.2.x.3-2 title. Suggest to substitute with “FR2 UE antenna model”

Typo in following formula:

G\_(ANT\_cmposite)≈10\*〖log〗\_10 ((4π\*82\*0.5λ\*162\* 0.5λ)/λ^2 )-1.8≈9dBi

Typo in following formula. There is one equal missing.

G\_(ANT\_composite)≈10\*〖log〗\_10 ((4π\*d\_v,\*d\_h)/λ^2 )-Loss≈10\*〖log〗\_10 (M\*N)+G\_(ANT\_element ) 6+3=9dBi

After correction of these typos, we are ok with this TP.

**Action:** All changes implemented

**ZTE:** prefer to have single TP with all simulation assumption implemented instead separating TPs. In addition, FR1 BS and FR2 BS should be replaced by IAB

General updates:

I have merged the text from the parameter selection subclause from 1025 and the general section of 17087 as they deal with the same issue. The flowchart from 1025 was not accepted so I have not included that.

The tables (after correction) I have left as per 1708 as these are same as the original WF for the simulation parameters

The gain approximation based on aperture in the general section and after tables was intended to be as an explanation that we have the figures correct. It’s not completely necessary, but I think explains why the element gain varies and it is clear that it’s an approximation! , I have removed the array calculation and just left the element to make it a bit simpler.

# References

[1] R4-19128889 TR skeleton Samsung

# Text proposal

Text proposal to TR 38.xxx v0.0.1

**<START OF CHANGE>**

## 6.2 Simulation assumption

Detailed structure of the subclause is TBD.

### 6.2.x Antenna configuration

#### 6.2.x.1 General

Since some parameters required by the array antenna model are not independent, arbitrary parameter values are not supported. If parameters are selected arbitrary the model will produce incorrect gain characteristics.

We define arrays using the number of columns, rows, the separation between them as well as the definition of the element radiation pattern and its gain.

Clearly the element cannot be physically larger than the space between the elements. The element beam width parameters are directly related to the available unit area for the element. Also, the element gain is directly related to the element directivity via the selected beam widths. Therefore, parameters for *GEmax*, *3dB* and *3dB* cannot be selected arbitrary.

The array spacing, the element gain and the element beam width must therefore all be aligned.

Antenna gain is based on the antenna effective aperture and can be approximated by:

Where Aeff is the effective aperture and ea is the radiation efficiency.

#### 6.2.x.2 FR1

The FR1 antenna is defined as:

Table 6.2.x.2-1 FR1 AIB antenna model for macro scenario

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Composite Array radiation pattern in dB | the steering matrix components are given by  the weighting factor is given by |
| Antenna element vertical radiation pattern (dB) |  |
| Antenna element horizontal radiation pattern (dB) |  |
| Combining method for 3D antenna element pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5 dBi |
| Antenna loss /Efficiency | 1.8 dB |
| BS antenna configuration | (Mg, Ng, M, N, P) = (1, 1, 8, 8, 1)  Note 1,2 |
| (dv, dh) | (0.8λ, 0.5λ) |
| Mechanical down tilt | 10° |
| Note 1: Mg = number of antenna panels in elevation, Ng – number of antenna panels in azimuth, M = number of antenna elements/subarrays in elevation, N= number of antenna elements/subarrays in azimuth, P = number of polarizations.  Note 2: single polarization simulated under the assumption of polarization match. | |

The element spacing is and hence the maximum element size is 0.8λ, 0.5λ, this corresponds to an element gain or approx.:

The radiation pattern for the 0.8λ, 0.5λ element has a beam width of approx. 65° in elevation and 130° in azimuth.

#### 6.2.x.3 FR2

The FR2 BS antenna is defined as:

Table 6.2.x.3-1. FR2 IAB antenna model for macro scenario

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Composite Array radiation pattern in dB | the steering matrix components are given by  the weighting factor is given by |
| Antenna element vertical radiation pattern (dB) |  |
| Antenna element horizontal radiation pattern (dB) |  |
| Combining method for 3D antenna element pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 3 dBi (assuming 1.8dB loss) |
| Antenna loss /Efficiency | 1.8 dB |
| BS antenna configuration | (Mg, Ng, M, N, P) = (1, 1, 8, 16, 1)  Note 1,2 |
| (dv, dh) | (0.5λ, 0.5λ) |
| Mechanical down tilt | 10° |
| Note 1: Mg = number of antenna panels in elevation, Ng – number of antenna panels in azimuth, M = number of antenna elements/subarrays in elevation, N= number of antenna elements/subarrays in azimuth, P = number of polarizations.  Note 2: single polarization simulated under the assumption of polarization match. | |

In this case the element spacing is and hence the maximum element size is 0.5λ, 0.5λ, this corresponds to an element gain or approx.:

The radiation pattern for the 0.5λ, 0.5λ element has a beam width of approx. 130° in elevation and 130° in azimuth.

The UE antenna is defined as:

Table 6.2.x.3-2. FR2 UE antenna model

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Composite Array radiation pattern in dB | the steering matrix components are given by  the weighting factor is given by |
| Antenna element vertical radiation pattern (dB) |  |
| Antenna element horizontal radiation pattern (dB) |  |
| Combining method for 3D antenna element pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 3 dBi (assuming 1.8dB loss) |
| Antenna loss /Efficiency | 1.8 dB |
| UE antenna configuration | (Mg, Ng, M, N, P) = (1, 1, 2, 2, 1) |
| (dv, dh) | (0.5λ, 0.5λ) |
| UE orientation | Random orientation in the azimuth domain: uniformly distributed between -90 and 90 degrees\*  Fixed elevation: 90 degrees |
| NOTE: This is done to emulate two panels: the configuration is equivalent to 2 panels with 180 shift in horizontal orientation and UE orientation uniformly distributed in the azimuth domain between -180 and 180 degrees. | |

The element definition is the same as that of the BS but the array is smaller.

By combining the element and array patterns this gives a composite gain of:

**<END OF CHANGE>**