3GPP TSG-RAN WG4 Meeting # 112 R4-2412590

Maastricht, Netherlands, 19th – 23rd August 2024

**Agenda Item:** **8.2.4.1**

**Source: Nokia, Fujitsu**

**Title:** **TP to TR 38.922: Revisions of system level simulation assumptions for study on IMT parameters for 14800 to 15350 MHz frequency range**

**Document for:** **Approval**

**1. Introduction**

The SI on IMT parameters for 4400 to 4800 MHz, 7125 to 8400 MHz and 14800 to 15350 MHz was approved at TSG RAN#103 [1]. One of the objectives of this SI is to study the IMT parameters relevant for sharing and compatibility for 14800 to 15350 MHz frequency range.

This study item aims as answering requests from ITU-R WP5D regarding NR in these frequencies for IMT [2]. Two set of parameters requested by ITU-R WP5D are the ACLR and ACS of BS and UE for 14800 to 15350 MHz frequency range. Currently, different sets of ACLR and ACS are specified in RAN4 specifications [3, 4, 5] for NR BS and UE in FR1 and FR2 based on coexistence studies as recorded in TR 38.803 [6]. Therefore, coexistence study will need to be carried out to provide answers to ITU-R WP5D on these parameters with sound technical justifications from coexistence perspective.

The text proposal on the simulation assumptions for the coexistence study was agreed in RAN4#111 [7]. This contribution proposes revisions to the agreed assumptions in TR 39.822 [8] based on the simulation results provided in [9] and the proposals made in [10]. Note that the BS height is updated to 20 m to be the same as the BS height (urban) in TR 38.921 [11], and the redundant clauses related to ASS BS without sub-array antenna are deleted to avoid ambiguity.

**2. Text proposal**

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6.1.1 Co-existence simulation scenarios

Table 6.1.1 summarizes the proposed initial simulation scenarios for 14800 - 15350 MHz.

**Table 6.1.1-1: Summary of initial simulation scenarios for 14800 - 15350 MHz**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Usage scenario** | **Aggressor** | **Victim** | **Direction** | **Simulation frequency** | **Deployment Scenario** | **Priority** |
| 1 | eMBB | NR, 100/200/400MHz | Same as aggressor | DL to DL | 15 GHz | Indoor hotspot | Second |
| 2 | eMBB | NR, 100/200/400 MHz | Same as aggressor | DL to DL | 15 GHz | Urban macro | First |
| 3 | eMBB | NR, 100/200/ 400MHz | Same as aggressor | DL to DL | 15 GHz | Dense urban | Third |
| 4 | eMBB | NR, 100/200/400 MHz | Same as aggressor | UL to UL | 15 GHz | Indoor hotspot | Second |
| 5 | eMBB | NR, 100/200/400 MHz | Same as aggressor | UL to UL | 15 GHz | Urban macro | First |
| 6 | eMBB | NR, 100/200/400 MHz | Same as aggressor | UL to UL | 15 GHz | Dense urban | Third |

**<Next change>**

6.1.2.1.1 Urban macro

Details on urban macro network layout model are listed in Table 6.1.2.1.1-1 and 6.1.2.1.1-2.

**Table 6.1.2.1.1-1: Single operator layout for urban macro**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | **Values** | **Remark** |
| Network layout | | hexagonal grid, 19 macro sites, 3 sectors per site with wrap around |  |
| Inter-site distance | | 450 m (first priority)  350 m (second priority)  Other (third priority) |  |
| BS antenna height | | 20 m |  |
| UE location | Outdoor/indoor | Outdoor and indoor |  |
| Indoor UE ratio | 20/0% |  |
| Low/high Penetration loss ratio | 50% low loss, 50% high loss |  |
| LOS/NLOS | LOS and NLOS |  |
| UE antenna height | Same as 3D-UMa in TR 36.873 |  |
| UE distribution (horizontal) | | Uniform |  |
| Minimum BS - UE distance (2D) | | 35 m |  |
| Channel model | | UMa |  |
| Shadowing correlation | | Between cells: 1.0  Between sites: 0.5 |  |

**Table 6.1.2.1.1-2: Multi operators layout for urban macro**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Values** | **Remark** |
| Multi operators layout | Coordinated/un-coordinated operation (0/100% Grid Shift) for FR1-like UE  Coordinated operation (0% Grid Shift) for FR2-like UE |  |

|  |  |
| --- | --- |
| Coordinated Operation: each network with co-location of sites | zero grade shift macro |

**Figure 6.1.2.1.1-1: Coordinated operation**

**A diagram of a cell range

Description automatically generated**

**Figure 6.1.2.1.1-2: Uncoordinated operation**

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6.1.2.1.3 Indoor

Details on indoor network layout model are listed in Table 6.1.2.1.3-1 and 6.1.2.1.3-2.

**Table 6.1.2.1.3-1: Single operator layout for indoor**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | **Values** | **Remark** |
| Network layout | | 50m x 120m, 12BSs |  |
| Inter-site distance | | 20m | Single sector per site |
| BS antenna height | | 3 m | Mounted on ceiling |
| UE location | Outdoor/indoor | Indoor |  |
| LOS/NLOS | LOS and NLOS |  |
| UE antenna height | 1 m |  |
| UE distribution (horizontal) | | Uniform |  |
| Minimum BS - UE distance (2D) | | 0 m |  |
| Channel model | | Indoor Office |  |
| Shadowing correlation | | NA |  |

**A diagram of a diagram

Description automatically generated**

**Figure 6.1.2.1.3-1: Network layout for indoor**

**Table 6.1.2.1.3-2: Multi operators layout for indoor**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Values** | **Remark** |
| Multi operator layout | Coordinated operation (0% Grid Shift) |  |

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6.1.2.3.2 BS Antenna modelling











To model an AAS BS equipped with a sub-array antenna geometry an extended antenna model is required. A sub-array antenna geometry is created by combining vertical elements to sub-arrays as indicated in Figure 6.1.2.3.2-1. The antenna model extension was created to model AAS base station operating within the frequency range 14800 - 15350 MHz required for sharing studies in ITU-R.

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**Figure 6.1.2.3.2-1: Sub-array structure**

In Table 6.1.2.3.2-1, the parameters used by the parameterized array antenna model supporting sub-array geometries are described.

**Table 6.1.2.3.2-1: Extended parameter definitions**

| **Level** | **Parameter** | **Symbol** | **Unit** |
| --- | --- | --- | --- |
| Element | Front to back ratio | *Am* | dB |
| Side lobe suppression | *SLAv* | dB |
| Horizontal half power beamwidth | *3dB* | Degrees |
| Vertical half power beamwidth | *3dB* | Degrees |
| Array element peak gain | *GE,max* | dBi |
| Sub-array | Number of element rows in sub-array | *Msub* | Integer |
| Vertical element separation | *dv,sub* | m |
| Electrical pre-set sub-array down-tilt angle | *subtilt* | Degrees |
| Array | Number of elements/sub-array rows | *M* | Integer |
| Number of elements columns | *N* | Integer |
| Horizontal element separation | *dh* | m |
| Vertical element/sub-array separation | *dv* | m |
| Electrical down-tilt angle | *etilt* | Degrees |
| Electrical scan angle | *escan* | Degrees |

The parameterized antenna model is built around array antenna model where the element factor, array factor and linear phase progressing is characterized as described by equations in Table 6.1.2.3.2-2.

**Table 6.1.2.3.2-2: Extended AAS model**

| **Description** | **Equation** |
| --- | --- |
| Peak normalized element radiation pattern |  |
| Peak gain normalized element radiation pattern |  |
| Sub-array excitation |  |
| Sub-array radiation pattern | , where |
| Array excitation |  |
| Composite array radiation pattern | , where |

In Table 6.1.2.3.2-3, representable parameter sets relevant for an AAS base station operating within 14800 - 15350 MHz are provided.

**Table 6.1.2.3.2-3: Antenna array parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Indoor** | **Urban macro** | **Dense urban** |
| Element gain (dBi) (Note 2) | 5 | 6.4 | 6.4 |
| Horizontal/vertical 3 dB beam width of single element (degree) | 90º for H 90º for V | 90º for H 65º for V | 90º for H 65º for V |
| Horizontal/vertical front‑to‑back ratio (dB) | 30 for both H/V | 30 for both H/V | 30 for both H/V |
| Antenna polarization | Linear ±45º | Linear ±45º | Linear ±45º |
| Antenna array configuration (Row × Column)  (Note 4) | [8 x 8 / 4 x 4] | 16 x 24 / 8 x 32 | 16 x 24 / 8 x 32 |
| Horizontal/Vertical radiating sub-array spacing | 0.5 of wavelength for H, 0.5 of wavelength for V | 0.5 of wavelength for H, 2.8/5.6 of wavelength for V (Note 5) | 0.5 of wavelength for H, 2.8/5.6 of wavelength for V (Note 5) |
| Number of element rows in sub-array | N/A | 4/8 | 4/8 |
| Vertical element separation in sub-array () | 0.5 of wavelength of V | 0.7 of wavelength of V | 0.7 of wavelength of V |
| Pre-set sub-array down-tilt (degrees) | N/A | 3 | 3 |
| Array Ohmic loss (dB) (Note 2) | 2 | 2 | 2 |
| Conducted power (before Ohmic loss) per sub-array or element (dBm) (Note 3) | [2/8] | 1413 | 10/9 |
| Base station horizontal coverage range (degrees) | +/-90 | +/-60 | +/-60 |
| Base station vertical coverage range (degrees) (Note 1) | 0-180 | 90-100 | 90-100 |
| Mechanical down-tilt (degrees) | 90 | 6 | 6 |
| Note 1: The vertical coverage range is given for the elevation angle θ, defined between 0° and 180°.  Note 2: The element gain includes the loss and is per polarization.  Note 3: The conducted power per sub-array assumes 16 × 24 / 8 x 32 sub-arrays and 2 polarizations for urban macro and dense urban cases; the conducted power per element assumes [8 × 8 / 4 x 4] elements and 2 polarizations for indoor case.  Note 4: 16 × 24/32 means there are 16 vertical and 24/32 horizontal radiating sub-arrays for urban macro and dense urban cases; [8 × 8 / 4 x 4] means there are [8 / 4] vertical and [8 / 4] horizontal radiating elements for indoor case.  Note 5: For the case of 4/8 elements per sub array, dv will be 2.8/5.6 wavelengths. | | | |

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6.1.2.4 Other simulation parameters

**Table 6.1.2.4-1: Other simulation parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Indoor** | **Urban macro** | **Dense urban** |
| **Channel bandwidth** | 100/200/400 MHz | 100/200/400 MHz | 100/200/400 MHz |
| **Scheduled channel bandwidth per UE (DL)** | 100/200/400 MHz | 100/200/400 MHz | 100/200/400 MHz |
| **Scheduled channel bandwidth per UE (UL)** | 100/200/400 MHz | 100/200/400 MHz | 100/200/400 MHz |
| **The number of active UE (DL)** | Same as the number of BS beam | Same as the number of BS beam | Same as the number of BS beam |
| **The number of active UE (UL)** | 1 UE per slot (first priority)  3 UE per slot (second priority) | 1 UE per slot (first priority)  3 UE per slot (second priority) | 1 UE per slot (first priority)  3 UE per slot (second priority) |
| **Traffic model** | Full buffer | Full buffer | Full buffer |
| **DL power control** | NO | NO | NO |
| **UL power control** | YES | YES | YES |
| **BS max TX power in dBm** | 23dBm | 43dBm (Note 1) | 33dBm |
| **UE max TX power in dBm** | 23dBm (first priority)  26dBm (second priority) | 23dBm (first priority)  26dBm (second priority) | 23dBm (first priority)  26dBm (second priority) |
| **UE min TX power in dBm** | -40dBm | -40dBm | -40dBm |
| **BS Noise figure in dB** | 16 | 8 | 13 |
| **UE Noise figure in dB** | 11 | 11 | 11 |
| **Handover margin** | 3dB | 3dB | 3dB |
| Note 1: BS max TX power is defined per polarization | | | |

**<End of text proposal>**

**References**

[1] RP-240787, “New SI proposal: Study on IMT parameters for 4400 to 4800 MHz, 7125 to 8400 MHz and 14800 to 15350 MHz”, Ericsson.

[2] R4-2400333, “Parameters of terrestrial component of IMT for sharing and compatibility studies in the frequency bands 4 400-4 800 MHz, 7 125-8 400 MHz and 14.8-15.35 GHz”, ITU-R WP5D.

[3] 3GPP TS 38.101-1 v18.5.0, “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”.

[4] 3GPP TS 38.101-2 v18.5.0, “NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone”.

[5] 3GPP TS 38.104 v18.5.0, “NR; Base Station (BS) radio transmission and reception”.

[6] 3GPP TR 38.803 v14.2.0, “Study on new radio access technology: Radio Frequency (RF) and co-existence aspects”.

[7] R4-2410592, “TP to TR 38.922: System level simulation methodology and assumptions for coexistence study for 14800 - 15350 MHz frequency rang”, Nokia.

[8] R4-2410763, “TR 38.922 version 0.1.0”, Ericsson.

[9] R4-2412589, “Urban macro coexistence simulation results for 14800 to 15350 MHz frequency range”, Nokia.

[10] R4-2412591, “BS antenna and simulation parameters for 14800 to 15350 MHz frequency range”, Nokia.

[11] 3GPP TR 38.921 v18.0.1, “NR; Study on International Mobile Telecommunications (IMT) parameters for 6.425-7.025GHz, 7.025-7.125GHz and 10.0-10.5 GHz”.