**3GPP TSG-RAN4 Meeting # 98-e  *R4-2100910***

**Electronic Meeting, 25th Jan – 5th Feb, 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.809** | **CR** | **0002** | **rev** | **-** | **Current version:** | **16.1.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **X** | Core Network |  |

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| --- |
|  |
| ***Title:***  | Big CR for update on TR38.809 |
|  |  |
| ***Source to WG:*** | Samsung |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_IAB-Core |  | ***Date:*** | 2021-02-08 |
|  |  |  |  |  |
| ***Category:*** | F |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | To include CR endorsed in RAN4#98e to TR38.809..  |
|  |  |
| ***Summary of change:*** | The content, which in below draft CR endorsed in RAN4#98e,is introduced in TR38.809:R4-2102422  |
|  |  |
| ***Consequences if not approved:*** | Misleading content will still exist in this TR  |
|  |  |
| ***Clauses affected:*** | 6.1.3, 6.2.2.2, 6.2.2.3, 6.2.3 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**<Start of changes>**

### 6.1.3 Co-location

An IAB node is capable of transmitting in the DL (IAB-DU) or the UL (IAB-MT). When acting as an IAB-MT there are 2 possible co-location interference scenarios between the IAB-MT and a BS.

- Aggressor IAB-MT transmitting in UL, victim BS receiving in UL

- Aggressor BS transmitting in DL, victim IAB-MT receiving in DL

For co-location, the interference is given by:

 $P\_{interference }=10\*log\_{10}\left(10^{\frac{P\_{ACLR}}{10}}+10^{\frac{P\_{ACS}}{10}}\right)$

Where:

PACLR = Ptx\_aggressor – ACLRaggressor – coupling

PACS = Ptx\_aggressor – ACSvictim – coupling

A conservative estimate for the coupling between two co-located systems is; 30Db for FR1 and 45Db for FR2.

NOTE: this figure is used only for this analysis. It is not an agreed FR2 isolation figure.

For a micro BS scenario:

Table 6.1.3-1: Co-location interference between BS and IAB-MT for FR1 and FR2

|  |  |  |  |
| --- | --- | --- | --- |
|  Parameters |   | IAB | BS |
|  | unit | FR1 | FR2 | FR1 | FR2 |
| **Ptx** | dBm | 30 | 30 | 33 | 33 |
| **ACLR** | dB | 45 (Note1) | 28 (Note1) | 45 | 28 |
| **Sensitivity (FR2 approx. equivalent conducted sensitivity)** | dBm | -96.5 (4.5MHz)(Note2) | approx. -85 (50MHz)(Note2) | -96.5 (4.5MHz) | approx. -85 (50MHz) |
| **ACS** | dB | 45 | 24 | 45 | 24 |
| **Coupling** | dB | 30 | 45 (Note3) | 30 | 45 (Note3) |
| **IAB to BS interference (UL)** | dBm | - | - | -42.0 | -37.5 |
| **BS to IAB interference (DL)** | dBm | -41.9 | -34.5 | - | - |
| Note1: the ACLR figures used are BS values, it has not been agreed to use BS figure for IAB, and however UE figures will result in worse interference.Note 2: sensitivity values based on NF assumption in co-location simulation see clause 8.2 and 10.2.Note 3: coupling figures for FR2 are not formally agreed, assumption used only for this example |
|  |

Note for FR2 there are no conducted requirements so the coupling and the sensitivity are estimated to a virtual conducted point for the purposes of comparison.

It can be seen that for both FR1 and FR2 significant additional isolation (50 to 60Db) is required if the systems are to be co-located.

The issue exists for both scenario 1 and scenario 2 (see clause 6.1.2) as it occurs in both the UL and the DL.

**<Unchanged part skipped>**

#### 6.2.2.2 FR1

The FR1 antenna is defined as:

Table 6.2.2.2-1 FR1 IAB antenna model for macro scenario

|  |  |
| --- | --- |
| Parameter | Values |
| Composite Array radiation pattern in Db  | $$A\_{A}\left(θ,φ\right)=A\_{E}”\left(θ,φ\right)+10log\_{10}\left(1+ρ\*\left(\left|\sum\_{n=1}^{N}\sum\_{m=1}^{M}w\_{n,m}\*v\_{n,m}\right|^{2}-1\right)\right)$$the steering matrix components are given by$$v\_{n,m}=exp\left(i\*2π\left(\left(m-1\right)\*\frac{d\_{M}}{λ}cos\left(θ\right)+\left(n-1\right)\*\frac{d\_{N}}{λ}sin\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$the weighting factor is given by$$w\_{n,m}=\frac{1}{\sqrt{NM}}exp\left(1\*2π\left(\left(m-1\right)\frac{d\_{M}}{λ}sin\left(θ\right)-\left(n-1\right)\frac{d\_{N}}{λ}cos\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$ |
| Antenna element vertical radiation pattern (Db) |  $A\_{E,V}\left(θ”\right)=-min\left\{12\left(\frac{θ”-90°}{θ\_{3dB}}\right)^{2},SLA\_{V}\right\},θ\_{3dB}=65°,SLA\_{V}=30dB$ |
| Antenna element horizontal radiation pattern (Db) |  $A\_{E,H}\left(φ”\right)=-min\left\{12\left(\frac{φ”}{φ\_{3dB}}\right)^{2},A\_{m}\right\},φ\_{3dB}=130°,A\_{m}=30dB$ |
| Combining method for 3D antenna element pattern (Db) | $$A\_{E}^{''}\left(θ^{''},φ^{''}\right)=-min\left\{-\left[A\_{E,V}\left(θ^{''}\right)+A\_{E,H}\left(φ^{''}\right)\right],A\_{m}\right\}$$ |
| 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.:

$$G\_{ANT\\_element}≈10\*log\_{10}\left(\frac{4π\*d\_{v},\*d\_{h}}{λ^{2}}\right)-Loss≈10\*log\_{10}\left(\frac{4π\*0.8λ,\*0.5λ}{λ^{2}}\right)-1.8≈5dBi$$

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

#### 6.2.2.3 FR2

The FR2 BS antenna is defined as:

Table 6.2.2.3-1. FR2 IAB antenna model for macro scenario

|  |  |
| --- | --- |
| Parameter | Values |
| Composite Array radiation pattern in Db  | $$A\_{A}\left(θ,φ\right)=A\_{E}”\left(θ,φ\right)+10log\_{10}\left(1+ρ\*\left(\left|\sum\_{n=1}^{N}\sum\_{m=1}^{M}w\_{n,m}\*v\_{n,m}\right|^{2}-1\right)\right)$$the steering matrix components are given by$$v\_{n,m}=exp\left(i\*2π\left(\left(m-1\right)\*\frac{d\_{M}}{λ}cos\left(θ\right)+\left(n-1\right)\*\frac{d\_{N}}{λ}sin\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$the weighting factor is given by$$w\_{n,m}=\frac{1}{\sqrt{NM}}exp\left(1\*2π\left(\left(m-1\right)\frac{d\_{M}}{λ}sin\left(θ\right)-\left(n-1\right)\frac{d\_{N}}{λ}cos\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$ |
| Antenna element vertical radiation pattern (Db) |  $A\_{E,V}\left(θ”\right)=-min\left\{12\left(\frac{θ”-90°}{θ\_{3dB}}\right)^{2},SLA\_{V}\right\},θ\_{3dB}=130°,SLA\_{V}=30dB$ |
| Antenna element horizontal radiation pattern (Db) |  $A\_{E,H}\left(φ”\right)=-min\left\{12\left(\frac{φ”}{φ\_{3dB}}\right)^{2},A\_{m}\right\},φ\_{3dB}=130°,A\_{m}=30dB$ |
| Combining method for 3D antenna element pattern (Db) | $$A^{''}\left(θ^{''},φ^{''}\right)=-min\left\{-\left[A\_{E,V}\left(θ^{''}\right)+A\_{E,H}\left(φ^{''}\right)\right],A\_{m}\right\}$$ |
| 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.:

$$G\_{ANT\\_element}≈10\*log\_{10}\left(\frac{4π\*d\_{v},\*d\_{h}}{λ^{2}}\right)-Loss≈10\*log\_{10}\left(\frac{4π\*0.5λ,\*0.5λ}{λ^{2}}\right)-1.8≈3dBi$$

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 6.2.2.3-2. FR2 UE antenna model

|  |  |
| --- | --- |
| Parameter | Values |
| Composite Array radiation pattern in Db  | $$A\_{A}\left(θ,φ\right)=A\_{E}”\left(θ,φ\right)+10log\_{10}\left(1+ρ\*\left(\left|\sum\_{n=1}^{N}\sum\_{m=1}^{M}w\_{n,m}\*v\_{n,m}\right|^{2}-1\right)\right)$$the steering matrix components are given by$$v\_{n,m}=exp\left(i\*2π\left(\left(m-1\right)\*\frac{d\_{M}}{λ}cos\left(θ\right)+\left(n-1\right)\*\frac{d\_{N}}{λ}sin\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$the weighting factor is given by$$w\_{n,m}=\frac{1}{\sqrt{NM}}exp\left(1\*2π\left(\left(m-1\right)\frac{d\_{M}}{λ}sin\left(θ\right)-\left(n-1\right)\frac{d\_{N}}{λ}cos\left(θ\right)sin\left(φ\right)\right)\right)$$$$n=1,2,…N, m=1,2,…M$$ |
| Antenna element vertical radiation pattern (Db) |  $A\_{E,V}\left(θ”\right)=-min\left\{12\left(\frac{θ”-90°}{θ\_{3dB}}\right)^{2},SLA\_{V}\right\},θ\_{3dB}=130°,SLA\_{V}=25dB$ |
| Antenna element horizontal radiation pattern (Db) |  $A\_{E,H}\left(φ”\right)=-min\left\{12\left(\frac{φ”}{φ\_{3dB}}\right)^{2},A\_{m}\right\},φ\_{3dB}=130°,A\_{m}=25dB$ |
| Combining method for 3D antenna element pattern (Db) | $$A^{''}\left(θ^{''},φ^{''}\right)=-min\left\{-\left[A\_{E,V}\left(θ^{''}\right)+A\_{E,H}\left(φ^{''}\right)\right],A\_{m}\right\}$$ |
| 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:

 $G\_{ANT\\_composite}≈10\*log\_{10}\left(\frac{4π\*d\_{v},\*d\_{h}}{λ^{2}}\right)-Loss≈10\*log\_{10}\left(M\*N\right)+G\_{ANT\_{element}}6+3≈9dBi$

### 6.2.3 Other simulation assumption

The remaining simulation assumptions such as link level assumption, system level assumption, and simulation methodology are captured in this clause.

Table 6.2.3-1: Link level assumptions

|  |  |
| --- | --- |
| Parameter | Details |
| Target SNR | IAB node-MT: SNR target: 22dB [upper limit of approx curve] γ = 1Legacy NR UE:  SNR target: 15 dB γ = 1 |
| Power control | MT for UL transmissions: Yes DU for DL transmission: No |
| Throughput mapping | Map SINR into throughput with the approx equation |

Table 6.2.3-2: System level assumptions

|  |  |
| --- | --- |
| Parameter | Details |
| Duplex mode | TDD |
| Frequency range | FR1: 4.9GHz – FR2: 30GHz |
| Beamforming | FR1: Yes – FR2: Yes |
| Simulation bandwidth | 100MHz for FR1200MHz for FR2 |
| Number of Ues in the network | FR2: 1 active UE/sectorFR1: 3 active Ues/sector |
| gNB Tx power  | 33 dBm for FR2 macro and micro 46 dBm for FR1 |
| IAB node Tx power | 33 dBm for FR2, PC is TBD for Scenario 2 for MT link38dBm for FR1 (medium range power limit) |
| IAB MT min TX power | -10dBm, 0dBm, 10dBm, 20dBm TRP |
|  gNB antenna height  |  25m for macro cells and 10m for micro cells |
| IAB node antenna height  | 25m for macro cells and 10m for micro cells  |
| gNB receiver noise figure | 10dB for FR25dB for FR1 |
| IAB node receiver noise figure | 10dB for FR25dB for FR1 |
| UE Tx power (dBm) | FR2: 22.4dBm EIRP (13.4dBm conducted)FR1: 23dBm (conducted) |
| UE noise figure (dB)  | 10 |

Table 6.2.3-3: Simulation methodology

|  |  |
| --- | --- |
| Parameter | Details |
| Layout 1 | Optimum orientation between parent and child |
| Layout 2 | Antenna orientation based on planned macro layout |
| Topology  | based on RSRP (based on pathloss and element antenna gain) |
| Activity factor | Up to company  |

**<End of changes>**