3GPP TSG RAN ITU-R ad hoc RT-170019

**Source:** Huawei

**Title:** Summary of email discussion “[ITU-R AH 01] Calibration for self-evaluation”

**Document for:** Discussion/Decision

# Introduction

At RAN#77 meeting, the general work plan of self evaluation is approved [1]. The three step work plan is proposed according to the agreed IMT-2020 submission timeplan as endorsed in [2]. It was agreed that

* The following email discussions are proposed for Step 1 after RAN#77
  + Plan an email discussion in RAN ITU-R Ad-Hoc on calibration for self evaluation – Lead by Huawei (Rapporteur)
    - Including calibration detailed plan, calibration metrics, baseline parameter for calibration, test environments and evaluation configurations for calibration as defined in Report ITU-R M.[IMT-2020. EVAL], etc.
  + ITU-R Ad-Hoc contact person will kick off the scope and timing of the E-mail discussion in the ITU-R Ad-Hoc mailing list

Based on the above agreement, ITU-R Ad-Hoc contact person sets up an email discussion “[ITU-R AH 01] Calibration for self-evaluation”. This document provides the summary of this email discussion.

# Scope and timing of the discussion

The scope and timing of this email discussion is set as follows.

* Goal: To calibrate simulations assumptions in view of self-evaluation, and provide the calibration results according to the baseline calibration parameters.
* Timeline: Until December 1st.

Based on the above scope, the calibration metrics and baseline parameters are discussed and captured as shown in Section 3 and 4, respectively. Companies who would like to contribute to self evaluation are encouraged to provide calibration results based on the parameters.

# Calibration metrics for self evaluation

The following metrics are selected for calibration of self evaluation at this stage:

* DL Geometry (wideband SINR)
* Coupling loss

The above metrics will be used with the cell association mechanism as defined in calibration assumptions in Section 4.

# Calibration parameters for self evaluation

This section provides baseline calibration parameters and models for the five test environments defined in Report ITU-R M.[IMT-2020.EVAL] (see [3]). It should be noted that these parameters are used for calibration purpose only.

## Indoor Hotspot - eMBB

The baseline parameters are provided in Table 1.

Table 1 Baseline parameter for Indoor Hotspot – eMBB

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Indoor Hotspot - eMBB** | Config. A | | Config. B | | Config. C | |
| Carrier frequency for evaluation | 4 GHz | | 30GHz | | 70GHz | |
| BS antenna height | 3 m | | 3 m | | 3 m | |
| Total transmit power per TRxP | Baseline: 21 dBm for 10MHz bandwdith | | Baseline: 20 dBm for 40 MHz bandwidth | | Baseline: 18 dBm for 40 MHz bandwidth | |
| UE power class | 23 dBm | | 23 dBm | | 21 dBm | |
| Inter-site distance | 20m | | 20 m | | 20 m | |
| Number of antenna elements per TRxP | 32Tx/Rx, (M,N,P,Mg,Ng) = (4,4,2,1,1), (dH,dV) = (0.5, 0.5)λ  +45°, -45° polarization | | 64Tx/Rx, (M,N,P,Mg,Ng) = (4,8,2,1,1), (dH,dV) = (0.5, 0.5)λ  +45°, -45° polarization | | 256Tx/Rx, (M,N,P,Mg,Ng) = (8,16,2,1,1), (dH,dV) = (0.5, 0.5)λ  +45°, -45° polarization | |
| Number of TXRU per TRxP | 32TXRU, (Mp,Np,P,Mg,Ng) = (4,4,2,1,1) (1-to-1 mapping) | | 8TXRU, (Mp,Np,P,Mg,Ng) =(2,2,2,1,1) | | 8TXRU, (Mp,Np,P,Mg,Ng)=(2,2,2,1,1) | |
| Number of UE antenna elements | 4Tx/Rx, (M,N,P,Mg,Ng) = (1,2,2,1,1), (dH,dV) = (0.5, N/A)λ  0°,90° polarization | | 32Tx/Rx, (M,N,P,Mg,Ng) = (2,4 ,2,1,2), (dH,dV) = (0.5, 0.5)λ  (dg,V,dg,H) = (0, 0)λ. Θmg,ng=90; Ω0,1=Ω0,0+180;  0°,90° polarization | | 32Tx/Rx, (M,N,P,Mg,Ng) = (2,4 ,2,1,2), (dH,dV) = (0.5, 0.5)λ  (dg,V,dg,H) = (0, 0)λ. Θmg,ng=90; Ω0,1=Ω0,0+180;  0°,90° polarization | |
| Number of TXRU per UE | 4TXRU, (Mp,Np,P,Mg,Ng) = (1,2,2,1,1) (1-to-1 mapping) | | 4TXRU, (Mp,Np,P,Mg,Ng)=(1,1,2,1,2) | | 4TXRU, (Mp,Np,P,Mg,Ng)=(1,1,2,1,2) | |
| Device deployment | 100% indoor Randomly and uniformly distributed over the area | | 100% indoor Randomly and uniformly distributed over the area | | 100% indoor Randomly and uniformly distributed over the area | |
| UE mobility model | Fixed and identical speed |v| of all UEs, randomly and uniformly distributed direction | | Fixed and identical speed |v| of all UEs, randomly and uniformly distributed direction | | Fixed and identical speed |v| of all UEs, randomly and uniformly distributed direction | |
| UE speeds of interest | 3 km/h | | 3 km/h | | 3 km/h | |
| Inter-site interference modeling | Explicitly modelled | | Explicitly modelled | | Explicitly modelled | |
| BS noise figure | 5 dB | | 7dB | | 7dB | |
| UE noise figure | 7 dB | | 10dB | | 10dB | |
| BS antenna element gain | 5dBi | | 5dBi | | 5dBi | |
| BS antenna element pattern | See Table 2 in Section 3.6 | | See Table 2 in Section 3.6 | | See Table 2 in Section 3.6 | |
| UE antenna element gain | 0 dBi | | 5dBi | | 5dBi | |
| UE antenna element pattern | Omni-directional | | See Table 3 in Section 3.6 | | See Table 3 in Section 3.6 | |
| Thermal noise level | -174 dBm/Hz | | -174 dBm/Hz | | -174 dBm/Hz | |
| Traffic model | Full buffer | | Full buffer | | Full buffer | |
| Simulation bandwidth | 10MHz | | 40MHz | | 40MHz | |
| UE density | 10 UEs per TRxP | | 10 UEs per TRxP | | 10 UEs per TRxP | |
| UE antenna height | 1.5m | | 1.5m | | 1.5m | |
| Channel model variant | Alt. 1: Channel model A Alt. 2: Channel model B | | (Channel model A or B is the same) | | (Channel model A or B is the same) | |
| TRxP number per site | 1 | 3 | 1 | 3 | 1 | 3 |
| Mechanic tilt | 180° in GCS (pointing to the ground)  Top view: | [110°] in GCS | 180° in GCS (pointing to the ground)  Top view: | [110°] in GCS | 180° in GCS (pointing to the ground)  Top view: | [110°] in GCS |
| Electronic tilt | 90° in LCS | 90° in LCS | (According to Zenith angle in "Beam set at TRxP") | (According to Zenith angle in "Beam set at TRxP") | (According to Zenith angle in "Beam set at TRxP") | (According to Zenith angle in "Beam set at TRxP") |
| Handover margin (dB) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) |
| TRxP boresight | - | 30 / 150 / 270 degrees | - | 30 / 150 / 270 degrees | - | 30 / 150 / 270 degrees |
| UT attachment | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0  The UE panel with the best receive SNR is chosen. i.e. no combining is done between panels. | Based on RSRP (formula (8.1-1) in TR36.873) from port 0  The UE panel with the best receive SNR is chosen. i.e. no combining is done between panels. | Based on RSRP (formula (8.1-1) in TR36.873) from port 0  The UE panel with the best receive SNR is chosen. i.e. no combining is done between panels. | Based on RSRP (formula (8.1-1) in TR36.873) from port 0  The UE panel with the best receive SNR is chosen. i.e. no combining is done between panels. |
| Wrapping around method | No wrapping around | No wrapping around | No wrapping around | No wrapping around | No wrapping around | No wrapping around |
| Minimum distance of TRxP and UE | d2D\_min=0m | d2D\_min=0m | d2D\_min=0m | d2D\_min=0m | d2D\_min=0m | d2D\_min=0m |
| Polarized antenna model | Model-2 in TR36.873 | Model-2 in TR36.873 | Model-2 in TR36.873 | Model-2 in TR36.873 | Model-2 in TR36.873 | Model-2 in TR36.873 |
| Beam set at TRxP (Constraints for the range of selective analog beams per TRxP) | - | - | For direction of TRxP analog beam steering (in LCS): Azimuth angle φi = [-3\*pi/8, -1\*pi/8, 1\*pi/8, 3\*pi/8] Zenith angle θj = [pi/4 3\*pi/4]  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (phai\_i, theta\_j) is given by equation 1 in Appendix 1 (2D DFT beam) | | For direction of TRxP analog beam steering (in LCS): Azimuth angle φi = [-7\*pi/16, -5\*pi/16, -3\*pi/16, -1\*pi/16, 1\*pi/16, 3\*pi/16, 5\*pi/16, 7\*pi/16] Zenith angle theta\_j = [pi/8 3\*pi/8 5\*pi/8 7\*pi/8]  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (phai\_i, theta\_j) is given by equation 1 in Appendix 1 (2D DFT beam) | |
| Beam set at UE (Constraints for the range of selective analog beams for UE) | - | - | For direction of UE analog beam steering (in LCS): Azimuth angle φi = [-3\*pi/8, -pi/8, pi/8, 3\*pi/8]; Zenith angle θj = [pi/4, 3\*pi/4];  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (φi, θj) is given by equation 1 in Appendix 1 (2D DFT beam) | | For direction of UE analog beam steering (in LCS): Azimuth angle φi = [-3\*pi/8, -pi/8, pi/8, 3\*pi/8]; Zenith angle θj = [pi/4, 3\*pi/4];  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (φi, θj) is given by equation 1 in Appendix 1 (2D DFT beam) | |
| Criteria for selection for serving TRxP | - | - | Maximizing RSRP with best analog beam pair, where the digital beamforming is not considered | | Maximizing RSRP with best analog beam pair, where the digital beamforming is not considered | |
| Criteria for analog beam selection for serving TRxP | - | - | Select the best beam pair among the set of DFT beams, based on the criteria of maximizing receive power after beamforming. | | Select the best beam pair among the set of DFT beams, based on the criteria of maximizing receive power after beamforming. | |
| Criteria for analog beam selection for interfering TRxP | - | - | Random selecting the random beams for non-serving TRxP | | Random selecting the random beams for non-serving TRxP | |

## Dense urban - eMBB

The baseline parameters are provided in Table 2.

Table 2 Baseline parameter for Dense Urban – eMBB

|  |  |  |
| --- | --- | --- |
| **Dense Urban - eMBB** | Config. A | Config. B |
| Carrier frequency for evaluation | 1 layer (Macro) with 4 GHz | 1 layer (Macro) with 30 GHz |
| BS antenna height | 25 m | 25 m |
| Total transmit power per TRxP | 41 dBm for 10 MHz bandwidth | 37 dBm for 40 MHz bandwidth |
| UE power class | 23 dBm | 23 dBm |
| Percentage of high loss and low loss building type | 20% high loss, 80% low loss (applies to Channel model B) | 20% high loss, 80% low loss |
| Inter-site distance | 200 m | 200 m |
| Number of antenna elements per TRxP | 128Tx/Rx, (M,N,P,Mg,Ng) = (8,8,2,1,1), (dH,dV) = (0.5, 0.8)λ  +45°, -45° polarization | 256Tx/Rx, (M,N,P,Mg,Ng) = (4,8,2,2,2), (dH,dV) = (0.5, 0.5)λ. (dg,H,dg,V) = (4.0, 2.0)λ  +45°, -45° polarization |
| Number of TXRU per TRxP | 4TXRU, (Mp,Np,P,Mg,Ng) = (2,1,2,1,1) | 8TXRU, (Mp,Np,P,Mg,Ng) =(1,1,2,2,2) |
| Number of UE antenna elements | 4Tx/Rx, (M,N,P,Mg,Ng) = (1,2,2,1,1), (dH,dV) = (0.5, N/A)λ  0°,90° polarization | 32Tx/Rx, (M,N,P,Mg,Ng) = (2,4,2,1,2), (dH,dV) = (0.5, 0.5)λ  (dg,V,dg,H) = (0, 0)λ. Θmg,ng=90; Ω0,1=Ω0,0+180;  0°,90° polarization |
| Number of TXRU per UE | 4TXRU, (Mp,Np,P,Mg,Ng) = (1,2,2,1,1) (1-to-1 mapping) | 4TXRU, (Mp,Np,P,Mg,Ng)=(1,1,2,1,2) |
| Device deployment | 80% indoor, 20% outdoor (in car) Randomly and uniformly distributed over the area under Macro layer | 80% indoor, 20% outdoor (in car) Randomly and uniformly distributed over the area under Macro layer |
| UE mobility model | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction |
| UE speeds of interest | Indoor users: 3km/h Outdoor users (in-car): 30 km/h | Indoor users: 3km/h Outdoor users (in-car): 30 km/h |
| Inter-site interference modeling | Explicitly modelled | Explicitly modelled |
| BS noise figure | 5 dB | 7 dB |
| UE noise figure | 7 dB | 10 dB |
| BS antenna element gain | 8 dBi | 8 dBi |
| BS antenna element pattern | See Table 1 in Section 3.6 | See Table 1 in Section 3.6 |
| UE antenna element gain | 0 dBi | 5 dBi |
| UE antenna element pattern | Omni-directional | See Table 3 in Section 3.6 |
| Thermal noise level | -174 dBm/Hz | -174 dBm/Hz |
| Traffic model | Full buffer | Full buffer |
| Simulation bandwidth | 10 MHz | 40 MHz |
| UE density | 10 UEs per TRxP | 10 UEs per TRxP |
| UE antenna height | Outdoor UEs: 1.5 m Indoor UTs: 3(nfl – 1) + 1.5;  nfl ~ uniform(1,Nfl) where  Nfl ~ uniform(4,8) | Outdoor UEs: 1.5 m Indoor UTs: 3(nfl – 1) + 1.5;  nfl ~ uniform(1,Nfl) where  Nfl ~ uniform(4,8) |
| Channel model variant | Alt. 1: Channel model A Alt. 2: Channel model B | (Channel model A or B is the same) |
| TRxP number per site | 3 | 3 |
| Mechanic tilt | 90° in GCS (pointing to horizontal direction) | 90° in GCS (pointing to horizontal direction) |
| Electronic tilt | (According to Zenith angle in "Beam set at TRxP") | (According to Zenith angle in "Beam set at TRxP") |
| Handover margin (dB) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) |
| TRxP boresight | 30 / 150 / 270 degrees | 30 / 150 / 270 degrees |
| UT attachment | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 The UE panel with the best receive SNR is chosen. i.e. no combining is done between panels. |
| Wrapping around method | Geographical distance based wrapping | Geographical distance based wrapping |
| Minimum distance of TRxP and UE | d2D\_min=10m | d2D\_min=10m |
| Polarized antenna model | Model-2 in TR36.873 | Model-2 in TR36.873 |
| Beam set at TRxP (Constraints for the range of selective analog beams per TRxP) | For direction of TRxP analog beam steering (in LCS): Azimuth angle φi = [-5\*pi/16, -3\*pi/16, -pi/16, pi/16, 3\*pi/16, 5\*pi/16]  Zenith angle θj = [5\*pi/8, 7\*pi/8]  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (φi, θj) is given by equation 1 in Appendix 1 (2D DFT beam) | For direction of TRxP analog beam steering (in LCS): Azimuth angle φi = [-5\*pi/16, -3\*pi/16, -pi/16, pi/16, 3\*pi/16, 5\*pi/16]  Zenith angle θj = [5\*pi/8, 7\*pi/8]  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (φi, θj) is given by equation 1 in Appendix 1 (2D DFT beam) |
| Beam set at UE (Constraints for the range of selective analog beams for UE) | - | For direction of UE analog beam steering (in LCS): Azimuth angle φi = [-3\*pi/8, -pi/8, pi/8, 3\*pi/8]; Zenith angle θj = [pi/4, 3\*pi/4];  NOTE: (azimuth, zenith)=(0, pi/2) is the direction perpendicular to the array. Precoder for beam at (φi, θj) is given by equation 1 in Appendix 1 (2D DFT beam) |
| Criteria for selection for serving TRxP | Maximizing RSRP with best analog beam pair, where the digital beamforming is not considered | Maximizing RSRP with best analog beam pair, where the digital beamforming is not considered |
| Criteria for analog beam selection for serving TRxP | Select the best beam pair among the limited set of DFT analog beams, based on the criteria of maximizing receive power after beamforming. | Select the best beam pair among the limited set of DFT analog beams, based on the criteria of maximizing receive power after beamforming. |
| Criteria for analog beam selection for interfering TRxP | Random selecting the random beams for non-serving TRxP | Random selecting the random beams for non-serving TRxP |

## Rural – eMBB

The baseline parameters are provided in Table 3.

Table 3 Baseline parameter for Rural – eMBB

|  |  |  |  |
| --- | --- | --- | --- |
| **Rural - eMBB** | Config. A | Config. B | Config. C (LMLC) |
| Carrier frequency for evaluation | 700 MHz | 4 GHz | 700 MHz |
| BS antenna height | 35 m | 35 m | 35 m |
| Total transmit power per TRxP | 46 dBm for 10 MHz bandwidth | 46 dBm for 10 MHz bandwidth | 46 dBm for 10 MHz bandwidth |
| UE power class | 23 dBm | 23 dBm | 23 dBm |
| Percentage of high loss and low loss building type | 100% low loss (applies to Channel model B) | 100% low loss (applies to Channel model B) | 100% low loss (applies to Channel model B) |
| Inter-site distance | 1732 m | 1732 m | 6000 m |
| Number of antenna elements per TRxP | 64 Tx/Rx, (M,N,P,Mg,Ng) = (8,4,2,1,1), (dH,dV) = (0.5, 0.8)λ  +45°, -45° polarization | 128Tx/Rx, (M,N,P,Mg,Ng) = (8,8,2,1,1), (dH,dV) = (0.5, 0.8)λ  +45°, -45° polarization | 64 Tx/Rx, (M,N,P,Mg,Ng) = (8,4,2,1,1), (dH,dV) = (0.5, 0.8)λ  +45°, -45° polarization |
| Number of TXRU per TRxP | 8TXRU, (Mp,Np,P,Mg,Ng) = (1,4,2,1,1) | 16TXRU, (Mp,Np,P,Mg,Ng) = (1,8,2,1,1) | 8TXRU, (Mp,Np,P,Mg,Ng) = (1,4,2,1,1) |
| Number of UE antenna elements | 2Tx/Rx, (M,N,P,Mg,Ng) = (1,1,2,1,1)  0°,90° polarization | 4Tx/Rx, (M,N,P,Mg,Ng) = (1,2,2,1,1), (dH,dV) = (0.5, N/A)λ  0°,90° polarization | 4Tx/Rx, (M,N,P,Mg,Ng) = (1,2,2,1,1), (dH,dV) = (0.5, N/A)λ  0°,90° polarization |
| Number of TXRU per UE | 2TXRU (1-to-1 mapping) | 4TXRU (1-to-1 mapping) | 4TXRU (1-to-1 mapping) |
| Device deployment | 50% indoor, 50% outdoor (in car) Randomly and uniformly distributed over the area | 50% indoor, 50% outdoor (in car) Randomly and uniformly distributed over the area | 40% indoor, 40% outdoor (pedestrian), 20% outdoor (in-car) Randomly and uniformly distributed over the area |
| UE mobility model | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction |
| UE speeds of interest | Indoor users: 3 km/h; Outdoor users (in-car): 120 km/h; | Indoor users: 3 km/h; Outdoor users (in-car): 120 km/h; | Indoor users: 3 km/h; Outdoor users (pedestrian): 3 km/h; Outdoor users (in-car): 30 km/h |
| Inter-site interference modeling | Explicitly modelled | Explicitly modelled | Explicitly modelled |
| BS noise figure | 5 dB | 5 dB | 5 dB |
| UE noise figure | 7 dB | 7 dB | 7 dB |
| BS antenna element gain | 8 dBi | 8 dBi | 8 dBi |
| BS antenna element pattern | See Table 1 in Section 3.6 | See Table 1 in Section 3.6 | See Table 1 in Section 3.6 |
| UE antenna element gain | 0 dBi | 0 dBi | 0 dBi |
| UE antenna element pattern | Omni-directional | Omni-directional | Omni-directional |
| Thermal noise level | -174 dBm/Hz | -174 dBm/Hz | -174 dBm/Hz |
| Traffic model | Full buffer | Full buffer | Full buffer |
| Simulation bandwidth | 10 MHz | 10 MHz | 10 MHz |
| UE density | 10 UEs per TRxP | 10 UEs per TRxP | 10 UEs per TRxP |
| UE antenna height | 1.5 m | 1.5 m | 1.5 m |
| Channel model variant | Alt. 1: Channel model A Alt. 2: Channel model B | Alt. 1: Channel model A Alt. 2: Channel model B | Alt. 1: Channel model A Alt. 2: Channel model B |
| TRxP number per site | 3 | 3 | 3 |
| Mechanic tilt | 90° in GCS (pointing to horizontal direction) | 90° in GCS (pointing to horizontal direction) | 90° in GCS (pointing to horizontal direction) |
| Electronic tilt | [100°] in LCS | [100°] in LCS | [96°] in LCS |
| Handover margin (dB) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) |
| TRxP boresight | 30 / 150 / 270 degrees | 30 / 150 / 270 degrees | 30 / 150 / 270 degrees |
| UT attachment | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 |
| Wrapping around method | Geographical distance based wrapping | Geographical distance based wrapping | Geographical distance based wrapping |
| Minimum distance of TRxP and UE | d2D\_min=10m | d2D\_min=10m | d2D\_min=10m |
| Polarized antenna model | Model-2 in TR36.873 | Model-2 in TR36.873 | Model-2 in TR36.873 |

## Urban Macro - mMTC

The baseline parameters are provided in Table 4.

Table 4 Baseline parameter for Urban Macro – mMTC

|  |  |  |
| --- | --- | --- |
| **Urban Macro - mMTC** | Config. A | Config. B |
| Carrier frequency for evaluation | 700 MHz | 700 MHz |
| BS antenna height | 25 m | 25 m |
| Total transmit power per TRxP[[1]](#footnote-1) | 46 dBm for 10 MHz bandwidth | 46 dBm for 10 MHz bandwidth |
| UE power class | 23 dBm | 23 dBm |
| Percentage of high loss and low loss building type | 20% high loss, 80% low loss (applies to Channel model B) | 20% high loss, 80% low loss (applies to Channel model B) |
| Inter-site distance | 500 m | 1732 m |
| Number of antenna elements per TRxP | 16 Tx/Rx, (M,N,P,Mg,Ng) = (8,1,2,1,1), (dH,dV) = (N/A, 0.8)λ  +45°, -45° polarization | 16 Tx/Rx, (M,N,P,Mg,Ng) = (8,1,2,1,1), (dH,dV) = (N/A, 0.8)λ  +45°, -45° polarization |
| Number of TXRU per TRxP | 2TXRU, (Mp,Np,P,Mg,Ng) = (1,1,2,1,1) | 2TXRU, (Mp,Np,P,Mg,Ng) = (1,1,2,1,1) |
| Number of UE antenna elements | 1Tx/Rx  0° polarization | 1Tx/Rx  0° polarization |
| Number of TXRU per UE | 1TXRU | 1TXRU |
| Device deployment | 80% indoor, 20% outdoor Randomly and uniformly distributed over the area | 80% indoor, 20% outdoor Randomly and uniformly distributed over the area |
| UE mobility model | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction. | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction. |
| UE speeds of interest | 3 km/h for indoor and outdoor | 3 km/h for indoor and outdoor |
| Inter-site interference modeling | Explicitly modelled | Explicitly modelled |
| BS noise figure | 5 dB | 5 dB |
| UE noise figure | 7 dB | 7 dB |
| BS antenna element gain | 8 dBi | 8 dBi |
| BS antenna element pattern | See Table 1 in Section 3.6 | See Table 1 in Section 3.6 |
| UE antenna element gain | 0 dBi | 0 dBi |
| UE antenna element pattern | Omni-directional | Omni-directional |
| Thermal noise level | -174 dBm/Hz | -174 dBm/Hz |
| Traffic model | Full buffer | Full buffer |
| Simulation bandwidth | 10 MHz | 10 MHz |
| UE density | 10 UEs per TRxP | 10 UEs per TRxP |
| UE antenna height | 1.5 m | 1.5 m |
| Channel model variant | Alt. 1: Channel model A Alt. 2: Channel model B | Alt. 1: Channel model A Alt. 2: Channel model B |
| TRxP number per site | 3 | 3 |
| Mechanic tilt | 90° in GCS (pointing to horizontal direction) | 90° in GCS (pointing to horizontal direction) |
| Electronic tilt | [99°] in LCS | [93°] in LCS |
| Handover margin (dB) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) |
| TRxP boresight | 30 / 150 / 270 degrees | 30 / 150 / 270 degrees |
| UT attachment | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 |
| Wrapping around method | Geographical distance based wrapping | Geographical distance based wrapping |
| Minimum distance of TRxP and UE | d2D\_min=10m | d2D\_min=10m |
| Polarized antenna model | Model-2 in TR36.873 | Model-2 in TR36.873 |

## Urban Macro – URLLC

The baseline parameters are provided in Table 5.

Table 5 Baseline parameter for Urban Macro – URLLC

|  |  |  |
| --- | --- | --- |
| **Urban Macro - URLLC** | Config. A | Config. B |
| Carrier frequency for evaluation | 4 GHz | 700 MHz |
| BS antenna height | 25 m | 25 m |
| Total transmit power per TRxP | 46 dBm for 10 MHz bandwidth | 46 dBm for 10 MHz bandwidth |
| UE power class | 23 dBm | 23 dBm |
| Percentage of high loss and low loss building type | 100% low loss (applies to Channel model B) | 100% low loss (applies to Channel model B) |
| Inter-site distance | 500 m | 500 m |
| Number of antenna elements per TRxP | 64 Tx/Rx, (M,N,P,Mg,Ng) = (8,4,2,1,1), (dH,dV) = (0.5, 0.8)λ  +45°, -45° polarization | 16 Tx/Rx, (M,N,P,Mg,Ng) = (8,1,2,1,1), (dH,dV) = (N/A, 0.8)λ  +45°, -45° polarization |
| Number of TXRU per TRxP | 8TXRU, (Mp,Np,P,Mg,Ng) = (1,4,2,1,1) | 2TXRU, (Mp,Np,P,Mg,Ng) = (1,1,2,1,1) |
| Number of UE antenna elements | 4Tx/Rx, (M,N,P,Mg,Ng) = (1,2,2,1,1), (dH,dV) = (0.5, N/A)λ  0°, 90° polarization | 2Tx/Rx, (M,N,P,Mg,Ng) = (1,1,2,1,1)  0°, 90° polarization |
| Number of TXRU per UE | 4TXRU (1-to-1 mapping) | 2TXRU (1-to-1 mapping) |
| Device deployment | 80% outdoor, 20% indoor Randomly and uniformly distributed over the area | 80% outdoor, 20% indoor Randomly and uniformly distributed over the area |
| UE mobility model | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction | Fixed and identical speed |v| of all UEs of the same mobility class, randomly and uniformly distributed direction |
| UE speeds of interest | 3 km/h for indoor and 30 km/h for outdoor | 3 km/h for indoor and 30 km/h for outdoor |
| Inter-site interference modeling | Explicitly modelled | Explicitly modelled |
| BS noise figure | 5 dB | 5 dB |
| UE noise figure | 7 dB | 7 dB |
| BS antenna element gain | 8 dBi | 8 dBi |
| BS antenna element pattern | See Table 1 in Section 3.6 | See Table 1 in Section 3.6 |
| UE antenna element gain | 0 dBi | 0 dBi |
| UE antenna element pattern | Omni-directional | Omni-directional |
| Thermal noise level | -174 dBm/Hz | -174 dBm/Hz |
| Traffic model | Full buffer | Full buffer |
| Simulation bandwidth | 10 MHz | 10 MHz |
| UE density | 10 UEs per TRxP | 10 UEs per TRxP |
| UE antenna height | 1.5 m | 1.5 m |
| Channel model variant | Alt. 1: Channel model A Alt. 2: Channel model B | Alt. 1: Channel model A Alt. 2: Channel model B |
| TRxP number per site | 3 | 3 |
| Mechanic tilt | 90° in GCS (pointing to horizontal direction) | 90° in GCS (pointing to horizontal direction) |
| Electronic tilt | [99°] in LCS | [99°] in LCS |
| Handover margin (dB) | 0 (i.e., the strongest cell is selected) | 0 (i.e., the strongest cell is selected) |
| TRxP boresight | 30 / 150 / 270 degrees | 30 / 150 / 270 degrees |
| UT attachment | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 | Based on RSRP (formula (8.1-1) in TR36.873) from port 0 |
| Wrapping around method | Geographical distance based wrapping | Geographical distance based wrapping |
| Minimum distance of TRxP and UE | d2D\_min=10m | d2D\_min=10m |
| Polarized antenna model | Model-2 in TR36.873 | Model-2 in TR36.873 |

## Antenna element pattern

The antenna element pattern is defined in Report ITU-R M.[IMT-2020.EVAL].

For BS side, the TRxP antenna element pattern is defined in Table 8-6 in Report ITU-R M.[IMT-2020.EVAL] for Dense Urban – eMBB, Rural – eMBB, Urban Macro – mMTC, and Urban macro – URLLC test environments. For Indoor Hotspot, the TRxP antenna element pattern is defined in Table 8-7 in Report ITU-R M.[IMT-2020.EVAL]. They are copied in Table 6 and Table 7 for reference.

Table 6\*

BS antenna element radiation pattern for   
Dense Urban – eMBB, Rural – eMBB, Urban Macro – mMTC, and Urban Macro - URLLC

|  |  |
| --- | --- |
| Parameters | Values |
| 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* | 8 dBi |

\* Note: This is a copy of Table 8-6 in Report ITU-R M.[IMT-2020. EVAL]

Table 7\*

BS antenna element radiation pattern for Indoor Hotspot - eMBB

|  |  |
| --- | --- |
| Parameters | Values |
| 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 |

\* Note: This is a copy of Table 8-7 in Report ITU-R M.[IMT-2020. EVAL]

For UE side, the UE antenna element pattern is Omni-directional for 4 GHz and 700 MHz; while for 30 GHz and 70 GHz, it is defined in Table 8-8 in Report ITU-R M.[IMT-2020.EVAL], which is copied to Table 8 for reference.

Table 8\*

UE antenna element radiation pattern for 30 GHz and 70 GHz

|  |  |
| --- | --- |
| Parameters | Values |
| Antenna element radiation pattern in dim (dB) |  |
| Antenna element radiation pattern in dim (dB) |  |
| Combining method for 3D antenna element pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5 dBi |

\* Note: This is a copy of Table 8-8 in Report ITU-R M.[IMT-2020. EVAL]

# Calibration results

The calibration results are provided in the attachment below. Until Dec 8th, thirteen 3GPP members provided the calibration results, including Huawei, CATT, CATR, China Telecom, OPPO, ZTE, ITRI, Ericsson, MediaTek, Intel, Samsung, Qualcomm, and NTT DOCOMO.

It is observed that most of the calibration results are well aligned according to the results collected so far.

A summary of the progress (samples collected of each test environment and evaluation configuration) is shown in Appendix 2.

***Attachment***: Calibration results until Dec 8, 2017.

# Summary and Recommendations

In this email discussion “[ITU-R AH 01] Calibration for self-evaluation”, the calibration metrics and calibration parameters are discussed and captured in section 3 and 4. The calibration results are provided in section 5. It is observed that the calibration results are well aligned according to the results collected so far.

Considering the tight time schedule of this email discussion, more companies may want to provide their calibration results. It is therefore proposed to extend the calibration to Jan 2018.

# References

1. RP-172101, “WF on Work plan of Self Evaluation SI”, Huawei, Ericsson, Telecom Italia, September 2017.
2. RP-172098, “3GPP submission towards IMT-2020”, ITU-R Ad-Hoc Contact person, September 2017.
3. Report ITU-R M.[IMT-2020.EVAL], “Guidelines for evaluation of radio interface technologies for IMT-2020”, ITU-R WP 5D, June 2017, available in RP-171559.

# Appendix 1: 2D DFT precoder

The TRxP planar array (or linear array) is illustrated in Figure 5.4.4.1.3-1 in TR37.840. In this plot, the steering azimuth angle is φ, and the steering zenith angle is θ.

dH

z

u

dv

φ

θ

x

y

……

Figure 5.4.4.1.3-1: Geometry distribution of AAS with multiple columns array

The 2D DFT beam precoder (virtualization weight vector) is used for the calibration purpose. The 2D sub-array partition model is assumed for generating the virtualization weight vector. And one TXRU is only connected to antenna elements with the same polarization. In this case, the weight vector for the TXRU mapping to KxL antenna elements at the direction of (φi, θj) is given by equation 1 as follows

**g**(φi, θj)= **v**s⊗**wo (1)**

- The length of **wo** is given by K = M/Mp, Mp is the number of TXRU in vertical domain;

- The length of **v**i is given by L = N/Np, Np is the number of TXRU in azimuth domain

**- wo** (vertical virtualization weight vector) for  is given by



**- v**s (horizontal virtualization weight vector) for is given by



# Appendix 2: Collected samples

Until Dec 8th, thirteen 3GPP members provided the calibration results, including Huawei, CATT, CATR, China Telecom, OPPO, ZTE, ITRI, Ericsson, MediaTek, Intel, Samsung, Qualcomm, and NTT DOCOMO. A summary of the progress (collected samples of each test environment and evaluation configuration) is shown in Table 9.

Table 9 Number of calibration samples for each test environment (until Dec 4th)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test environment** | **Evaluation configuration** | **Channel model** | **Number of samples** | **Remarks (contributor list)** |
| Indoor Hotspot - eMBB | Config. A (4 GHz) | Channel model A | For 12TRxP: 8  For 36TRxP: 7 | Huawei, CATT, CATR, OPPO, ZTE (for 12TRxP), MediaTek, Intel, Samsung |
| Channel model B | For 12TRxP: 9  For 36TRxP: 7 | Huawei, CATT, CATR, China Telecom, OPPO, ZTE (for 12TRxP), MediaTek, Intel, Samsung (for 12TRxP) |
| Config. B (30 GHz) | Channel model A/B | For 12TRxP: 6  For 36TRxP: 5 | Huawei, CATT, CATR, ZTE (for 12TRxP), MediaTek, Samsung |
| Config. C (70 GHz) | Channel model A/B | For 12TRxP: 4  For 36TRxP: 4 | Huawei, CATT, CATR, MediaTek |
| Dense Urban - eMBB | Config. A (4 GHz) | Channel model A | 6 | Huawei, CATT, CATR, OPPO, ZTE, Intel |
| Channel model B | 7 | Huawei, CATT, CATR, OPPO, ZTE, Intel, NTT DOCOMO |
| Config. B (30 GHz) | Channel model A/B | 7 | Huawei, CATT, CATR, OPPO, Intel, Samsung, NTT DOCOMO |
| Rural - eMBB | Config. A (1732 m, 700 MHz) | Channel model A | 10 | Huawei, CATT, CATR, China Telecom, OPPO, ZTE, Ericsson, MediaTek, Intel, Samsung |
| Channel model B | 11 | Huawei, CATT, CATR, China Telecom, OPPO, ZTE, Ericsson, MediaTek, Intel, Samsung, NTT DOCOMO |
| Config. B (1732 m, 4 GHz) | Channel model A | 10 | Huawei, CATT, CATR, China Telecom, OPPO, ZTE, Ericsson, MediaTek, Intel, Samsung |
| Channel model B | 11 | Huawei, CATT, CATR, China Telecom, OPPO, ZTE, Ericsson, MediaTek, Intel, Samsung, NTT DOCOMO |
| Config. C (LMLC, 6000 m, 700 MHz) | Channel model A | 5 | Huawei, CATT, CATR, ZTE, MediaTek |
| Channel model B | 6 | Huawei, CATT, CATR, ZTE, MediaTek, NTT DOCOMO |
| Urban Macro - mMTC | Config. A (500 m, 700 MHz) | Channel model A | 9 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, MediaTek |
| Channel model B | 10 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, NTT DOCOMO, MediaTek |
| Config. B (1732 m, 700 MHz) | Channel model A | 9 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, MediaTek |
| Channel model B | 9 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, NTT DOCOMO, MediaTek |
| Urban Macro - URLLC | Config. A (4 GHz) | Channel model A | 9 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, MediaTek |
| Channel model B | 11 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, Qualcomm, NTT DOCOMO, MediaTek |
| Config. B (700 MHz) | Channel model A | 9 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, MediaTek |
| Channel model B | 11 | Huawei, CATT, CATR, OPPO, ZTE, ITRI, Ericsson, Intel, Qualcomm, NTT DOCOMO, MediaTek |

1. This parameter(s) is/are used for cell association [↑](#footnote-ref-1)