**3GPP TSG-RAN4 Meeting #113 *R4-2419811***

**Orlando, United States, 18th - 22nd November, 2024**

**Agenda item:** 7.12.2.3

**Source:** Keysight Technologies UK Ltd, Spirent Communications

**Title:** TP for TR 38.762:On Dynamic MIMO OTA Testing

**Document for:** Approval

# Introduction

This contribution is incorporating additional channel model validation details and corrections.

# Discussion

The draft TP includes the following aspects:

* In Clause 8.2.1, update the measurement setup diagrams
* Correct the normalized PL values for UMi route in Table 8.2.2.4-2
* In Clause 8.2.3.6, define the PDP target values for UMa and UMi routes
* In Clause 8.2.4, update TCF targets for UMa route
* In Clause 8.2.5, clarify the offset distances
* In Annex A, correct ‘UE DoT Az’ for UMi route segments 7 through 10
* Misc editorial corrections

It should be noted that the UMa channel model targets from CTIA underwent an extensive alignment between Keysight and Spirent.

It is proposed to approve the TP with the understanding that additional changes and modifications can be made.

Proposal 1: approve the TP with the understanding that additional changes and modifications can be made

<<< Skip Unchanged Sections >>>

**<<< START OF CHANGES >>>**

## 8.2 Validation of the dynamic channel models

### 8.2.1 Measurement Setup

The measurement setup includes the following equipment listed in Table 8.2.1-1.

Table 8.2.1-1: Required Measurement Equipment

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | Quantity | Item | PL | PDP | TCF | SCF | XPO |
| 1 | 1 | Channel Emulator (CE) | x | x | x | x | x |
| 2 | 1 | Signal Generator (SG) (Optional, Note 1-2) | x | (x) | x | (x) | x |
| 3 | 1 | Signal Analyser (SAN)  | x | (x) | x | (x) | x |
| 4 | 1 | Vector Network Analyser (VNA) (Note 3) | - | (x) | - | (x) | - |
| 5 | 1 | Dipole  | x | x | x | x | x |
| 6 | 1 | Loop | - | - | - | - | x |
| Note 1. VNA can typically generate CW.Note 2. Some gNB emulators can generate NR/AWGN signals in non-signaling mode.Note 3. Frequency domain method uses VNA and time domain method SG + SAN. |

#### 8.2.1.1 Network Analyser (VNA) Setup

Figure 8.2.1.1-1 shows a typical network analyser setup for channel model validation purposes.

 

Figure 8.2.1.1-1: Setup for Anechoic Chamber VNA Measurements

#### 8.2.1.2 Signal Analyser (SAN) Setup

Figure 8.2.1.2-1 shows a typical signal generator and signal analyser setup for channel model validation purposes. Depending on CE implementation, the trigger direction between SAN and CE needs to be adjusted, i.e., from SAN to CE or from CE to SAN.



Figure 8.2.1.2-1: Setup for Signal Analyser Measurements

### 8.2.2 Validation of dynamic path loss

The intention of this validation measurement is to capture the emulated dynamic path loss (PL) as it is realized in the centre of the test zone. Measurement antenna is a vertical dipole.

#### 8.2.2.1 PL Method of Measurement

The measurement antenna is placed in the centre of the test zone. Time domain technique depicted in Figure 8.2.1.2-1 is used. Table 8.2.2.1-1 outlines the settings for the channel emulator, signal generator, and signal analyser respectively.

The time domain technique (time sweep) is used for the validation. A signal generator transmits a CW signal through the test system. The CW signal is split to two input ports of fading emulator that correspond to the two first signal streams of the gNB emulator, i.e., two orthogonally polarized co-located gNB antennas. The signal is received by a test antenna within the test area. Finally, the signal is collected by a signal analyser and the measured signal is stored. Signal generator and signal analyser settings are listed in Tables 8.2.2.1-2 and 8.2.2.1-3, respectively. The measurement is triggered to start with the time instant 0 of the channel model and to stop at the last time instant of the channel model.

Table 8.2.2.1-1: MPAC Dynamic Channel Model Specification

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Channel emulator mode | N/A | Triggered start and stop |
| Channel model |  | As specified in Clause 7.1 |
| Mobile speed | km/h | Dynamic, as specified in Clause 7.1 |

Table 8.2.2.1-2: MPAC Path Loss Signal Generator Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Output Power | dBm | Function of the CE. Sufficiently above Noise Floor |

Table 8.2.2.1-3: MPAC Path Loss Signal Analyser Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Sampling | Hz | At least 15 times bigger than the max Doppler spread (*fd=v/λ)* |
| Observation time | s | One full duration of the channel model route. |

The channel emulator should issue a trigger signal when the channel model is started. When the channel model is run to the end, another trigger signal is issued. A time domain trace with the SAN is collected. Data recording is synchronized with the channel emulator trigger.

<<< Skip Unchanged Sections >>>

#### 8.2.2.4 PL Target Values

 The target values for the UMa route are specified in Table 8.2.2.4-1 and illustrated in Figure 8.2.2.4-1 while the target values for the UMi route are specified in Table 8.2.2.4-2 and illustrated in Figure 8.2.2.4-2.

Table 8.2.2.4-1: Dynamic Path Gain (Path Loss) Target Values for the Measured Normalized Channel Gain for the UMa Route

|  |  |
| --- | --- |
| Segment # | Target [dB] |
| 1 | [-0.8] |
| 2 | [0] |
| 3 | [-29.5] |
| 4 | [-27.6] |
| 5 | [-21.5] |
| 6 | [-30.1] |
| 7 | [-0.1] |
| 8 | [-19.8] |
| 9 | [-0.7] |



Figure 8.2.2.4-1: Dynamic Path Gain (Path Loss) Targets for the Measured Normalized Channel Gain for the UMa Route

Table 8.2.2.4-2: Dynamic Path Gain (Path Loss) Target Values for the Measured Normalized Channel Gain for the UMi Route

|  |  |
| --- | --- |
| Segment # | Target [dB] |
| 1 | [-7.5] |
| 2 | [0] |
| 3 | [-16.6] |
| 4 | [-12.9] |
| 5 | [-16.5] |
| 6 | [-0.9] |
| 7 | [-0.7] |



Figure 8.2.2.4-2: Dynamic Path Gain (Path Loss) Targets for the Measured Normalized Channel Gain for the UMi Route

<<< Skip Unchanged Sections >>>

#### 8.2.3.1 PDP Method of Measurement using Frequency-Domain Technique

A network analyser transmits frequency tones through the test system when the frequency sweep technique is used in the validation. See Figure 8.2.1.1-1 for the block diagram. The signal is received by a test antenna within the test area. During each frequency sweep the channel model is paused by the channel emulator. After the sweep, channel model is stepped to the next time instant and paused again for the next frequency sweep. The time increment between consecutive frequency sweeps measuring the frequency responses of channel model instances is defined in Table 8.2.3.1-1. It is at most the inverse of twice the maximum Doppler frequency, i.e., .

Channel model segments are specified in Tables 8.2.2.3-1 and 8.2.2.3-2. At the first time instant of a segment the model is paused and the complex channel frequency response is measured and stored. This is repeated with the specified time increment until the whole time segment is covered. The sequence of measured channel responses of the segment is analysed as defined in clause 8.2.3-4. The subsequent channel segments are measured then correspondingly. Network analyser settings are defined in Table 8.2.3.1-1. The measured channel frequency response of channel model segment at frequency and channel model time instant is

where is the lowest frequency point, is the index of frequency point, is the spacing between frequency points, is the first time instant of segment , is the index of time instants, and is the increment between measured time instants.

Table 8.2.3.1-1: MPAC PDP Network Analyser Settings

| Item | Unit | Value |
| --- | --- | --- |
| Bandwidth | MHz | 200 |
| Number of frequency points | - | 1101 |
| Number of traces | - | One per every CIR within the segment |

<<< Skip Unchanged Sections >>>

#### 8.2.3.6 PDP Target Values

The target values for the UMa route are specified in [Table 8.2.3.6-1](#_Hlk176087530) and illustrated in [Figure 8.2.3.6-1](#_Hlk176087417) which uses the time segments defined in [Table 8.2.2.3-1](#_Hlk176085569" \s "1,68642,68657,4094,TABLHEADER BEST,Table 4.2.1.2-1). The target values for the UMi route are specified in [Table 8.2.3.6-2](#_Hlk176087530) and illustrated in [Figure 8.2.3.6-2](#_Hlk176087417) which uses the time segments defined in [Table 8.2.2.3-2](#_Hlk176085569" \s "1,68642,68657,4094,TABLHEADER BEST,Table 4.2.1.2-1). Note that red lines in the figures denote the power per excess delay and blue lines the power per cluster index. Entries of the table contain either discrete excess delay/power pairs or cluster index/power pairs, depending on the segment type. In the case of segments with time variant excess delays the initial and final excess delays of clusters must be as specified in the model parameter tables in Annex A and rounded to the delay resolution supported by the measurement bandwidth (1/200 MHz = 5 ns).



Figure 8.2.3.6-1 Target PDP Segments of the Dynamic UMa Channel Model

Table 8.2.3.6-1 Dynamic PDP Targets of the UMa Route

|  |  |  |
| --- | --- | --- |
| Segment # |  | UMa Target PDP |
| 1 | Delay [ns] | [0, 130, 170, 245, 380, 745, 885] |
| Power [dB] | [0, -18.5, -20.2, -22.5, -36.0, -25.5, -31.9] |
| 2 | Delay [ns] | [0, 130, 170, 245, 380, 745, 885] |
| Power [dB] | [0, -19.2, -20.9, -23.2, -32.8, -23.9, -34.5] |
| 3 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-9.8, 0.0, -1.9, -6.3, -8.2, -6.6, -3.3, -8.9, -8.3, -11.7, -8.5, -16.3, -10.0, -13.4, -12.1, -12.8, -29.3, -29.0, -18.4, -19.3, -17.5, -31.9, -29.8] |
| 4 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-15.0, 0.0, -2.0, -9.7, -11.8, -14.2, -3.9, -13.3, -6.9, -20.8, -6.5, -16.0, -19.0, -17.5, -12.3, -11.3, -28.2, -29.1, -22.3, -18.2, -17.2, -30.3, -28.0] |
| 5 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-8.2, -0.8, -3.7, -3.5, -5.2, 0.0, -1.6, -3.7, -10.4, -10.1, -13.4, -22.5, -7.9, -13.5, -16.2, -18.9, -23.1, -21.4, -23.4, -22.5, -20.3, -26.5, -33.1] |
| 6 | Delay [ns] | [0, 80, 235, 300, 340, 445, 475, 790, 985, 1550, 1675, 2000, 2040, 2295, 2415, 2565] |
| Power [dB] | [-13.0, -3.3, 0.0, -12.6, -33.3, -15.8, -19.7, -25.1, -18.0, -17.8, -16.4, -39.6, -20.4, -19.0, -20.7, -29.4] |
| 7 | Delay [ns] | [0, 50, 65, 175, 240, 335, 495, 1090, 1875] |
| Power [dB] | [0, -17.1, -21.2, -15.0, -21.0, -24.9, -19.9, -32.8, -32.8] |
| 8 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [0.0, -5.7, -7.9, -11.5, -15.2, -15.4, -9.1, -14.1, -14.0, -19.6, -12.3, -19.9, -25.2, -20.9, -26.6, -27.9, -23.1, -25.6, -26.3, -33.4, -35.9, -27.5, -38.8] |
| 9 | Delay [ns] | [0, 60, 130, 170, 245, 380, 745, 885, 1180] |
| Power [dB] | [0, -36.1, -17.9, -19.5, -22.0, -38.8, -27.0, -29.5, -38.7] |



Figure 8.2.3.6-2 Target PDP Segments of the Dynamic UMi Channel Model

Table 8.2.3.6-2 Dynamic PDP Targets of the UMi Route

|  |  |  |
| --- | --- | --- |
| Segment # |  | UMi Target PDP |
| 1 | Cluster index  | 1, 2, ...11, 13, …, 18 |
| Power [dB] | [0.0, -21.9, -22.5, -24.3, -16.8, -16.7, -16.5, -18.3, -25.5, -24.5, -29.6, -24.0, -30.0, -34.7, -40.0, -39.9, -37.8] |
| 2 | Delay [ns] | [0, 35, 75, 100, 140, 430, 510, 680] |
| Power [dB] | [0.0, -35.0, -17.4, -18.8, -21.5, -28.8, -28.2, -37.5] |
| 3 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-17.1, 0.0, -2.8, -2.8, -4.8, -1.6, -2.0, -4.4, -5.9, -9.0, -6.1, -26.4, -7.5, -21.5, -20.3, -10.7, -15.2, -16.2, -16.8, -16.8, -15.5, -19.2, -23.6] |
| 4 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-11.3, 0.0, -2.5, -4.3, -6.1, -2.0, -2.0, -5.2, -7.8, -11.5, -8.4, -21.8, -9.3, -15.9, -16.6, -13.6, -21.0, -20.8, -19.5, -19.3, -18.0, -24.4, -27.7] |
| 5 | Cluster index  | 1, 2, ..., 23 |
| Power [dB] | [-11.0, 0.0, -2.0, -5.6, -7.5, -5.9, -3.1, -8.2, -8.1, -11.2, -8.4, -17.6, -9.4, -14.4, -13.3, -12.5, -27.1, -26.7, -17.5, -18.8, -16.6, -30.1, -28.9] |
| 6 | Delay [ns] | [0, 30, 100, 140, 195, 285] |
| Power [dB] | [0.0, -20.5, -17.4, -25.9, -33.6, -20.0] |
| 7 | Delay [ns] | [0, 30, 100, 140, 195, 285] |
| Power [dB] | [0.0, -20.9, -16.5, -24.2, -30.6, -20.0] |

### 8.2.4 Validation of Doppler/Temporal Correlation

The purpose of this item is to validate the slow variation of Doppler effect due of the dynamic channel model. This is done indirectly by observing the temporal correlation function (TCF). TCF at a few time lags are evaluated from the measured narrowband signal transmitted through the test system.

#### 8.2.4.1 TCF Method of Measurement

The time domain technique (time sweep) is used for the validation. See the block diagram of the setup in Figure 8.2.1.2-1. A signal generator transmits a CW signal through the test system. The signal is received by a test antenna within the test area. Finally, the signal is collected by a signal analyser and the measured signal is stored. Signal analyser and signal generator settings are defined in Tables 8.2.4.1-1 and 8.2.4.1-2. The measurement is triggered to start with the time instant 0 of the channel model and to stop at the last time instant of the channel model.

Table 8.2.4.1-1: MPAC TCF Signal Generator Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Output Power | dBm | Function of the CE. Sufficiently above Noise Floor |

Table 8.2.4.1-2: MPAC TCF Signal Analyser Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Sampling | Hz | At least 15 times bigger than the max Doppler spread (fd=v/λ) |
| Observation time | s | One full duration of the channel model route. |

The signal analyser records I/Q samples at the rate of 15 times the maximum Doppler frequency (72.24 Hz). The full model length is measured at once.

<<< Skip Unchanged Sections >>>

#### 8.2.4.5 TCF Target Values

The target values for the UMa route are specified in [Table 8.2.4.5-1](#_Hlk176087530) and illustrated in [Figure 8.2.4.5-1](#_Hlk176087417) which uses the time segments defined in [Table 8.2.2.3-1](#_Hlk176085569" \s "1,68642,68657,4094,TABLHEADER BEST,Table 4.2.1.2-1). The target values for the UMi route are specified in [Table 8.2.4.5-2](#_Hlk176087530) and illustrated in [Figure 8.2.4.5-2](#_Hlk176087417) which uses the time segments defined in [Table 8.2.2.3-2](#_Hlk176085569" \s "1,68642,68657,4094,TABLHEADER BEST,Table 4.2.1.2-1). Estimated temporal correlation values at time lag ms and ms are illustrated in the top and bottom figure, respectively. Target values are shown within time segment limits.

 ****

Figure 8.2.4.5-1 Temporal Correlation Function of UMa Route for Two Different TFC Time Lags

Table 8.2.4.5-1 Dynamic Temporal Correlation Targets of the UMa Route

|  |  |  |
| --- | --- | --- |
| Segment # | Target TCF at ms  | Target TCF at ms |
| 1 | [0.970] | [0.876] |
| 2 | [0.961] | [0.879] |
| 3 | [0.994] | [0.886] |
| 4 | [0.436] | [0.355] |
| 5 | [0.648] | [0.345] |
| 6 | [0.523] | [0.100] |
| 7 | [0.801] | [0.228] |
| 8 | [0.837] | [0.399] |
| 9 | [0.940] | [0.616] |

 ****

Figure 8.2.4.5-2 Temporal Correlation Function of UMi Route for Two Different TFC Time Lags

Table 8.2.4.5-2 Dynamic Temporal Correlation Targets of the UMi Route

|  |  |  |
| --- | --- | --- |
| Segment # | Target TCF at ms  | Target TCF at ms |
| 1 | [0.871] | [0.437] |
| 2 | [0.952] | [0.857] |
| 3 | [0.514] | [0.195] |
| 4 | [0.698] | [0.071] |
| 5 | [0.743] | [0.372] |
| 6 | [0.959] | [0.814] |
| 7 | [0.965] | [0.854] |

<<< Skip Unchanged Sections >>>

#### 8.2.5.1 SCF Method of Measurement

The time domain technique (time sweep) is used for the validation. See the block diagram of the setup in Figure 8.2.1.2-1. A signal generator transmits a CW signal through the test system. The CW signal is split to two input ports of fading emulator that correspond to the two first signal streams of the gNB emulator. The signal is received by a test antenna in a specific position within the test area. Finally, the signal is collected by a signal analyser and the measured signal is stored. Signal analyser and signal generator settings are defined in Tables 4.2.3.1-1 and 4.2.3.1-2. The measurement is triggered to start with the time instant 0 of the channel model and to stop at the last time instant of the channel model. The position of test antenna is changed and the measurement is repeated. All spatial positions are illustrated in Figure 8.2.5.1-1.

Table 8.2.5.1-1: MPAC SCF Signal Generator Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Output Power | dBm | Function of the CE. Sufficiently above Noise Floor |

Table 8.2.5.1-2: MPAC SCF Signal Analyser Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Sampling | Hz | At least 15 times bigger than the max Doppler spread (fd=v/λ) |
| Observation time | s | One full duration of the channel model route. |

The full model length is measured at once.



Figure 8.2.5.1-1: Spatial sampling points within the test zone at 2450 MHz

Table 8.2.5.1-3: Spatial sample points, i.e., positions of test antenna for the SCF validation at 2450 MHz

| Point number | x [mm] | y [mm] | z [mm] |
| --- | --- | --- | --- |
| #1 (reference point) | 0 | -150 | 0 |
| #2 | -22.88 | -148.29 | 0 |
| #3 | -86.27 | -122.71 | 0 |
| #4 | -149.90 | -5.73 | 0 |

#### 8.2.5.2 SCF Measurement Antenna

The measurement antenna shall be a vertically-oriented dipole

#### 8.2.5.3 SCF Measurement Results Analysis

Time segments of recorded I/Q samples are selected. For each time segment the cross correlation (with zero time lag) of I/Q samples measured in different spatial sample points is calculated. Spatial sample points picked for SFC have at maximum Euclidian distance D*d* = 1.7 wavelength to the reference sample point. Absolute values of estimated complex spatial correlations per time segment are chosen as the target SCF values.

#### 8.2.5.4 Target Values

The target values for the UMa route are specified in [Table](#_Hlk176088316" \s "1,89079,89094,4094,TABLHEADER BEST,Table 4.2.4.2-1) 8.2.5.4-1 and illustrated in [Figure 8.2.5.4-1](#_Hlk176088241" \s "1,88764,88780,4094,FIGBEST,Figure 4.2.4.2-1), which uses the time segments along the dynamic UMa model proposed in [Table 8.2.2.3-1](#_Hlk176085569). The target values for the UMi route are specified in [Table](#_Hlk176088316" \s "1,89079,89094,4094,TABLHEADER BEST,Table 4.2.4.2-1) 8.2.5.4-2 and illustrated in [Figure 8.2.5.4-2](#_Hlk176088241" \s "1,88764,88780,4094,FIGBEST,Figure 4.2.4.2-1), which uses the time segments along the dynamic UMi model proposed in [Table 8.2.2.3-2](#_Hlk176085569). Estimated spatial correlation values at spatial spacing  mm,  mm, and  mm (referenced to reference point #1) are illustrated in Figures 8.2.5.4-1 and 8.2.5.4-2. Target values are shown within time segment limits. ****

Figure 8.2.5.4-1: Spatial Correlation Function of UMa Route for Three Different SFC Test Antenna Positions

Table 8.2.5.4-1: Dynamic Spatial Correlation Targets of the UMa Route for 2450 MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Segment # | Target SCF at mm  | Target SCF at mm  | Target SCF at mm  |
| 1 | [0.986] | [0.908] | [0.932] |
| 2 | [0.963] | [0.611] | [0.326] |
| 3 | [0.800] | [0.160] | [0.111] |
| 4 | [0.699] | [0.721] | [0.492] |
| 5 | [0.831] | [0.414] | [0.156] |
| 6 | [0.794] | [0.393] | [0.454] |
| 7 | [0.928] | [0.481] | [0.367] |
| 8 | [0.834] | [0.283] | [0.605] |
| 9 | [0.959] | [0.574] | [0.220] |

 ****

Figure 8.2.5.4-2: Spatial Correlation Function of UMi Route for Three Different SFC Test Antenna Positions

Table 8.2.5.4-2: Dynamic Spatial Correlation Targets of the UMi Route for 2450 MHz

|  |  |  |  |
| --- | --- | --- | --- |
| Segment # | Target SCF at mm  | Target SCF at mm  | Target SCF at mm  |
| 1 | [0.944] | [0.758] | [0.733] |
| 2 | [0.981] | [0.937] | [0.939] |
| 3 | [0.787] | [0.228] | [0.153] |
| 4 | [0.764] | [0.328] | [0.314] |
| 5 | [0.856] | [0.572] | [0.286] |
| 6 | [0.973] | [0.809] | [0.685] |
| 7 | [0.982] | [0.950] | [0.943] |

<<< Skip Unchanged Sections >>>

#### 8.2.6.1 XPO Method of Measurement

The time domain technique (time sweep) is used for the validation. See the block diagram of the setup in Figure 8.2.1.2-1. A signal generator transmits a CW signal through the test system. The CW signal is split to two input ports of fading emulator that correspond to the two first signal streams of the gNB emulator, i.e., that correspond to two co-located ±45° slanted linearly polarized elements. The signal is received by a vertically polarized test antenna within the test area. Finally, the signal is collected by a signal analyser and the measured signal is stored. Signal generator and signal analyser settings are listed in Tables 8.2.6.1-1 and 8.2.6.1-2. The measurement is triggered to start with the time instant 0 of the channel model and to stop at the last time instant of the channel model. The measurement is repeated with a horizontally polarized test antenna, placed in the same position. The result is a stored sequence of channel gains of segment received with the vertically and horizontally polarized test antennas are denoted and , respectively, where Note that the time increment and correspondingly the number of stored time samples is different in this measurement as compared to the PDP measurement.

Table 8.2.6.1-1: MPAC path loss Signal Generator Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Output Power | dBm | Function of the CE. Sufficiently above Noise Floor |

Table 8.2.6.1-2: MPAC path loss Signal Analyser Settings

| Item | Unit | Value |
| --- | --- | --- |
| Centre frequency | MHz | 2450 |
| Sampling | Hz | At least 15 times bigger than the max Doppler spread (fd=v/λ) |
| Observation time | s | One full duration of the channel model route. |

<<< Skip Unchanged Sections >>>

Annex A:
Channel model parameters

Table A-1: Parameter Table for Dynamic UMa Channel Model

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Way point | 1 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 179.99 | -0.01 | 0 | 93.09 |
| 1 | -13.83 | 0 | 179.99 | -0.01 | 29.75 | 93.09 |
| 2 | -19.13 | 3 | -157.71 | 79.75 | 29.75 | 89.46 |
| 3 | -21.33 | 58 | -157.71 | 79.75 | 26.775 | 89.46 |
| 4 | -23.13 | 128 | -157.71 | 79.75 | 23.8 | 89.46 |
| 5 | -18.23 | 132 | 116.76 | 11.61 | 29.75 | 92.81 |
| 6 | -23.23 | 167 | -20.09 | 30.93 | 29.75 | 93.09 |
| 7 | -20.43 | 170 | 116.76 | 11.61 | 26.775 | 92.81 |
| 8 | -22.23 | 244 | 116.76 | 11.61 | 23.8 | 92.81 |
| 9 | -28.13 | 380 | 147.62 | -57.68 | 29.75 | 90.27 |
| 10 | -23.93 | 747 | -14.52 | -29.43 | 29.75 | 91.08 |
| 11 | -25.13 | 887 | 44.63 | 47.02 | 29.75 | 94.57 |
| 12 | -30.33 | 913 | 95.59 | -118.13 | 29.75 | 88 |
| 13 | -28.03 | 1178 | 177.77 | 69.02 | 29.75 | 89.74 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1456 | 11 | 94.69 | 90 | 4.47 | 0 | 0.84 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 125.17 | (435.78,-0.11,1.5) | (0,0,25) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 2 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | -162.14 | 17.86 | 0 | 93.6 |
| 1 | -13.83 | 0 | -162.14 | 17.86 | 29.75 | 93.6 |
| 2 | -19.13 | 3 | -139.84 | 97.62 | 29.75 | 88.68 |
| 3 | -21.33 | 58 | -139.84 | 97.62 | 26.775 | 88.68 |
| 4 | -23.13 | 128 | -139.84 | 97.62 | 23.8 | 88.68 |
| 5 | -18.23 | 132 | 134.63 | 29.48 | 29.75 | 93.22 |
| 6 | -23.23 | 167 | -2.22 | 48.8 | 29.75 | 93.6 |
| 7 | -20.43 | 170 | 134.63 | 29.48 | 26.775 | 93.22 |
| 8 | -22.23 | 244 | 134.63 | 29.48 | 23.8 | 93.22 |
| 9 | -28.13 | 380 | 165.49 | -39.81 | 29.75 | 89.78 |
| 10 | -23.93 | 747 | 3.35 | -11.56 | 29.75 | 90.87 |
| 11 | -25.13 | 887 | 62.5 | 64.89 | 29.75 | 95.61 |
| 12 | -30.33 | 913 | 113.46 | -100.26 | 29.75 | 86.71 |
| 13 | -28.03 | 1178 | -164.36 | 86.89 | 29.75 | 89.06 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1247 | 11 | 92.38 | 90 | 4.47 | 0 | 1.14 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 112.77 | (355.11,114.39,1.5) | (0,0,25) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 3 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -77.57 | -18.59 | 15.63 | 102.25 |
| 2 | -8.89 | 76 | 137.57 | -2.91 | 15.63 | 102.71 |
| 3 | -10.19 | 79 | -105.19 | -14.7 | 15.63 | 103.35 |
| 4 | -11.19 | 81 | 137.57 | -2.91 | 14.067 | 102.71 |
| 5 | -12.89 | 85 | 137.57 | -2.91 | 12.504 | 102.71 |
| 6 | -7.69 | 232 | -169.91 | 12.32 | 15.63 | 102.9 |
| 7 | -9.89 | 235 | -169.91 | 12.32 | 14.067 | 102.9 |
| 8 | -11.59 | 239 | -169.91 | 12.32 | 12.504 | 102.9 |
| 9 | -15.09 | 240 | 70.25 | 60.29 | 15.63 | 104.83 |
| 10 | -14.79 | 289 | 81.82 | -30.38 | 15.63 | 101.64 |
| 11 | -18.39 | 299 | -22.44 | 64.97 | 15.63 | 105.12 |
| 12 | -18.79 | 340 | 61.39 | -51.87 | 15.63 | 101.06 |
| 13 | -12.79 | 447 | 83.48 | -24.32 | 15.63 | 104.35 |
| 14 | -14.49 | 476 | -43.91 | -30.25 | 15.63 | 104.51 |
| 15 | -16.39 | 790 | 97.45 | -39.61 | 15.63 | 100.9 |
| 16 | -20.89 | 987 | 44.51 | 79.79 | 15.63 | 104.51 |
| 17 | -21.59 | 1551 | -4.58 | 77.49 | 15.63 | 101.51 |
| 18 | -21.59 | 1675 | 16.47 | 70.63 | 15.63 | 100.93 |
| 19 | -23.49 | 1999 | -1.76 | -55.03 | 15.63 | 100.64 |
| 20 | -24.79 | 2042 | 22.62 | 72.87 | 15.63 | 105.32 |
| 21 | -23.69 | 2296 | 18.35 | 73.6 | 15.63 | 100.9 |
| 22 | -23.39 | 2417 | 13.24 | 82.36 | 15.63 | 100.87 |
| 23 | -29.29 | 2564 | -10.31 | 90.86 | 15.63 | 104.83 |
| 24 | -30.49 | 3151 | 47.53 | -69.46 | 15.63 | 105.67 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1245 | 7 | 121.84 | 90 | 1.32 | 0 | 0.97 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 0.833 | 161.92 | (352.65,120.25,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 4 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 91.07 | -42.7 | 9.56 | 98.71 |
| 2 | -5.4 | 139 | -133.34 | 18.09 | 9.56 | 100.85 |
| 3 | -7.6 | 147 | -133.34 | 18.09 | 8.604 | 100.85 |
| 4 | -11.4 | 168 | 113.06 | 51.08 | 9.56 | 102.28 |
| 5 | -13.6 | 196 | 113.06 | 51.08 | 8.604 | 102.28 |
| 6 | -15.9 | 209 | -2.18 | 62.03 | 9.56 | 103.69 |
| 7 | -9.4 | 214 | -133.34 | 18.09 | 7.648 | 100.85 |
| 8 | -15.3 | 244 | 113.06 | 51.08 | 7.648 | 102.28 |
| 9 | -12.9 | 277 | -37.03 | -9 | 9.56 | 98.96 |
| 10 | -21.3 | 560 | 128.35 | 74.92 | 9.56 | 97.52 |
| 11 | -12 | 691 | 91.59 | -9.46 | 9.56 | 102.5 |
| 12 | -17.8 | 791 | 69.6 | -33.93 | 9.56 | 103.75 |
| 13 | -22.1 | 810 | -101.35 | 66.67 | 9.56 | 104.75 |
| 14 | -20.6 | 908 | 113.06 | -40.57 | 9.56 | 104.04 |
| 15 | -16.2 | 915 | -6.7 | -25.85 | 9.56 | 98.56 |
| 16 | -16.7 | 1114 | -20.61 | -27.99 | 9.56 | 98.22 |
| 17 | -18.1 | 1486 | -41.64 | 77.37 | 9.56 | 98.37 |
| 18 | -21.6 | 1623 | 142.43 | 71.43 | 9.56 | 104.27 |
| 19 | -23.7 | 1664 | 172.07 | 65.94 | 9.56 | 96.75 |
| 20 | -24.3 | 1747 | -178.54 | -21.9 | 9.56 | 97.04 |
| 21 | -22 | 1823 | 135.13 | -34.31 | 9.56 | 104.76 |
| 22 | -25.3 | 1931 | -132.56 | 63.77 | 9.56 | 97.34 |
| 23 | -35.1 | 3517 | 94.46 | -0.09 | 9.56 | 103.42 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1189 | 10 | 121.06 | 90 | 1.75 | 0 | 0.15 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 0.833 | 155.87 | (332.43,126.85,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 5 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 92.44 | -41.33 | 9.56 | 98.7 |
| 2 | -5.4 | 139 | -131.97 | 19.46 | 9.56 | 100.93 |
| 3 | -7.6 | 147 | -131.97 | 19.46 | 8.604 | 100.93 |
| 4 | -11.4 | 168 | 114.43 | 52.45 | 9.56 | 102.42 |
| 5 | -13.6 | 196 | 114.43 | 52.45 | 8.604 | 102.42 |
| 6 | -15.9 | 209 | -0.81 | 63.4 | 9.56 | 103.89 |
| 7 | -9.4 | 214 | -131.97 | 19.46 | 7.648 | 100.93 |
| 8 | -15.3 | 244 | 114.43 | 52.45 | 7.648 | 102.42 |
| 9 | -12.9 | 277 | -35.66 | -7.63 | 9.56 | 98.96 |
| 10 | -21.3 | 560 | 129.72 | 76.29 | 9.56 | 97.47 |
| 11 | -12 | 691 | 92.96 | -8.09 | 9.56 | 102.65 |
| 12 | -17.8 | 791 | 70.97 | -32.56 | 9.56 | 103.95 |
| 13 | -22.1 | 810 | -99.98 | 68.04 | 9.56 | 104.99 |
| 14 | -20.6 | 908 | 114.43 | -39.2 | 9.56 | 104.25 |
| 15 | -16.2 | 915 | -5.33 | -24.48 | 9.56 | 98.55 |
| 16 | -16.7 | 1114 | -19.24 | -26.62 | 9.56 | 98.2 |
| 17 | -18.1 | 1486 | -40.27 | 78.74 | 9.56 | 98.35 |
| 18 | -21.6 | 1623 | 143.8 | 72.8 | 9.56 | 104.49 |
| 19 | -23.7 | 1664 | 173.44 | 67.31 | 9.56 | 96.66 |
| 20 | -24.3 | 1747 | -177.17 | -20.53 | 9.56 | 96.97 |
| 21 | -22 | 1823 | 136.5 | -32.94 | 9.56 | 105 |
| 22 | -25.3 | 1931 | -131.19 | 65.14 | 9.56 | 97.28 |
| 23 | -35.1 | 3517 | 95.83 | 1.28 | 9.56 | 103.61 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1162 | 10 | 120.67 | 90 | 1.75 | 0 | 0.16 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -130.59 | (321.65,131.68,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 6 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -96.5 | -37.52 | 15.63 | 104.24 |
| 2 | -8.89 | 76 | 118.64 | -21.84 | 15.63 | 105.24 |
| 3 | -10.19 | 79 | -124.12 | -33.63 | 15.63 | 106.67 |
| 4 | -11.19 | 81 | 118.64 | -21.84 | 14.067 | 105.24 |
| 5 | -12.89 | 85 | 118.64 | -21.84 | 12.504 | 105.24 |
| 6 | -7.69 | 232 | 171.16 | -6.61 | 15.63 | 105.67 |
| 7 | -9.89 | 235 | 171.16 | -6.61 | 14.067 | 105.67 |
| 8 | -11.59 | 239 | 171.16 | -6.61 | 12.504 | 105.67 |
| 9 | -15.09 | 240 | 51.32 | 41.36 | 15.63 | 109.94 |
| 10 | -14.79 | 289 | 62.89 | -49.31 | 15.63 | 102.89 |
| 11 | -18.39 | 299 | -41.37 | 46.04 | 15.63 | 110.59 |
| 12 | -18.79 | 340 | 42.46 | -70.8 | 15.63 | 101.61 |
| 13 | -12.79 | 447 | 64.55 | -43.25 | 15.63 | 108.87 |
| 14 | -14.49 | 476 | -62.84 | -49.18 | 15.63 | 109.23 |
| 15 | -16.39 | 790 | 78.52 | -58.54 | 15.63 | 101.25 |
| 16 | -20.89 | 987 | 25.58 | 60.86 | 15.63 | 109.23 |
| 17 | -21.59 | 1551 | -23.51 | 58.56 | 15.63 | 102.6 |
| 18 | -21.59 | 1675 | -2.46 | 51.7 | 15.63 | 101.32 |
| 19 | -23.49 | 1999 | -20.69 | -73.96 | 15.63 | 100.68 |
| 20 | -24.79 | 2042 | 3.69 | 53.94 | 15.63 | 111.01 |
| 21 | -23.69 | 2296 | -0.58 | 54.67 | 15.63 | 101.25 |
| 22 | -23.39 | 2417 | -5.69 | 63.43 | 15.63 | 101.18 |
| 23 | -29.29 | 2564 | -29.24 | 71.93 | 15.63 | 109.94 |
| 24 | -30.49 | 3151 | 28.6 | -88.39 | 15.63 | 111.8 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 700 | 7 | 112.06 | 90 | 1.32 | 0 | 2.14 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -51.25 | (208.50,-0.36,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 7 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -119.5 | -60.52 | 15.63 | 102.45 |
| 2 | -8.89 | 76 | 95.64 | -44.84 | 15.63 | 102.97 |
| 3 | -10.19 | 79 | -147.12 | -56.63 | 15.63 | 103.71 |
| 4 | -11.19 | 81 | 95.64 | -44.84 | 14.067 | 102.97 |
| 5 | -12.89 | 85 | 95.64 | -44.84 | 12.504 | 102.97 |
| 6 | -7.69 | 232 | 148.16 | -29.61 | 15.63 | 103.19 |
| 7 | -9.89 | 235 | 148.16 | -29.61 | 14.067 | 103.19 |
| 8 | -11.59 | 239 | 148.16 | -29.61 | 12.504 | 103.19 |
| 9 | -15.09 | 240 | 28.32 | 18.36 | 15.63 | 105.41 |
| 10 | -14.79 | 289 | 39.89 | -72.31 | 15.63 | 101.75 |
| 11 | -18.39 | 299 | -64.37 | 23.04 | 15.63 | 105.74 |
| 12 | -18.79 | 340 | 19.46 | -93.8 | 15.63 | 101.09 |
| 13 | -12.79 | 447 | 41.55 | -66.25 | 15.63 | 104.86 |
| 14 | -14.49 | 476 | -85.84 | -72.18 | 15.63 | 105.04 |
| 15 | -16.39 | 790 | 55.52 | -81.54 | 15.63 | 100.9 |
| 16 | -20.89 | 987 | 2.58 | 37.86 | 15.63 | 105.04 |
| 17 | -21.59 | 1551 | -46.51 | 35.56 | 15.63 | 101.6 |
| 18 | -21.59 | 1675 | -25.46 | 28.7 | 15.63 | 100.94 |
| 19 | -23.49 | 1999 | -43.69 | -96.96 | 15.63 | 100.6 |
| 20 | -24.79 | 2042 | -19.31 | 30.94 | 15.63 | 105.97 |
| 21 | -23.69 | 2296 | -23.58 | 31.67 | 15.63 | 100.9 |
| 22 | -23.39 | 2417 | -28.69 | 40.43 | 15.63 | 100.86 |
| 23 | -29.29 | 2564 | -52.24 | 48.93 | 15.63 | 105.41 |
| 24 | -30.49 | 3151 | 5.6 | -111.39 | 15.63 | 106.37 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1151 | 7 | 120.5 | 90 | 1.32 | 0 | 1.11 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 45.03 | (316.65,-135.09,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 8 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 158.87 | -21.13 | 0 | 93.85 |
| 1 | -22.24 | 0 | 158.87 | -21.13 | 18.91 | 93.85 |
| 2 | -16.01 | 47 | -119.23 | 40.14 | 18.91 | 97.13 |
| 3 | -18.31 | 49 | -119.23 | 40.14 | 17.019 | 97.13 |
| 4 | -23.11 | 49 | 24.46 | -42.55 | 18.91 | 93.71 |
| 5 | -20.01 | 51 | -119.23 | 40.14 | 15.128 | 97.13 |
| 6 | -22.61 | 65 | 43.54 | -3.87 | 18.91 | 94.71 |
| 7 | -18.81 | 173 | -159.02 | -11.22 | 18.91 | 93.28 |
| 8 | -21.01 | 175 | -159.02 | -11.22 | 17.019 | 93.28 |
| 9 | -22.81 | 178 | -159.02 | -11.22 | 15.128 | 93.28 |
| 10 | -22.51 | 240 | -138.05 | -0.88 | 18.91 | 94.71 |
| 11 | -25.81 | 337 | -54.52 | 13.72 | 18.91 | 91.57 |
| 12 | -20.41 | 495 | 102.15 | -20.6 | 18.91 | 93.35 |
| 13 | -30.01 | 1091 | 46.04 | 38.44 | 18.91 | 91 |
| 14 | -29.41 | 1876 | 63.57 | 40.25 | 18.91 | 97.41 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1168 | 8 | 91. 76 | 90 | 5.33 | 0 | 2.14 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 5.64 | (325.81,-125.92,1.5) | (0,0,25) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 9 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 163.96 | -16.04 | 0 | 93.16 |
| 1 | -22.24 | 0 | 163.96 | -16.04 | 18.91 | 93.16 |
| 2 | -16.01 | 47 | -114.14 | 45.23 | 18.91 | 95.42 |
| 3 | -18.31 | 49 | -114.14 | 45.23 | 17.019 | 95.42 |
| 4 | -23.11 | 49 | 29.55 | -37.46 | 18.91 | 93.06 |
| 5 | -20.01 | 51 | -114.14 | 45.23 | 15.128 | 95.42 |
| 6 | -22.61 | 65 | 48.63 | 1.22 | 18.91 | 93.75 |
| 7 | -18.81 | 173 | -153.93 | -6.13 | 18.91 | 92.77 |
| 8 | -21.01 | 175 | -153.93 | -6.13 | 17.019 | 92.77 |
| 9 | -22.81 | 178 | -153.93 | -6.13 | 15.128 | 92.77 |
| 10 | -22.51 | 240 | -132.96 | 4.21 | 18.91 | 93.75 |
| 11 | -25.81 | 337 | -49.43 | 18.81 | 18.91 | 91.58 |
| 12 | -20.41 | 495 | 107.24 | -15.51 | 18.91 | 92.82 |
| 13 | -30.01 | 1091 | 51.13 | 43.53 | 18.91 | 91.19 |
| 14 | -29.41 | 1876 | 68.66 | 45.34 | 18.91 | 95.62 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1422 | 8 | 94.28 | 90 | 5.33 | 0 | 1.48 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 142.83 | (409.22,-117.68,1.5) | (0,0,25) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 10 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 56.01 | -77.76 | 9.56 | 98.73 |
| 2 | -5.4 | 139 | -168.4 | -16.97 | 9.56 | 100.52 |
| 3 | -7.6 | 147 | -168.4 | -16.97 | 8.604 | 100.52 |
| 4 | -11.4 | 168 | 78 | 16.02 | 9.56 | 101.72 |
| 5 | -13.6 | 196 | 78 | 16.02 | 8.604 | 101.72 |
| 6 | -15.9 | 209 | -37.24 | 26.97 | 9.56 | 102.9 |
| 7 | -9.4 | 214 | -168.4 | -16.97 | 7.648 | 100.52 |
| 8 | -15.3 | 244 | 78 | 16.02 | 7.648 | 101.72 |
| 9 | -12.9 | 277 | -72.09 | -44.06 | 9.56 | 98.94 |
| 10 | -21.3 | 560 | 93.29 | 39.86 | 9.56 | 97.74 |
| 11 | -12 | 691 | 56.53 | -44.52 | 9.56 | 101.91 |
| 12 | -17.8 | 791 | 34.54 | -68.99 | 9.56 | 102.95 |
| 13 | -22.1 | 810 | -136.41 | 31.61 | 9.56 | 103.79 |
| 14 | -20.6 | 908 | 78 | -75.63 | 9.56 | 103.19 |
| 15 | -16.2 | 915 | -41.76 | -60.91 | 9.56 | 98.61 |
| 16 | -16.7 | 1114 | -55.67 | -63.05 | 9.56 | 98.33 |
| 17 | -18.1 | 1486 | -76.7 | 42.31 | 9.56 | 98.45 |
| 18 | -21.6 | 1623 | 107.37 | 36.37 | 9.56 | 103.38 |
| 19 | -23.7 | 1664 | 137.01 | 30.88 | 9.56 | 97.09 |
| 20 | -24.3 | 1747 | 146.4 | -56.96 | 9.56 | 97.34 |
| 21 | -22 | 1823 | 100.07 | -69.37 | 9.56 | 103.79 |
| 22 | -25.3 | 1931 | -167.62 | 28.71 | 9.56 | 97.59 |
| 23 | -35.1 | 3517 | 59.4 | -35.15 | 9.56 | 102.68 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1312 | 10 | 122.73 | 90 | 1.75 | 0 | 0.12 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 0.833 | 34.08 | (380.81,-96.14,1.5) | (0,0,25) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 11 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 167.81 | -12.19 | 0 | 93.32 |
| 1 | -13.83 | 0 | 167.81 | -12.19 | 29.75 | 93.32 |
| 2 | -19.13 | 3 | -169.89 | 67.57 | 29.75 | 89.11 |
| 3 | -21.33 | 58 | -169.89 | 67.57 | 26.775 | 89.11 |
| 4 | -23.13 | 128 | -169.89 | 67.57 | 23.8 | 89.11 |
| 5 | -18.23 | 132 | 104.58 | -0.57 | 29.75 | 93 |
| 6 | -23.23 | 167 | -32.27 | 18.75 | 29.75 | 93.32 |
| 7 | -20.43 | 170 | 104.58 | -0.57 | 26.775 | 93 |
| 8 | -22.23 | 244 | 104.58 | -0.57 | 23.8 | 93 |
| 9 | -28.13 | 380 | 135.44 | -69.86 | 29.75 | 90.05 |
| 10 | -23.93 | 747 | -26.7 | -41.61 | 29.75 | 90.99 |
| 11 | -25.13 | 887 | 32.45 | 34.84 | 29.75 | 95.03 |
| 12 | -30.33 | 913 | 83.41 | -130.31 | 29.75 | 87.43 |
| 13 | -28.03 | 1178 | 165.59 | 56.84 | 29.75 | 89.44 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1355 | 11 | 93.44 | 90 | 4.47 | 0 | 0.97 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 65.26 | (396.39,-85.60,1.5) | (0,0,25) | 9 |  |  |

Table A-2: Parameter Table for Dynamic UMi Channel Model

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Way point | 1 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -120.63 | -36.99 | 12.29 | 100.34 |
| 2 | -8.89 | 23 | 125.47 | -21.62 | 12.29 | 100.44 |
| 3 | -10.19 | 24 | -142.34 | -33.18 | 12.29 | 100.6 |
| 4 | -11.19 | 24 | 125.47 | -21.62 | 11.061 | 100.44 |
| 5 | -12.89 | 25 | 125.47 | -21.62 | 9.832 | 100.44 |
| 6 | -7.69 | 69 | 166.77 | -6.71 | 12.29 | 100.49 |
| 7 | -9.89 | 70 | 166.77 | -6.71 | 11.061 | 100.49 |
| 8 | -11.59 | 71 | 166.77 | -6.71 | 9.832 | 100.49 |
| 9 | -15.09 | 72 | 72.53 | 40.28 | 12.29 | 100.96 |
| 10 | -14.79 | 86 | 81.63 | -48.54 | 12.29 | 100.19 |
| 11 | -18.39 | 89 | -77.28 | 44.87 | 12.29 | 101.03 |
| 12 | -18.79 | 102 | 65.57 | -69.59 | 12.29 | 100.05 |
| 13 | -12.79 | 134 | 82.94 | -42.6 | 12.29 | 100.84 |
| 14 | -14.49 | 142 | -94.16 | -48.41 | 12.29 | 100.88 |
| 15 | -16.39 | 236 | 93.92 | -57.58 | 12.29 | 100.01 |
| 16 | -20.89 | 295 | 52.29 | 59.39 | 12.29 | 100.88 |
| 17 | -21.59 | 463 | 13.7 | 57.13 | 12.29 | 100.16 |
| 18 | -21.59 | 500 | 30.25 | 50.42 | 12.29 | 100.02 |
| 19 | -23.49 | 597 | 15.91 | -72.69 | 12.29 | 99.95 |
| 20 | -24.79 | 610 | 35.08 | 52.61 | 12.29 | 101.07 |
| 21 | -23.69 | 686 | 31.72 | 53.32 | 12.29 | 100.01 |
| 22 | -23.39 | 722 | 27.71 | 61.91 | 12.29 | 100 |
| 23 | -29.29 | 766 | 9.19 | 70.24 | 12.29 | 100.96 |
| 24 | -30.49 | 941 | 54.67 | -86.82 | 12.29 | 101.16 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1389 | 7 | 123.16 | 90 | 1.29 | 0 | 0.23 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 0.833 | -39.55 | (416.41,0.53,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 2 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 178.36 | -1.64 | 0 | 91.13 |
| 1 | -13.83 | 0 | 178.36 | -1.64 | 22.34 | 91.13 |
| 2 | -19.13 | 2 | -75.17 | 84.91 | 22.34 | 87.85 |
| 3 | -21.33 | 33 | -75.17 | 84.91 | 20.106 | 87.85 |
| 4 | -23.13 | 73 | -75.17 | 84.91 | 17.872 | 87.85 |
| 5 | -18.23 | 75 | 130.89 | 10.97 | 22.34 | 90.88 |
| 6 | -23.23 | 95 | -61.58 | 31.93 | 22.34 | 91.13 |
| 7 | -20.43 | 97 | 130.89 | 10.97 | 20.106 | 90.88 |
| 8 | -22.23 | 139 | 130.89 | 10.97 | 17.872 | 90.88 |
| 9 | -28.13 | 217 | -116.21 | -64.23 | 22.34 | 88.58 |
| 10 | -23.93 | 426 | 32.33 | -33.56 | 22.34 | 89.32 |
| 11 | -25.13 | 506 | -13 | 49.4 | 22.34 | 92.47 |
| 12 | -30.33 | 521 | -64.46 | -129.82 | 22.34 | 86.54 |
| 13 | -28.03 | 672 | 86.96 | 73.27 | 22.34 | 88.11 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1442 | 11 | 104.42 | 90 | 4.85 | 0 | 0.76 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -123.94 | (432.02,-12.36,1.5) | (0,0,10) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 3 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | 155.21 | -24.79 | 0 | 91.32 |
| 1 | -13.83 | 0 | 155.21 | -24.79 | 22.34 | 91.32 |
| 2 | -19.13 | 2 | -98.32 | 61.76 | 22.34 | 88.04 |
| 3 | -21.33 | 33 | -98.32 | 61.76 | 20.106 | 88.04 |
| 4 | -23.13 | 73 | -98.32 | 61.76 | 17.872 | 88.04 |
| 5 | -18.23 | 75 | 107.74 | -12.18 | 22.34 | 91.07 |
| 6 | -23.23 | 95 | -84.73 | 8.78 | 22.34 | 91.32 |
| 7 | -20.43 | 97 | 107.74 | -12.18 | 20.106 | 91.07 |
| 8 | -22.23 | 139 | 107.74 | -12.18 | 17.872 | 91.07 |
| 9 | -28.13 | 217 | -139.36 | -87.38 | 22.34 | 88.77 |
| 10 | -23.93 | 426 | 9.18 | -56.71 | 22.34 | 89.51 |
| 11 | -25.13 | 506 | -36.15 | 26.25 | 22.34 | 92.66 |
| 12 | -30.33 | 521 | -87.61 | -152.97 | 22.34 | 86.73 |
| 13 | -28.03 | 672 | 63.81 | 50.12 | 22.34 | 88.3 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1235 | 11 | 101.72 | 90 | 4.85 | 0 | 0.76 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -174.45 | (335.93,-155.15,1.5) | (0,0,10) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 4 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 71.19 | -88.13 | 7.52 | 98.1 |
| 2 | -5.4 | 42 | 177.81 | -28.58 | 7.52 | 98.58 |
| 3 | -7.6 | 44 | 177.81 | -28.58 | 6.768 | 98.58 |
| 4 | -11.4 | 50 | 88.48 | 3.75 | 7.52 | 98.9 |
| 5 | -13.6 | 58 | 88.48 | 3.75 | 6.768 | 98.9 |
| 6 | -15.9 | 63 | -79.06 | 14.47 | 7.52 | 99.21 |
| 7 | -9.4 | 64 | 177.81 | -28.58 | 6.016 | 98.58 |
| 8 | -15.3 | 73 | 88.48 | 3.75 | 6.016 | 98.9 |
| 9 | -12.9 | 83 | -106.47 | -55.12 | 7.52 | 98.16 |
| 10 | -21.3 | 167 | 100.51 | 27.1 | 7.52 | 97.84 |
| 11 | -12 | 206 | 71.6 | -55.56 | 7.52 | 98.95 |
| 12 | -17.8 | 236 | 54.3 | -79.53 | 7.52 | 99.22 |
| 13 | -22.1 | 242 | -157.04 | 19.02 | 7.52 | 99.45 |
| 14 | -20.6 | 271 | 88.48 | -86.04 | 7.52 | 99.29 |
| 15 | -16.2 | 273 | -82.61 | -71.62 | 7.52 | 98.07 |
| 16 | -16.7 | 333 | -93.55 | -73.71 | 7.52 | 97.99 |
| 17 | -18.1 | 444 | -110.09 | 29.5 | 7.52 | 98.03 |
| 18 | -21.6 | 485 | 111.58 | 23.68 | 7.52 | 99.34 |
| 19 | -23.7 | 497 | 134.88 | 18.3 | 7.52 | 97.67 |
| 20 | -24.3 | 522 | 142.27 | -67.75 | 7.52 | 97.73 |
| 21 | -22 | 545 | 105.84 | -79.91 | 7.52 | 99.45 |
| 22 | -25.3 | 577 | 178.42 | 16.18 | 7.52 | 97.8 |
| 23 | -35.1 | 1051 | 73.85 | -46.39 | 7.52 | 99.15 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1199 | 10 | 120.9 | 90 | 1.71 | 0 | 0.03 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 120.08 | (323.58,-156.35,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 5 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -124.81 | -41.17 | 12.29 | 101.17 |
| 2 | -8.89 | 23 | 121.29 | -25.8 | 12.29 | 101.27 |
| 3 | -10.19 | 24 | -146.52 | -37.36 | 12.29 | 101.43 |
| 4 | -11.19 | 24 | 121.29 | -25.8 | 11.061 | 101.27 |
| 5 | -12.89 | 25 | 121.29 | -25.8 | 9.832 | 101.27 |
| 6 | -7.69 | 69 | 162.59 | -10.89 | 12.29 | 101.32 |
| 7 | -9.89 | 70 | 162.59 | -10.89 | 11.061 | 101.32 |
| 8 | -11.59 | 71 | 162.59 | -10.89 | 9.832 | 101.32 |
| 9 | -15.09 | 72 | 68.35 | 36.1 | 12.29 | 101.79 |
| 10 | -14.79 | 86 | 77.45 | -52.72 | 12.29 | 101.02 |
| 11 | -18.39 | 89 | -81.46 | 40.69 | 12.29 | 101.86 |
| 12 | -18.79 | 102 | 61.39 | -73.77 | 12.29 | 100.88 |
| 13 | -12.79 | 134 | 78.76 | -46.78 | 12.29 | 101.67 |
| 14 | -14.49 | 142 | -98.34 | -52.59 | 12.29 | 101.71 |
| 15 | -16.39 | 236 | 89.74 | -61.76 | 12.29 | 100.84 |
| 16 | -20.89 | 295 | 48.11 | 55.21 | 12.29 | 101.71 |
| 17 | -21.59 | 463 | 9.52 | 52.95 | 12.29 | 100.99 |
| 18 | -21.59 | 500 | 26.07 | 46.24 | 12.29 | 100.85 |
| 19 | -23.49 | 597 | 11.73 | -76.87 | 12.29 | 100.78 |
| 20 | -24.79 | 610 | 30.9 | 48.43 | 12.29 | 101.9 |
| 21 | -23.69 | 686 | 27.54 | 49.14 | 12.29 | 100.84 |
| 22 | -23.39 | 722 | 23.53 | 57.73 | 12.29 | 100.83 |
| 23 | -29.29 | 766 | 5.01 | 66.06 | 12.29 | 101.79 |
| 24 | -30.49 | 941 | 50.49 | -91 | 12.29 | 101.99 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 814 | 7 | 114.96 | 90 | 1.29 | 0 | 0.23 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 98.5 | (243.15,-17.48,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 6 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 96.83 | -62.49 | 7.52 | 98.77 |
| 2 | -5.4 | 42 | -156.55 | -2.94 | 7.52 | 99.25 |
| 3 | -7.6 | 44 | -156.55 | -2.94 | 6.768 | 99.25 |
| 4 | -11.4 | 50 | 114.12 | 29.39 | 7.52 | 99.57 |
| 5 | -13.6 | 58 | 114.12 | 29.39 | 6.768 | 99.57 |
| 6 | -15.9 | 63 | -53.42 | 40.11 | 7.52 | 99.88 |
| 7 | -9.4 | 64 | -156.55 | -2.94 | 6.016 | 99.25 |
| 8 | -15.3 | 73 | 114.12 | 29.39 | 6.016 | 99.57 |
| 9 | -12.9 | 83 | -80.83 | -29.48 | 7.52 | 98.83 |
| 10 | -21.3 | 167 | 126.15 | 52.74 | 7.52 | 98.51 |
| 11 | -12 | 206 | 97.24 | -29.92 | 7.52 | 99.62 |
| 12 | -17.8 | 236 | 79.94 | -53.89 | 7.52 | 99.89 |
| 13 | -22.1 | 242 | -131.4 | 44.66 | 7.52 | 100.12 |
| 14 | -20.6 | 271 | 114.12 | -60.4 | 7.52 | 99.96 |
| 15 | -16.2 | 273 | -56.97 | -45.98 | 7.52 | 98.74 |
| 16 | -16.7 | 333 | -67.91 | -48.07 | 7.52 | 98.66 |
| 17 | -18.1 | 444 | -84.45 | 55.14 | 7.52 | 98.7 |
| 18 | -21.6 | 485 | 137.22 | 49.32 | 7.52 | 100.01 |
| 19 | -23.7 | 497 | 160.52 | 43.94 | 7.52 | 98.34 |
| 20 | -24.3 | 522 | 167.91 | -42.11 | 7.52 | 98.4 |
| 21 | -22 | 545 | 131.48 | -54.27 | 7.52 | 100.12 |
| 22 | -25.3 | 577 | -155.94 | 41.82 | 7.52 | 98.47 |
| 23 | -35.1 | 1051 | 99.49 | -20.75 | 7.52 | 99.82 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 803 | 10 | 114.76 | 90 | 1.71 | 0 | 0.03 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 0.833 | 81.43 | (240.63,-0.61,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 7 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -12.09 | 0 | -117.19 | -33.55 | 12.29 | 101.17 |
| 2 | -8.89 | 23 | 128.91 | -18.18 | 12.29 | 101.27 |
| 3 | -10.19 | 24 | -138.9 | -29.74 | 12.29 | 101.43 |
| 4 | -11.19 | 24 | 128.91 | -18.18 | 11.061 | 101.27 |
| 5 | -12.89 | 25 | 128.91 | -18.18 | 9.832 | 101.27 |
| 6 | -7.69 | 69 | 170.21 | -3.27 | 12.29 | 101.32 |
| 7 | -9.89 | 70 | 170.21 | -3.27 | 11.061 | 101.32 |
| 8 | -11.59 | 71 | 170.21 | -3.27 | 9.832 | 101.32 |
| 9 | -15.09 | 72 | 75.97 | 43.72 | 12.29 | 101.79 |
| 10 | -14.79 | 86 | 85.07 | -45.1 | 12.29 | 101.02 |
| 11 | -18.39 | 89 | -73.84 | 48.31 | 12.29 | 101.86 |
| 12 | -18.79 | 102 | 69.01 | -66.15 | 12.29 | 100.88 |
| 13 | -12.79 | 134 | 86.38 | -39.16 | 12.29 | 101.67 |
| 14 | -14.49 | 142 | -90.72 | -44.97 | 12.29 | 101.71 |
| 15 | -16.39 | 236 | 97.36 | -54.14 | 12.29 | 100.84 |
| 16 | -20.89 | 295 | 55.73 | 62.83 | 12.29 | 101.71 |
| 17 | -21.59 | 463 | 17.14 | 60.57 | 12.29 | 100.99 |
| 18 | -21.59 | 500 | 33.69 | 53.86 | 12.29 | 100.85 |
| 19 | -23.49 | 597 | 19.35 | -69.25 | 12.29 | 100.78 |
| 20 | -24.79 | 610 | 38.52 | 56.05 | 12.29 | 101.9 |
| 21 | -23.69 | 686 | 35.16 | 56.76 | 12.29 | 100.84 |
| 22 | -23.39 | 722 | 31.15 | 65.35 | 12.29 | 100.83 |
| 23 | -29.29 | 766 | 12.63 | 73.68 | 12.29 | 101.79 |
| 24 | -30.49 | 941 | 58.11 | -83.38 | 12.29 | 101.99 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 812 | 7 | 114.94 | 90 | 1.29 | 0 | 0.23 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | 54.59 | (242.97,14.91,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 8 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| 1 | -18.8 | 0 | 122.37 | -36.95 | 7.52 | 98.01 |
| 2 | -5.4 | 42 | -131.01 | 22.6 | 7.52 | 98.49 |
| 3 | -7.6 | 44 | -131.01 | 22.6 | 6.768 | 98.49 |
| 4 | -11.4 | 50 | 139.66 | 54.93 | 7.52 | 98.81 |
| 5 | -13.6 | 58 | 139.66 | 54.93 | 6.768 | 98.81 |
| 6 | -15.9 | 63 | -27.88 | 65.65 | 7.52 | 99.12 |
| 7 | -9.4 | 64 | -131.01 | 22.6 | 6.016 | 98.49 |
| 8 | -15.3 | 73 | 139.66 | 54.93 | 6.016 | 98.81 |
| 9 | -12.9 | 83 | -55.29 | -3.94 | 7.52 | 98.07 |
| 10 | -21.3 | 167 | 151.69 | 78.28 | 7.52 | 97.75 |
| 11 | -12 | 206 | 122.78 | -4.38 | 7.52 | 98.86 |
| 12 | -17.8 | 236 | 105.48 | -28.35 | 7.52 | 99.13 |
| 13 | -22.1 | 242 | -105.86 | 70.2 | 7.52 | 99.36 |
| 14 | -20.6 | 271 | 139.66 | -34.86 | 7.52 | 99.2 |
| 15 | -16.2 | 273 | -31.43 | -20.44 | 7.52 | 97.98 |
| 16 | -16.7 | 333 | -42.37 | -22.53 | 7.52 | 97.9 |
| 17 | -18.1 | 444 | -58.91 | 80.68 | 7.52 | 97.94 |
| 18 | -21.6 | 485 | 162.76 | 74.86 | 7.52 | 99.25 |
| 19 | -23.7 | 497 | -173.94 | 69.48 | 7.52 | 97.58 |
| 20 | -24.3 | 522 | -166.55 | -16.57 | 7.52 | 97.64 |
| 21 | -22 | 545 | 157.02 | -28.73 | 7.52 | 99.36 |
| 22 | -25.3 | 577 | -130.4 | 67.36 | 7.52 | 97.71 |
| 23 | -35.1 | 1051 | 125.03 | 4.79 | 7.52 | 99.06 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1294 | 10 | 122.07 | 90 | 1.71 | 0 | 0.03 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -23.91 | (350.59,166.27,1.5) | (0,0,10) | - |  |  |
|  |  |  |  |  |  |  |
| Way point | 9 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | -156.01 | 23.99 | 0 | 91.23 |
| 1 | -22.24 | 0 | -156.01 | 23.99 | 14.19 | 91.23 |
| 2 | -16.01 | 27 | -4.8 | 90.48 | 14.19 | 93.18 |
| 3 | -18.31 | 28 | -4.8 | 90.48 | 12.771 | 93.18 |
| 4 | -23.11 | 28 | 103.08 | 0.75 | 14.19 | 91.15 |
| 5 | -20.01 | 29 | -4.8 | 90.48 | 11.352 | 93.18 |
| 6 | -22.61 | 37 | 117.4 | 42.72 | 14.19 | 91.74 |
| 7 | -18.81 | 99 | -124.4 | 34.74 | 14.19 | 90.89 |
| 8 | -21.01 | 100 | -124.4 | 34.74 | 12.771 | 90.89 |
| 9 | -22.81 | 102 | -124.4 | 34.74 | 11.352 | 90.89 |
| 10 | -22.51 | 137 | -108.65 | 45.96 | 14.19 | 91.74 |
| 11 | -25.81 | 193 | -45.94 | 61.8 | 14.19 | 89.88 |
| 12 | -20.41 | 283 | 161.41 | 24.57 | 14.19 | 90.93 |
| 13 | -30.01 | 622 | 29.55 | 88.63 | 14.19 | 89.54 |
| 14 | -29.41 | 1070 | 42.71 | 90.6 | 14.19 | 93.34 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1322 | 8 | 102.91 | 90 | 5.78 | 0 | 1.27 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -66.13 | (362.14,161.15,1.5) | (0,0,10) | 9 |  |  |
|  |  |  |  |  |  |  |
| Way point | 10 |  |  |  |  |  |
| Cluster# | Power [dB] | Excess delay [ns] | AoA [°] | AoD [°] | ASA [°] | ZoD [°] |
| LOS | -0.51 | 0 | -178.47 | 1.53 | 0 | 91.14 |
| 1 | -22.24 | 0 | -178.47 | 1.53 | 14.19 | 91.14 |
| 2 | -16.01 | 27 | -27.26 | 68.02 | 14.19 | 93.09 |
| 3 | -18.31 | 28 | -27.26 | 68.02 | 12.771 | 93.09 |
| 4 | -23.11 | 28 | 80.62 | -21.71 | 14.19 | 91.06 |
| 5 | -20.01 | 29 | -27.26 | 68.02 | 11.352 | 93.09 |
| 6 | -22.61 | 37 | 94.94 | 20.26 | 14.19 | 91.65 |
| 7 | -18.81 | 99 | -146.86 | 12.28 | 14.19 | 90.8 |
| 8 | -21.01 | 100 | -146.86 | 12.28 | 12.771 | 90.8 |
| 9 | -22.81 | 102 | -146.86 | 12.28 | 11.352 | 90.8 |
| 10 | -22.51 | 137 | -131.11 | 23.5 | 14.19 | 91.65 |
| 11 | -25.81 | 193 | -68.4 | 39.34 | 14.19 | 89.79 |
| 12 | -20.41 | 283 | 138.95 | 2.11 | 14.19 | 90.84 |
| 13 | -30.01 | 622 | 7.09 | 66.17 | 14.19 | 89.45 |
| 14 | -29.41 | 1070 | 20.25 | 68.14 | 14.19 | 93.25 |
| Ini. delay [ns] | XPR [dB] | PL [dB] | ZoA [°] | ASD [°] | ZSA [°] | ZSD [°] |
| 1430 | 8 | 104.27 | 90 | 5.78 | 0 | 1.27 |
| UE speed [m/s] | UE DoT Az [°] | UE coordinates (x,y,z) [m] | BS coordinates (x,y,z) [m] | K-factor [dB] |   |  |
| 8.33 | -137.83 | (428.41,11.4,1.5) | (0,0,10) | 9 |  |  |

**<<< END OF CHANGES >>>**