**­­3GPP TSG RAN Meeting #88-e *­­*RP-200717**

**e-Meeting, June 29 – July 3, 2020**

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| *CR-Form-v11.4* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.811** | **CR** | **0006** | **rev** | **-** | **Current version:** | **15.2.0** |  |
|  | | | | | | | | |
| *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 |  | Core Network |  |

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| ***Title:*** | Correction for inconsistent shadow fading parameters in NTN rural scenario | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_NR\_nonterr\_nw | | | | |  | ***Date:*** | | | 2020-06-17 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-15 |
|  | *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 can be 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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Inconsistent shadow fading parameters for NTN rural scenario in clauses 6.6.2 and 6.7.2. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Replaced duplicated shadow fading specification in the channel model parameter tables of clause 6.7.2 by a reference to a corresponding table in clause 6.6.2 and eliminated the inconsistency of the two wrt. the rural scenario. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Shadow fading parameters are duplicated in two clauses. The incosistency for the rural scenario may result in misunderstanding and incorrect implementation of the channel model, which may lead to incorrect link and system level results. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.7.2 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | | Endorsed by RAN1#101e as R1-2004750 and liaised to RAN#88e as RP-200558 | | | | | | | | |

**<Unchanged parts are omitted>**

6.7.2 Frequency selective fading

In the fast fading model, the process in 7.5 of TR 38.901 [12] is used. This section is not a stand-alone description of the fast fading model, but it describes the differences between the channel models used for terrestrial and satellite/HAPS communications. As can be seen from Figure 6.7.2-1, there is not much difference in local scattering between the HAPS and satellite cases. Therefore, the same fast fading parameters can be used for the both cases, including different satellite orbits as well. The critical parameter is the elevation angle of the LOS path of the satellite/HAPS vs. ground horizon.

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**Figure 6.7.2-1: HAPS to UE vs. satellite to UE propagation**

Instead of the parameterization tables in TR 38.901 [12] (Table 7.5-6 Part-1 and Part-2) the following tables shall be used.

NOTE 1: Some channel models may lead to pessimistic results of the performance of satellite/HAPS to UE link especially in the higher elevations due to the high number of clusters and low K factor.

NOTE 2: In some cases, the correlation distances are shorter in real world conditions.

Angular scaling factors in cluster generation need to be added to the NTN scenarios that have lower number of clusters than the scenarios described in TR 38.901 [12] (Table 6.7.2-1aa below corresponds to Table 7.5-2 in TR 38.901 [12] and Table 6.7.2-1ab below corresponds to Table 7.5-3 in TR 38.901 [12]).

**Table 6.7.2-1aa: Scaling factors for AOA, AOD generation**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **# clusters** | **2** | **3** | **4** | **5** | **8** | **10** | **11** | **12** | **14** | **15** | **16** | **19** | **20** |
|  | 0.501 | 0.680 | 0.779 | 0.860 | 1.018 | 1.090 | 1.123 | 1.146 | 1.190 | 1.211 | 1.226 | 1.273 | 1.289 |

**Table 6.7.2-1ab: Scaling factors for ZOA, ZOD generation**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **# clusters** | **2** | **3** | **4** | **8** | **10** | **11** | **12** | **15** | **19** | **20** |
|  | 0.430 | 0.594 | 0.697 | 0.889 | 0.957 | 1.031 | 1.104 | 1.1088 | 1.184 | 1.178 |

**Table 6.7.2-1a: Channel model parameters for Dense Urban Scenario (LOS) in S band**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Dense Urban LOS** | | | | | | | | | | | |
| **10°** | **20°** | **30°** | | **40°** | **50°** | **60°** | | **70°** | | **80°** | **90°** |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.12 | -7.28 | -7.45 | | -7.73 | -7.91 | -8.14 | | -8.23 | | -8.28 | -8.36 |
| **lgDS | 0.80 | 0.67 | 0.68 | | 0.66 | 0.62 | 0.51 | | 0.45 | | 0.31 | 0.08 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.06 | -2.68 | -2.51 | | -2.40 | -2.31 | -2.20 | | -2.00 | | -1.64 | -0.63 |
| **lgASD | 0.48 | 0.36 | 0.38 | | 0.32 | 0.33 | 0.39 | | 0.40 | | 0.32 | 0.53 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.94 | 0.87 | 0.92 | | 0.79 | 0.72 | 0.60 | | 0.55 | | 0.71 | 0.81 |
| **lgASA | 0.70 | 0.66 | 0.68 | | 0.64 | 0.63 | 0.54 | | 0.52 | | 0.53 | 0.62 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 0.82 | 0.50 | 0.82 | | 1.23 | 1.43 | 1.56 | | 1.66 | | 1.73 | 1.79 |
| **lgZSA | 0.03 | 0.09 | 0.05 | | 0.03 | 0.06 | 0.05 | | 0.05 | | 0.02 | 0.01 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.52 | -2.29 | -2.19 | | -2.24 | -2.30 | -2.48 | | -2.64 | | -2.68 | -2.61 |
| **lgZSD | 0.50 | 0.53 | 0.58 | | 0.51 | 0.46 | 0.35 | | 0.31 | | 0.39 | 0.28 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-1 | | | | | | | | | | | |
| K-factor (K) [dB] | *K* | 4.4 | 9.0 | 9.3 | | 7.9 | 7.4 | 7.0 | | 6.9 | | 6.5 | 6.8 |
| *K* | 3.3 | 6.6 | 6.1 | | 4.0 | 3.0 | 2.6 | | 2.2 | | 2.1 | 1.9 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | | 0.4 | 0.4 | 0.4 | | 0.4 | | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | | 0.8 | 0.8 | 0.8 | | 0.8 | | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | | -0.5 | -0.5 | -0.5 | | -0.5 | | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | | -0.5 | -0.5 | -0.5 | | -0.5 | | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | | -0.4 | -0.4 | -0.4 | | -0.4 | | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | | 0 | 0 | 0 | | 0 | | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | | -0.2 | -0.2 | -0.2 | | -0.2 | | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | | -0.4 | -0.4 | -0.4 | | -0.4 | | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | | -0.8 | | -0.8 | | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | | -0.2 | | -0.2 | | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | | 0.5 | | 0.5 | | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | | -0.3 | | -0.3 | | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | | 0.4 | | 0.4 | | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.5 | 2.5 | 2.5 | 2.5 | | 2.5 | | 2.5 | | 2.5 | 2.5 | 2.5 |
| XPR [dB] | **XPR | 24.4 | 23.6 | 23.2 | 22.6 | | 21.8 | | 20.5 | | 19.3 | 17.4 | 12.3 |
| **XPR | 3.8 | 4.7 | 4.6 | 4.9 | | 5.7 | | 6.9 | | 8.1 | 10.3 | 15.2 |
| Number of clusters | | 3 | 3 | 3 | 3 | | 3 | | 3 | | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | | 20 | | 20 | | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 3.9 | 3.9 | 3.9 | 3.9 | | 3.9 | | 3.9 | | 3.9 | 3.9 | 3.9 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 11 | 11 | 11 | 11 | | 11 | | 11 | | 11 | 11 | 11 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | | 7 | | 7 | | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | | 3 | | 3 | | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | | 30 | | 30 | | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | | 18 | | 18 | | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | | 15 | | 15 | | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | | 37 | | 37 | | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | | 12 | | 12 | | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | | 15 | | 15 | | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | | 15 | | 15 | | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | | | | |

**Table 6.7.2-1b: Channel model parameters for Dense Urban Scenario (LOS) in Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Dense Urban LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.43 | -7.62 | -7.76 | -8.02 | -8.13 | -8.30 | -8.34 | -8.39 | -8.45 |
| **lgDS | 0.90 | 0.78 | 0.80 | 0.72 | 0.61 | 0.47 | 0.39 | 0.26 | 0.01 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.43 | -3.06 | -2.91 | -2.81 | -2.74 | -2.72 | -2.46 | -2.30 | -1.11 |
| **lgASD | 0.54 | 0.41 | 0.42 | 0.34 | 0.34 | 0.70 | 0.40 | 0.78 | 0.51 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.65 | 0.53 | 0.60 | 0.43 | 0.36 | 0.16 | 0.18 | 0.24 | 0.36 |
| **lgASA | 0.82 | 0.78 | 0.83 | 0.78 | 0.77 | 0.84 | 0.64 | 0.81 | 0.65 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 0.82 | 0.47 | 0.80 | 1.23 | 1.42 | 1.56 | 1.65 | 1.73 | 1.79 |
| **lgZSA | 0.05 | 0.11 | 0.05 | 0.04 | 0.10 | 0.06 | 0.07 | 0.02 | 0.01 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.75 | -2.64 | -2.49 | -2.51 | -2.54 | -2.71 | -2.85 | -3.01 | -3.08 |
| **lgZSD | 0.55 | 0.64 | 0.69 | 0.57 | 0.50 | 0.37 | 0.31 | 0.45 | 0.27 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-1 | | | | | | | | |
| K-factor (K) [dB] | *K* | 6.1 | 13.7 | 12.9 | 10.3 | 9.2 | 8.4 | 8.0 | 7.4 | 7.6 |
| *K* | 2.6 | 6.8 | 6.0 | 3.3 | 2.2 | 1.9 | 1.5 | 1.6 | 1.3 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| XPR [dB] | **XPR | 24.7 | 24.4 | 24.4 | 24.2 | 23.9 | 23.3 | 22.6 | 21.2 | 17.6 |
| **XPR | 2.1 | 2.8 | 2.7 | 2.7 | 3.1 | 3.9 | 4.8 | 6.8 | 12.7 |
| Number of clusters | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | |

**Table 6.7.2-2a: Channel model parameters for Dense Urban Scenario (NLOS) in S band**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | | **Dense Urban NLOS** | | | | | | | | | | |
| **10**° | | **20**° | | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -6.84 | | -6.81 | | -6.94 | | -7.14 | -7.34 | -7.53 | -7.67 | -7.82 | -7.84 |
| **lgDS | 0.82 | | 0.61 | | 0.49 | | 0.49 | 0.51 | 0.47 | 0.44 | 0.42 | 0.55 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.08 | | -1.68 | | -1.46 | | -1.43 | -1.44 | -1.33 | -1.31 | -1.11 | -0.11 |
| **lgASD | 0.87 | | 0.73 | | 0.53 | | 0.50 | 0.58 | 0.49 | 0.65 | 0.69 | 0.53 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 1.00 | | 1.44 | | 1.54 | | 1.53 | 1.48 | 1.39 | 1.42 | 1.38 | 1.23 |
| **lgASA | 1.60 | | 0.87 | | 0.64 | | 0.56 | 0.54 | 0.68 | 0.55 | 0.60 | 0.60 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 1.00 | | 0.94 | | 1.15 | | 1.35 | 1.44 | 1.56 | 1.64 | 1.70 | 1.70 |
| **lgZSA | 0.63 | | 0.65 | | 0.42 | | 0.28 | 0.25 | 0.16 | 0.18 | 0.09 | 0.17 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.08 | | -1.66 | | -1.48 | | -1.46 | -1.53 | -1.61 | -1.77 | -1.90 | -1.99 |
| **lgZSD | 0.58 | | 0.50 | | 0.40 | | 0.37 | 0.47 | 0.43 | 0.50 | 0.42 | 0.50 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-1 | | | | | | | | | | | |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | | 0.4 | | 0.4 | | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.6 | | 0.6 | | 0.6 | | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| *ASA* vs *SF* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | -0.6 | | -0.6 | | -0.6 | | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 |
| *DS* vs *SF* | -0.4 | | -0.4 | | -0.4 | | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0.4 | | 0.4 | | 0.4 | | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASD* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.4 | | -0.4 | | -0.4 | | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ZSD* vs *K* | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | -0.5 | | -0.5 | | -0.5 | | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ZSA*vs *DS* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | | 0.5 | | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | -0.1 | | -0.1 | | -0.1 | | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 |
| *ZSD* vs *ASA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *ASA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ZSA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | | 2.3 | | 2.3 | | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| XPR [dB] | **XPR | 23.8 | | 21.9 | | 19.7 | | 18.1 | 16.3 | 14.0 | 12.1 | 8.7 | 6.4 |
| **XPR | 4.4 | | 6.3 | | 8.1 | | 9.3 | 11.5 | 13.3 | 14.9 | 17.0 | 12.3 |
| Number of clusters | | | 4 | | 4 | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of rays per cluster | | | 20 | | 20 | | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | | 3.9 | | 3.9 | | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| Cluster *ASD* () in [deg] | | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | | 15 | | 15 | | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Cluster *ZSA* () in [deg] | | | 7 | | 7 | | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | | 3 | | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | | 40 | | 40 | | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | | | | |

**Table 6.7.2-2b: Channel model parameters for Dense Urban Scenario (NLOS) in Ka band**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | | **Dense Urban NLOS** | | | | | | | | | | |
| **10**° | | **20**° | | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -6.86 | | -6.84 | | -7.00 | | -7.21 | -7.42 | -7.86 | -7.76 | -8.07 | -7.95 |
| **lgDS | 0.81 | | 0.61 | | 0.56 | | 0.56 | 0.57 | 0.55 | 0.47 | 0.42 | 0.59 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.12 | | -1.74 | | -1.56 | | -1.54 | -1.45 | -1.64 | -1.37 | -1.29 | -0.41 |
| **lgASD | 0.94 | | 0.79 | | 0.66 | | 0.63 | 0.56 | 0.78 | 0.56 | 0.76 | 0.59 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 1.02 | | 1.44 | | 1.48 | | 1.46 | 1.40 | 0.97 | 1.33 | 1.12 | 1.04 |
| **lgASA | 1.44 | | 0.77 | | 0.70 | | 0.60 | 0.59 | 1.27 | 0.56 | 1.04 | 0.63 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 1.01 | | 0.96 | | 1.13 | | 1.30 | 1.40 | 1.41 | 1.63 | 1.68 | 1.70 |
| **lgZSA | 0.56 | | 0.55 | | 0.43 | | 0.37 | 0.32 | 0.45 | 0.17 | 0.14 | 0.17 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.11 | | -1.69 | | -1.52 | | -1.51 | -1.54 | -1.84 | -1.86 | -2.16 | -2.21 |
| **lgZSD | 0.59 | | 0.51 | | 0.46 | | 0.43 | 0.45 | 0.63 | 0.51 | 0.74 | 0.61 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-1 | | | | | | | | | | | |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | | 0.4 | | 0.4 | | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.6 | | 0.6 | | 0.6 | | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| *ASA* vs *SF* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | -0.6 | | -0.6 | | -0.6 | | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 |
| *DS* vs *SF* | -0.4 | | -0.4 | | -0.4 | | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0.4 | | 0.4 | | 0.4 | | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASD* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.4 | | -0.4 | | -0.4 | | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ZSD* vs *K* | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | -0.5 | | -0.5 | | -0.5 | | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ZSA*vs *DS* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | | 0.5 | | 0.5 | | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | -0.1 | | -0.1 | | -0.1 | | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 |
| *ZSD* vs *ASA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *ASA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ZSA* | 0 | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | | 2.3 | | 2.3 | | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| XPR [dB] | **XPR | 23.7 | | 21.8 | | 19.6 | | 18.0 | 16.3 | 15.9 | 12.3 | 10.5 | 10.5 |
| **XPR | 4.5 | | 6.3 | | 8.2 | | 9.4 | 11.5 | 12.4 | 15.0 | 15.7 | 15.7 |
| Number of clusters | | | 4 | | 4 | | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of rays per cluster | | | 20 | | 20 | | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | | 3.9 | | 3.9 | | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| Cluster *ASD* () in [deg] | | | 0 | | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | | 15 | | 15 | | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Cluster *ZSA* () in [deg] | | | 7 | | 7 | | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | | 3 | | 3 | | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | | 40 | | 40 | | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | | N/A | | N/A | | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | | 50 | | 50 | | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | | | | |

**Table 6.7.2-3a: Channel model parameters for Urban Scenario (LOS) at S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Urban LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.97 | -8.12 | -8.21 | -8.31 | -8.37 | -8.39 | -8.38 | -8.35 | -8.34 |
| **lgDS | 1 | 0.83 | 0.68 | 0.48 | 0.38 | 0.24 | 0.18 | 0.13 | 0.09 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.6 | -2.48 | -2.44 | -2.6 | -2.71 | -2.76 | -2.78 | -2.65 | -2.27 |
| **lgASD | 0.79 | 0.8 | 0.91 | 1.02 | 1.17 | 1.17 | 1.2 | 1.45 | 1.85 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.18 | 0.42 | 0.41 | 0.18 | -0.07 | -0.43 | -0.64 | -0.91 | -0.54 |
| **lgASA | 0.74 | 0.9 | 1.3 | 1.69 | 2.04 | 2.54 | 2.47 | 2.69 | 1.66 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -0.63 | -0.15 | 0.54 | 0.35 | 0.27 | 0.26 | -0.12 | -0.21 | -0.07 |
| **lgZSA | 2.6 | 3.31 | 1.1 | 1.59 | 1.62 | 0.97 | 1.99 | 1.82 | 1.43 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.54 | -2.67 | -2.03 | -2.28 | -2.48 | -2.56 | -2.96 | -3.08 | -3 |
| **lgZSD | 2.62 | 2.96 | 0.86 | 1.19 | 1.4 | 0.85 | 1.61 | 1.49 | 1.09 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-2 | | | | | | | | |
| K-factor (K) [dB] | *K* | 31.83 | 18.78 | 10.49 | 7.46 | 6.52 | 5.47 | 4.54 | 4.03 | 3.68 |
| *K* | 13.84 | 13.78 | 10.42 | 8.01 | 8.27 | 7.26 | 5.53 | 4.49 | 3.14 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| XPR [dB] | **XPR | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| **XPR | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of clusters | | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| Cluster *ASD* () in [deg] | | 0.09 | 0.09 | 0.12 | 0.16 | 0.2 | 0.28 | 0.44 | 0.9 | 2.87 |
| Cluster *ASA* () in [deg] | | 12.55 | 12.76 | 14.36 | 16.42 | 17.13 | 19.01 | 19.31 | 22.39 | 27.8 |
| Cluster *ZSA* () in [deg] | | 1.25 | 3.23 | 4.39 | 5.72 | 6.17 | 7.36 | 7.3 | 7.7 | 9.25 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | |

**Table 6.7.2-3b: Channel model parameters for Urban Scenario (LOS) at Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Urban LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -8.52 | -8.59 | -8.51 | -8.49 | -8.48 | -8.44 | -8.4 | -8.37 | -8.35 |
| **lgDS | 0.92 | 0.79 | 0.65 | 0.48 | 0.46 | 0.34 | 0.27 | 0.19 | 0.14 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.18 | -3.05 | -2.98 | -3.11 | -3.19 | -3.25 | -3.33 | -3.22 | -2.83 |
| **lgASD | 0.79 | 0.87 | 1.04 | 1.06 | 1.12 | 1.14 | 1.25 | 1.35 | 1.62 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | -0.4 | -0.15 | -0.18 | -0.31 | -0.58 | -0.9 | -1.16 | -1.48 | -1.14 |
| **lgASA | 0.77 | 0.97 | 1.58 | 1.69 | 2.13 | 2.51 | 2.47 | 2.61 | 1.7 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -0.67 | -0.34 | 0.07 | -0.08 | -0.21 | -0.25 | -0.61 | -0.79 | -0.58 |
| **lgZSA | 2.22 | 3.04 | 1.33 | 1.45 | 1.62 | 1.06 | 1.88 | 1.87 | 1.19 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.61 | -2.82 | -2.48 | -2.76 | -2.93 | -3.05 | -3.45 | -3.66 | -3.56 |
| **lgZSD | 2.41 | 2.59 | 1.02 | 1.27 | 1.38 | 0.96 | 1.51 | 1.49 | 0.89 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-2 | | | | | | | | |
| K-factor (K) [dB] | *K* | 40.18 | 23.62 | 12.48 | 8.56 | 7.42 | 5.97 | 4.88 | 4.22 | 3.81 |
| *K* | 16.99 | 18.96 | 14.23 | 11.06 | 11.21 | 9.47 | 7.24 | 5.79 | 4.25 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| XPR [dB] | **XPR | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| **XPR | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of clusters | | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0.09 | 0.09 | 0.11 | 0.15 | 0.18 | 0.27 | 0.42 | 0.86 | 2.55 |
| Cluster *ASA* () in [deg] | | 11.78 | 11.6 | 13.05 | 14.56 | 15.35 | 16.97 | 17.96 | 20.68 | 25.08 |
| Cluster *ZSA* () in [deg] | | 1.14 | 2.78 | 3.87 | 4.94 | 5.41 | 6.31 | 6.66 | 7.31 | 9.23 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | |

**Table 6.7.2-4a: Channel model parameters for Urban Scenario (NLOS) at S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Urban NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.21 | -7.63 | -7.75 | -7.97 | -7.99 | -8.01 | -8.09 | -7.97 | -8.17 |
| **lgDS | 1.19 | 0.98 | 0.84 | 0.73 | 0.73 | 0.72 | 0.71 | 0.78 | 0.67 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -1.55 | -1.61 | -1.73 | -1.95 | -1.94 | -1.88 | -2.1 | -1.8 | -1.77 |
| **lgASD | 0.87 | 0.88 | 1.15 | 1.13 | 1.21 | 0.99 | 1.77 | 1.54 | 1.4 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.17 | 0.32 | 0.52 | 0.61 | 0.68 | 0.64 | 0.58 | 0.71 | 0.49 |
| **lgASA | 2.97 | 2.99 | 2.71 | 2.26 | 2.08 | 1.93 | 1.71 | 0.96 | 1.16 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -0.97 | 0.49 | 1.03 | 1.12 | 1.3 | 1.32 | 1.35 | 1.31 | 1.5 |
| **lgZSA | 2.35 | 2.11 | 1.29 | 1.45 | 1.07 | 1.2 | 1.1 | 1.35 | 0.56 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.86 | -2.64 | -2.05 | -2.18 | -2.24 | -2.21 | -2.69 | -2.81 | -4.29 |
| **lgZSD | 2.77 | 2.79 | 1.53 | 1.67 | 1.95 | 1.87 | 2.72 | 2.98 | 4.37 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-2 | | | | | | | | |
| K-factor (K) [dB] | *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ASD* vs *DS* | 0.54 | 0.46 | 0.56 | 0.52 | 0.6 | 0.59 | 0.6 | 0.57 | 0.64 |
| *ASA* vs *DS* | 0.38 | 0.36 | 0.27 | 0.29 | 0.21 | 0.24 | 0.22 | 0.24 | 0.24 |
| *ASA* vs *SF* | -0.05 | -0.04 | -0.04 | -0.04 | -0.03 | -0.05 | -0.02 | -0.01 | 0 |
| *ASD* vs *SF* | -0.48 | -0.53 | -0.52 | -0.52 | -0.54 | -0.51 | -0.5 | -0.48 | -0.43 |
| *DS* vs *SF* | -0.22 | -0.26 | -0.21 | -0.25 | -0.21 | -0.19 | -0.19 | -0.2 | -0.2 |
| *ASD*vs *ASA* | 0.41 | 0.4 | 0.33 | 0.37 | 0.23 | 0.23 | 0.22 | 0.23 | 0.21 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | 0.98 | 0.97 | 0.96 | 0.9 | 0.89 | 0.92 | 0.93 | 0.89 | 0.8 |
| *ZSA*vs *DS* | -0.01 | 0.06 | 0.06 | 0.06 | -0.05 | -0.19 | -0.18 | -0.39 | -0.34 |
| *ZSD* vs *ASD* | 0.72 | 0.6 | 0.75 | 0.69 | 0.7 | 0.71 | 0.79 | 0.77 | 0.92 |
| *ZSA* vs *ASD* | 0 | 0.08 | 0.11 | 0.12 | -0.04 | -0.13 | -0.17 | -0.35 | -0.3 |
| *ZSD* vs *ASA* | 0.47 | 0.43 | 0.38 | 0.41 | 0.34 | 0.33 | 0.28 | 0.3 | 0.42 |
| *ZSA* vs *ASA* | 0.04 | 0.15 | 0.18 | 0.15 | 0.15 | 0.16 | -0.03 | -0.26 | -0.55 |
| *ZSD* vs *ZSA* | -0.01 | 0.06 | 0.09 | 0.09 | -0.02 | -0.14 | -0.16 | -0.35 | -0.36 |
| Delay scaling parameter *rτ* | | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| XPR [dB] | **XPR | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **XPR | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of clusters | | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 |
| Cluster *ASD* () in [deg] | | 0.08 | 0.1 | 0.14 | 0.23 | 0.33 | 0.53 | 1 | 1.4 | 6.63 |
| Cluster *ASA* () in [deg] | | 15.07 | 16.2 | 18.14 | 19.96 | 21.53 | 22.44 | 23.59 | 26.57 | 32.7 |
| Cluster *ZSA* () in [deg] | | 1.66 | 4.71 | 7.33 | 9.82 | 11.52 | 11.75 | 10.93 | 12.19 | 16.68 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | |

**Table 6.7.2-4b: Channel model parameters for Urban Scenario (NLOS) at Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Urban NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.24 | -7.7 | -7.82 | -8.04 | -8.08 | -8.1 | -8.16 | -8.03 | -8.33 |
| **lgDS | 1.26 | 0.99 | 0.86 | 0.75 | 0.77 | 0.76 | 0.73 | 0.79 | 0.7 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -1.58 | -1.67 | -1.84 | -2.02 | -2.06 | -1.99 | -2.19 | -1.88 | -2 |
| **lgASD | 0.89 | 0.89 | 1.3 | 1.15 | 1.23 | 1.02 | 1.78 | 1.55 | 1.4 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.13 | 0.19 | 0.44 | 0.48 | 0.56 | 0.55 | 0.48 | 0.53 | 0.32 |
| **lgASA | 2.99 | 3.12 | 2.69 | 2.45 | 2.17 | 1.93 | 1.72 | 1.51 | 1.2 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -1.13 | 0.49 | 0.95 | 1.15 | 1.14 | 1.13 | 1.16 | 1.28 | 1.42 |
| **lgZSA | 2.66 | 2.03 | 1.54 | 1.02 | 1.61 | 1.84 | 1.81 | 1.35 | 0.6 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.87 | -2.68 | -2.12 | -2.27 | -2.5 | -2.47 | -2.83 | -2.82 | -4.55 |
| **lgZSD | 2.76 | 2.76 | 1.54 | 1.77 | 2.36 | 2.33 | 2.84 | 2.87 | 4.27 |
| Shadow fading (SF) [dB] | *SF* | See Table 6.6.2-2 | | | | | | | | |
| K-factor (K) [dB] | *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ASD* vs *DS* | 0.55 | 0.47 | 0.55 | 0.52 | 0.55 | 0.57 | 0.61 | 0.59 | 0.65 |
| *ASA* vs *DS* | 0.38 | 0.37 | 0.29 | 0.3 | 0.23 | 0.21 | 0.23 | 0.23 | 0.36 |
| *ASA* vs *SF* | -0.05 | -0.04 | -0.04 | -0.04 | -0.03 | -0.05 | -0.03 | -0.01 | -0.03 |
| *ASD* vs *SF* | -0.48 | -0.52 | -0.52 | -0.53 | -0.57 | -0.53 | -0.5 | -0.49 | -0.38 |
| *DS* vs *SF* | -0.21 | -0.25 | -0.21 | -0.26 | -0.25 | -0.2 | -0.19 | -0.2 | -0.19 |
| *ASD*vs *ASA* | 0.41 | 0.42 | 0.34 | 0.38 | 0.28 | 0.2 | 0.26 | 0.23 | 0.31 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | -0.02 | 0 | 0.01 | 0.01 | 0.03 | 0.03 | -0.02 | -0.05 | -0.12 |
| *ZSA* vs *SF* | -0.31 | -0.32 | -0.33 | -0.33 | -0.41 | -0.4 | -0.36 | -0.37 | -0.33 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | 0.68 | 0.72 | 0.68 | 0.67 | 0.65 | 0.67 | 0.63 | 0.61 | 0.54 |
| *ZSA*vs *DS* | 0.06 | 0.1 | 0.11 | 0.13 | -0.04 | -0.14 | -0.11 | -0.24 | -0.19 |
| *ZSD* vs *ASD* | 0.52 | 0.48 | 0.59 | 0.55 | 0.54 | 0.6 | 0.64 | 0.6 | 0.6 |
| *ZSA* vs *ASD* | 0.06 | 0.12 | 0.14 | 0.18 | 0.01 | -0.1 | -0.11 | -0.24 | -0.2 |
| *ZSD* vs *ASA* | 0.4 | 0.41 | 0.34 | 0.38 | 0.31 | 0.25 | 0.23 | 0.22 | 0.29 |
| *ZSA* vs *ASA* | 0.05 | 0.13 | 0.16 | 0.16 | 0.18 | 0.21 | 0.02 | -0.13 | -0.35 |
| *ZSD* vs *ZSA* | -0.02 | 0.04 | 0.09 | 0.11 | 0 | -0.09 | -0.15 | -0.29 | -0.33 |
| Delay scaling parameter *rτ* | | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| XPR [dB] | **XPR | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **XPR | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of clusters | | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0.08 | 0.1 | 0.14 | 0.22 | 0.31 | 0.49 | 0.97 | 1.52 | 5.36 |
| Cluster *ASA* () in [deg] | | 14.72 | 14.62 | 16.4 | 17.86 | 19.74 | 19.73 | 20.5 | 26.16 | 25.83 |
| Cluster *ZSA* () in [deg] | | 1.57 | 4.3 | 6.64 | 9.21 | 10.32 | 10.3 | 10.2 | 12.27 | 12.75 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros.  NOTE 9: The number of clusters is based on a limited data. The number may be different in the real field conditions. | | | | | | | | | | |

**Table 6.7.2-5a: Channel model parameters for Suburban Scenario (LOS) in S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Suburban LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -8.16 | -8.56 | -8.72 | -8.71 | -8.72 | -8.66 | -8.38 | -8.34 | -8.34 |
| **lgDS | 0.99 | 0.96 | 0.79 | 0.81 | 1.12 | 1.23 | 0.55 | 0.63 | 0.63 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.57 | -3.80 | -3.77 | -3.57 | -3.42 | -3.27 | -3.08 | -2.75 | -2.75 |
| **lgASD | 1.62 | 1.74 | 1.72 | 1.60 | 1.49 | 1.43 | 1.36 | 1.26 | 1.26 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.05 | -0.38 | -0.56 | -0.59 | -0.58 | -0.55 | -0.28 | -0.17 | -0.17 |
| **lgASA | 1.84 | 1.94 | 1.75 | 1.82 | 1.87 | 1.92 | 1.16 | 1.09 | 1.09 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -1.78 | -1.84 | -1.67 | -1.59 | -1.55 | -1.51 | -1.27 | -1.28 | -1.28 |
| **lgZSA | 0.62 | 0.81 | 0.57 | 0.86 | 1.05 | 1.23 | 0.54 | 0.67 | 0.67 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -1.06 | -1.21 | -1.28 | -1.32 | -1.39 | -1.36 | -1.08 | -1.31 | -1.31 |
| **lgZSD | 0.96 | 0.95 | 0.49 | 0.79 | 0.97 | 1.17 | 0.62 | 0.76 | 0.76 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | 11.40 | 19.45 | 20.80 | 21.20 | 21.60 | 19.75 | 12.00 | 12.85 | 12.85 |
| *K* | 6.26 | 10.32 | 16.34 | 15.63 | 14.22 | 14.19 | 5.70 | 9.91 | 9.91 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.20 | 3.36 | 3.50 | 2.81 | 2.39 | 2.73 | 2.07 | 2.04 | 2.04 |
| XPR [dB] | **XPR | 21.3 | 21.0 | 21.2 | 21.1 | 20.7 | 20.6 | 20.3 | 19.8 | 19.1 |
| **XPR | 7.6 | 8.9 | 8.5 | 8.4 | 9.2 | 9.8 | 10.8 | 12.2 | 13.0 |
| Number of clusters | | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-5b: Channel model parameters for Suburban Scenario (LOS) in Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Suburban LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -8.07 | -8.61 | -8.72 | -8.63 | -8.54 | -8.48 | -8.42 | -8.39 | -8.37 |
| **lgDS | 0.46 | 0.45 | 0.28 | 0.17 | 0.14 | 0.15 | 0.09 | 0.05 | 0.02 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.55 | -3.69 | -3.59 | -3.38 | -3.23 | -3.19 | -2.83 | -2.66 | -1.22 |
| **lgASD | 0.48 | 0.41 | 0.41 | 0.35 | 0.35 | 0.43 | 0.33 | 0.44 | 0.31 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.89 | 0.31 | 0.02 | -0.10 | -0.19 | -0.54 | -0.24 | -0.52 | -0.15 |
| **lgASA | 0.67 | 0.78 | 0.75 | 0.65 | 0.55 | 0.96 | 0.43 | 0.93 | 0.44 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 0.63 | 0.76 | 1.11 | 1.37 | 1.53 | 1.65 | 1.74 | 1.82 | 1.87 |
| **lgZSA | 0.35 | 0.30 | 0.28 | 0.23 | 0.23 | 0.17 | 0.11 | 0.05 | 0.02 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -3.37 | -3.28 | -3.04 | -2.88 | -2.83 | -2.86 | -2.95 | -3.21 | -3.49 |
| **lgZSD | 0.28 | 0.27 | 0.26 | 0.21 | 0.18 | 0.17 | 0.10 | 0.07 | 0.24 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | 8.9 | 14.0 | 11.3 | 9.0 | 7.5 | 6.6 | 5.9 | 5.5 | 5.4 |
| *K* | 4.4 | 4.6 | 3.7 | 3.5 | 3.0 | 2.6 | 1.7 | 0.7 | 0.3 |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| *ASA* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *DS* vs ** | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 | -0.8 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *DS* | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 | -0.2 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASA* | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 | -0.3 |
| *ZSA* vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| XPR [dB] | **XPR | 23.2 | 23.6 | 23.5 | 23.4 | 23.2 | 23.3 | 23.4 | 23.2 | 23.1 |
| **XPR | 5.0 | 4.5 | 4.7 | 5.2 | 5.7 | 5.9 | 6.2 | 7.0 | 7.6 |
| Number of clusters | | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASD* | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| *ASA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-6a: Channel model parameters for Suburban Scenario (NLOS) in S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Suburban NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.91 | -8.39 | -8.69 | -8.59 | -8.64 | -8.74 | -8.98 | -9.28 | -9.28 |
| **lgDS | 1.42 | 1.46 | 1.46 | 1.21 | 1.18 | 1.13 | 1.37 | 1.50 | 1.50 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.54 | -3.63 | -3.66 | -3.66 | -3.66 | -3.57 | -3.18 | -2.71 | -2.71 |
| **lgASD | 1.80 | 1.43 | 1.68 | 1.48 | 1.55 | 1.38 | 1.62 | 1.63 | 1.63 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 0.91 | 0.70 | 0.38 | 0.30 | 0.28 | 0.23 | 0.10 | 0.04 | 0.04 |
| **lgASA | 1.70 | 1.33 | 1.52 | 1.46 | 1.44 | 1.44 | 1.24 | 1.04 | 1.04 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -1.90 | -1.70 | -1.75 | -1.80 | -1.80 | -1.85 | -1.45 | -1.19 | -1.19 |
| **lgZSA | 1.63 | 1.24 | 1.54 | 1.25 | 1.21 | 1.20 | 1.38 | 1.58 | 1.58 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -2.01 | -1.67 | -1.75 | -1.49 | -1.53 | -1.57 | -1.48 | -1.62 | -1.62 |
| **lgZSD | 1.79 | 1.31 | 1.42 | 1.28 | 1.40 | 1.24 | 0.98 | 0.88 | 0.88 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| *ASA* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 |
| *ZSD* vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.28 | 2.33 | 2.43 | 2.26 | 2.71 | 2.10 | 2.19 | 2.06 | 2.06 |
| XPR [dB] | **XPR | 20.6 | 16.7 | 13.2 | 11.3 | 9.6 | 7.5 | 9.1 | 11.7 | 11.7 |
| **XPR | 8.5 | 12.0 | 12.8 | 13.8 | 12.5 | 11.2 | 10.1 | 13.1 | 13.1 |
| Number of clusters | | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-6b: Channel model parameters for Suburban Scenario (NLOS) in Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Suburban NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -7.43 | -7.63 | -7.86 | -7.96 | -7.98 | -8.45 | -8.21 | -8.69 | -8.69 |
| **lgDS | 0.50 | 0.61 | 0.56 | 0.58 | 0.59 | 0.47 | 0.36 | 0.29 | 0.29 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.89 | -2.76 | -2.64 | -2.41 | -2.42 | -2.53 | -2.35 | -2.31 | -2.31 |
| **lgASD | 0.41 | 0.41 | 0.41 | 0.52 | 0.70 | 0.50 | 0.58 | 0.73 | 0.73 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | 1.49 | 1.24 | 1.06 | 0.91 | 0.98 | 0.49 | 0.73 | -0.04 | -0.04 |
| **lgASA | 0.40 | 0.82 | 0.71 | 0.55 | 0.58 | 1.37 | 0.49 | 1.48 | 1.48 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | 0.81 | 1.06 | 1.12 | 1.14 | 1.29 | 1.38 | 1.36 | 1.38 | 1.38 |
| **lgZSA | 0.36 | 0.41 | 0.40 | 0.39 | 0.35 | 0.36 | 0.29 | 0.20 | 0.20 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -3.09 | -2.93 | -2.91 | -2.78 | -2.70 | -3.03 | -2.90 | -3.20 | -3.20 |
| **lgZSD | 0.32 | 0.47 | 0.46 | 0.54 | 0.45 | 0.36 | 0.42 | 0.30 | 0.30 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| Cross-Correlations | *ASD* vs *DS* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASA* vs *DS* | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| *ASA* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 | -0.6 |
| *DS* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ASD*vs *ASA* | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *SF* | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 | -0.4 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ZSA*vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ASD* | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| *ZSA* vs *ASD* | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 | -0.1 |
| *ZSD* vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSD* vs *ZSA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Delay scaling parameter *rτ* | | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| XPR [dB] | **XPR | 22.5 | 19.4 | 15.5 | 13.9 | 11.7 | 9.8 | 10.3 | 15.6 | 15.6 |
| **XPR | 5.0 | 8.5 | 10.0 | 10.6 | 10.0 | 9.1 | 9.1 | 9.1 | 9.1 |
| Number of clusters | | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 |
| Cluster *ASD* () in [deg] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cluster *ASA* () in [deg] | | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Cluster *ZSA* () in [deg] | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ASD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *SF* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-7a: Channel model parameters for Rural Scenario (LOS) at S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Rural LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -9.55 | -8.68 | -8.46 | -8.36 | -8.29 | -8.26 | -8.22 | -8.2 | -8.19 |
| **lgDS | 0.66 | 0.44 | 0.28 | 0.19 | 0.14 | 0.1 | 0.1 | 0.05 | 0.06 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -3.42 | -3 | -2.86 | -2.78 | -2.7 | -2.66 | -2.53 | -2.21 | -1.78 |
| **lgASD | 0.89 | 0.63 | 0.52 | 0.45 | 0.42 | 0.41 | 0.42 | 0.5 | 0.91 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | -9.45 | -4.45 | -2.39 | -1.28 | -0.99 | -1.05 | -0.9 | -0.89 | -0.81 |
| **lgASA | 7.83 | 6.86 | 5.14 | 3.44 | 2.59 | 2.42 | 1.78 | 1.65 | 1.26 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -4.2 | -2.31 | -0.28 | -0.38 | -0.38 | -0.46 | -0.49 | -0.53 | -0.46 |
| **lgZSA | 6.3 | 5.04 | 0.81 | 1.16 | 0.82 | 0.67 | 1 | 1.18 | 0.91 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -6.03 | -4.31 | -2.57 | -2.59 | -2.59 | -2.65 | -2.69 | -2.65 | -2.65 |
| **lgZSD | 5.19 | 4.18 | 0.61 | 0.79 | 0.65 | 0.52 | 0.78 | 1.01 | 0.71 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | 24.72 | 12.31 | 8.05 | 6.21 | 5.04 | 4.42 | 3.92 | 3.65 | 3.59 |
| *K* | 5.07 | 5.75 | 5.46 | 5.23 | 3.95 | 3.75 | 2.56 | 1.77 | 1.77 |
| Cross-Correlations | *ASD* vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *DS* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *DS* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| *ZSA* vs *SF* | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |
| *ZSD* vs *DS* | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 |
| *ZSA*vs *DS* | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| *ZSD* vs *ASD* | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 |
| *ZSA* vs *ASD* | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 |
| *ZSD* vs *ASA* | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 |
| *ZSA* vs *ASA* | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| *ZSD* vs *ZSA* | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 |
| Delay scaling parameter *rτ* | | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| XPR [dB] | **XPR | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **XPR | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of clusters | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cluster *ASD* () in [deg] | | 0.39 | 0.31 | 0.29 | 0.37 | 0.61 | 0.9 | 1.43 | 2.87 | 5.48 |
| Cluster *ASA* () in [deg] | | 10.81 | 8.09 | 13.7 | 20.05 | 24.51 | 26.35 | 31.84 | 36.62 | 36.77 |
| Cluster *ZSA* () in [deg] | | 1.94 | 1.83 | 2.28 | 2.93 | 2.84 | 3.17 | 3.88 | 4.17 | 4.29 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASD* | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| *ASA* | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-7b: Channel model parameters for Rural Scenario (LOS) at Ka band.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Rural LOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -9.68 | -8.86 | -8.59 | -8.46 | -8.36 | -8.3 | -8.26 | -8.22 | -8.21 |
| **lgDS | 0.46 | 0.29 | 0.18 | 0.19 | 0.14 | 0.15 | 0.13 | 0.03 | 0.07 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -4.03 | -3.55 | -3.45 | -3.38 | -3.33 | -3.29 | -3.24 | -2.9 | -2.5 |
| **lgASD | 0.91 | 0.7 | 0.55 | 0.52 | 0.46 | 0.43 | 0.46 | 0.44 | 0.82 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | -9.74 | -4.88 | -2.6 | -1.92 | -1.56 | -1.66 | -1.59 | -1.58 | -1.51 |
| **lgASA | 7.52 | 6.67 | 4.63 | 3.45 | 2.44 | 2.38 | 1.67 | 1.44 | 1.13 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -5.85 | -3.27 | -0.88 | -0.93 | -0.99 | -1.04 | -1.17 | -1.19 | -1.13 |
| **lgZSA | 6.51 | 5.36 | 0.93 | 0.96 | 0.97 | 0.83 | 1.01 | 1.01 | 0.85 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -7.45 | -5.25 | -3.16 | -3.15 | -3.2 | -3.27 | -3.42 | -3.36 | -3.35 |
| **lgZSD | 5.3 | 4.42 | 0.68 | 0.73 | 0.77 | 0.61 | 0.74 | 0.79 | 0.65 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | 25.43 | 12.72 | 8.40 | 6.52 | 5.24 | 4.57 | 4.02 | 3.70 | 3.62 |
| *K* | 7.04 | 7.47 | 7.18 | 6.88 | 5.28 | 4.92 | 3.40 | 2.22 | 2.28 |
| Cross-Correlations | *ASD* vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs *DS* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs *SF* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *DS* vs *SF* | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 |
| *ASD*vs *ASA* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASD* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ASA* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *DS* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *SF* vs ** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cross-Correlations | *ZSD* vs *SF* | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| *ZSA* vs *SF* | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 | -0.17 |
| *ZSD* vs *K* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *ZSA* vs *K* | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 | -0.02 |
| *ZSD* vs *DS* | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 | -0.05 |
| *ZSA*vs *DS* | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| *ZSD* vs *ASD* | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 | 0.73 |
| *ZSA* vs *ASD* | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 | -0.14 |
| *ZSD* vs *ASA* | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 | -0.20 |
| *ZSA* vs *ASA* | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| *ZSD* vs *ZSA* | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 | -0.07 |
| Delay scaling parameter *rτ* | | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| XPR [dB] | **XPR | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| **XPR | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Number of clusters | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cluster *ASD* () in [deg] | | 0.36 | 0.3 | 0.25 | 0.35 | 0.53 | 0.88 | 1.39 | 2.7 | 4.97 |
| Cluster *ASA* () in [deg] | | 4.63 | 6.83 | 12.91 | 18.9 | 22.44 | 25.69 | 27.95 | 31.45 | 28.01 |
| Cluster *ZSA* () in [deg] | | 0.75 | 1.25 | 1.93 | 2.37 | 2.66 | 3.23 | 3.71 | 4.17 | 4.14 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ASD* | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |
| *ASA* | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 35 |
| *SF* | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| ** | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *ZSA* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *ZSD* | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-8a: Channel model parameters for Rural Scenario (NLOS) at S band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Rural NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -9.01 | -8.37 | -8.05 | -7.92 | -7.92 | -7.96 | -7.91 | -7.79 | -7.74 |
| **lgDS | 1.59 | 0.95 | 0.92 | 0.92 | 0.87 | 0.87 | 0.82 | 0.86 | 0.81 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.9 | -2.5 | -2.12 | -1.99 | -1.9 | -1.85 | -1.69 | -1.46 | -1.32 |
| **lgASD | 1.34 | 1.18 | 1.08 | 1.06 | 1.05 | 1.06 | 1.14 | 1.16 | 1.3 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | -3.33 | -0.74 | 0.08 | 0.32 | 0.53 | 0.33 | 0.55 | 0.45 | 0.4 |
| **lgASA | 6.22 | 4.22 | 3.02 | 2.45 | 1.63 | 2.08 | 1.58 | 2.01 | 2.19 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -0.88 | -0.07 | 0.75 | 0.72 | 0.95 | 0.97 | 1.1 | 0.97 | 1.35 |
| **lgZSA | 3.26 | 3.29 | 1.92 | 1.92 | 1.45 | 1.62 | 1.43 | 1.88 | 0.62 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -4.92 | -4.06 | -2.33 | -2.24 | -2.24 | -2.22 | -2.19 | -2.41 | -2.45 |
| **lgZSD | 3.96 | 4.07 | 1.7 | 2.01 | 2 | 1.82 | 1.66 | 2.58 | 2.52 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ASD* vs *DS* | 0.32 | 0.19 | 0.23 | 0.25 | 0.15 | 0.08 | 0.13 | 0.15 | 0.64 |
| *ASA* vs *DS* | 0.3 | 0.32 | 0.32 | 0.4 | 0.45 | 0.39 | 0.51 | 0.27 | 0.05 |
| *ASA* vs *SF* | 0.02 | 0 | 0 | 0.01 | 0.02 | 0.02 | 0.04 | 0.01 | 0.06 |
| *ASD* vs *SF* | 0.45 | 0.52 | 0.54 | 0.53 | 0.55 | 0.56 | 0.56 | 0.58 | 0.47 |
| *DS* vs *SF* | -0.36 | -0.39 | -0.41 | -0.37 | -0.4 | -0.41 | -0.4 | -0.46 | -0.3 |
| *ASD*vs *ASA* | 0.45 | 0.12 | 0.07 | 0.22 | 0.16 | 0.14 | 0.2 | -0.04 | -0.11 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | -0.06 | -0.04 | -0.04 | -0.05 | -0.06 | -0.07 | -0.11 | -0.05 | -0.1 |
| *ZSA* vs *SF* | -0.07 | -0.17 | -0.19 | -0.17 | -0.19 | -0.2 | -0.19 | -0.23 | -0.13 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | 0.58 | 0.67 | 0.65 | 0.73 | 0.79 | 0.81 | 0.79 | 0.7 | 0.42 |
| *ZSA*vs *DS* | 0.06 | 0.03 | 0 | -0.09 | -0.2 | -0.22 | -0.32 | -0.41 | -0.35 |
| *ZSD* vs *ASD* | 0.6 | 0.41 | 0.37 | 0.32 | 0.19 | 0.16 | 0.2 | 0.15 | 0.28 |
| *ZSA* vs *ASD* | 0.21 | -0.02 | -0.09 | -0.1 | -0.12 | -0.11 | -0.1 | -0.14 | -0.25 |
| *ZSD* vs *ASA* | 0.33 | 0.35 | 0.31 | 0.37 | 0.46 | 0.44 | 0.49 | 0.27 | 0.07 |
| *ZSA* vs *ASA* | 0.1 | 0.21 | 0.22 | 0.07 | -0.04 | -0.12 | -0.29 | -0.26 | -0.36 |
| *ZSD* vs *ZSA* | 0.01 | -0.02 | -0.12 | -0.21 | -0.27 | -0.27 | -0.38 | -0.35 | -0.36 |
| Delay scaling parameter *rτ* | | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| XPR [dB] | **XPR | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **XPR | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of clusters | | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cluster *ASD* () in [deg] | | 0.03 | 0.05 | 0.07 | 0.1 | 0.15 | 0.22 | 0.5 | 1.04 | 2.11 |
| Cluster *ASA* () in [deg] | | 18.16 | 26.82 | 21.99 | 22.86 | 25.93 | 27.79 | 28.5 | 37.53 | 29.23 |
| Cluster *ZSA* () in [deg] | | 2.32 | 7.34 | 8.28 | 8.76 | 9.68 | 9.94 | 8.9 | 13.74 | 12.16 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| *ASD* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASA* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *SF* | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values.  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**Table 6.7.2-8b: Channel model parameters for Rural Scenario (NLOS) at Ka band**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenarios** | | **Rural NLOS** | | | | | | | | |
| **10**° | **20**° | **30**° | **40**° | **50**° | **60**° | **70**° | **80**° | **90**° |
| Delay spread (DS)  lgDS=log10(DS/1s) | **lgDS | -9.13 | -8.39 | -8.1 | -7.96 | -7.99 | -8.05 | -8.01 | -8.05 | -7.91 |
| **lgDS | 1.91 | 0.94 | 0.92 | 0.94 | 0.89 | 0.87 | 0.82 | 1.65 | 0.76 |
| AOD spread (ASD)  lgASD=log10(ASD/1°) | **lgASD | -2.9 | -2.53 | -2.16 | -2.04 | -1.99 | -1.95 | -1.81 | -1.56 | -1.53 |
| **lgASD | 1.32 | 1.18 | 1.08 | 1.09 | 1.08 | 1.06 | 1.17 | 1.2 | 1.27 |
| AOA spread (ASA)  lgASA=log10(ASA/1°) | **lgASA | -3.4 | -0.51 | 0.06 | 0.2 | 0.4 | 0.32 | 0.46 | 0.33 | 0.24 |
| **lgASA | 6.28 | 3.75 | 2.95 | 2.65 | 1.85 | 1.83 | 1.57 | 1.99 | 2.18 |
| ZOA spread (ZSA)  lgZSA=log10(ZSA/1°) | **lgZSA | -1.19 | -0.11 | 0.72 | 0.69 | 0.84 | 0.99 | 0.95 | 0.92 | 1.29 |
| **lgZSA | 3.81 | 3.33 | 1.93 | 1.91 | 1.7 | 1.27 | 1.86 | 1.84 | 0.59 |
| ZOD spread (ZSD)  lgZSA=log10(ZSD/1°) | **lgZSD | -5.47 | -4.06 | -2.32 | -2.19 | -2.16 | -2.24 | -2.29 | -2.65 | -2.23 |
| **lgZSD | 4.39 | 4.04 | 1.54 | 1.73 | 1.5 | 1.64 | 1.66 | 2.86 | 1.12 |
| Shadow fading (SF) [dB] | *SF* | Table 6.6.2-3 | | | | | | | | |
| K-factor (K) [dB] | *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ASD* vs *DS* | 0.33 | 0.24 | 0.21 | 0.26 | 0.16 | 0.12 | 0.29 | 0.14 | 0.59 |
| *ASA* vs *DS* | 0.32 | 0.34 | 0.33 | 0.43 | 0.46 | 0.38 | 0.37 | 0.28 | 0.06 |
| *ASA* vs *SF* | 0.02 | 0 | 0 | 0.01 | 0.01 | 0.02 | 0.04 | 0.01 | 0.04 |
| *ASD* vs *SF* | 0.45 | 0.52 | 0.54 | 0.53 | 0.55 | 0.56 | 0.54 | 0.57 | 0.46 |
| *DS* vs *SF* | -0.36 | -0.38 | -0.42 | -0.36 | -0.39 | -0.42 | -0.36 | -0.44 | -0.27 |
| *ASD*vs *ASA* | 0.45 | 0.13 | 0.08 | 0.21 | 0.12 | 0.15 | 0.22 | -0.03 | -0.11 |
| *ASD* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ASA* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *DS* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *SF* vs ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cross-Correlations | *ZSD* vs *SF* | -0.07 | -0.04 | -0.04 | -0.05 | -0.06 | -0.06 | -0.09 | -0.06 | -0.08 |
| *ZSA* vs *SF* | -0.06 | -0.16 | -0.19 | -0.16 | -0.19 | -0.2 | -0.17 | -0.22 | -0.11 |
| *ZSD* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* vs *K* | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSD* vs *DS* | 0.55 | 0.65 | 0.64 | 0.73 | 0.78 | 0.77 | 0.74 | 0.75 | 0.52 |
| *ZSA*vs *DS* | 0.06 | 0.02 | 0.04 | -0.06 | -0.16 | -0.17 | -0.3 | -0.35 | -0.28 |
| *ZSD* vs *ASD* | 0.61 | 0.41 | 0.39 | 0.44 | 0.15 | 0.2 | 0.3 | 0.11 | 0.41 |
| *ZSA* vs *ASD* | 0.19 | -0.02 | -0.06 | -0.08 | -0.13 | -0.09 | -0.09 | -0.14 | -0.25 |
| *ZSD* vs *ASA* | 0.38 | 0.35 | 0.33 | 0.4 | 0.46 | 0.45 | 0.33 | 0.29 | 0.06 |
| *ZSA* vs *ASA* | 0.12 | 0.21 | 0.22 | 0.11 | 0.02 | -0.08 | -0.2 | -0.16 | -0.18 |
| *ZSD* vs *ZSA* | 0.05 | -0.03 | -0.08 | -0.2 | -0.25 | -0.24 | -0.37 | -0.31 | -0.32 |
| Delay scaling parameter *rτ* | | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 |
| XPR [dB] | **XPR | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| **XPR | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Number of clusters | | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Number of rays per cluster | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Cluster *DS* () in [ns] | | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Cluster *ASD* () in [deg] | | 0.03 | 0.05 | 0.07 | 0.09 | 0.16 | 0.22 | 0.51 | 0.89 | 1.68 |
| Cluster *ASA* () in [deg] | | 18.21 | 24.08 | 22.06 | 21.4 | 24.26 | 24.15 | 25.99 | 36.07 | 24.51 |
| Cluster *ZSA* () in [deg] | | 2.13 | 6.52 | 7.72 | 8.45 | 8.92 | 8.76 | 9 | 13.6 | 10.56 |
| Per cluster shadowing std  [dB] | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Correlation distance in the horizontal plane [m] | *DS* | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 |
| *ASD* | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| *ASA* | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| *SF* | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 |
| ** | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| *ZSA* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *ZSD* | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| *fc* is carrier frequency in GHz; *d*2D is BS-UT distance in km.  NOTE 1: *DS* = rms delay spread, *ASD* = rms azimuth spread of departure angles, *ASA* = rms azimuth spread of arrival angles, *ZSD* = rms zenith spread of departure angles, *ZSA* = rms zenith spread of arrival angles, *SF* = shadow fading, and *K* = Ricean K-factor.  NOTE 2: The sign of the shadow fading is defined so that positive SF means more received power at UT than predicted by the path loss model.  NOTE 3: All large scale parameters are assumed to have no correlation between different floors.  NOTE 4: The following notation for mean (*μ*lgX=mean{log10(X) }) and standard deviation (*σ*lgX=std{log10(X) }) is used for logarithmized parameters X.  NOTE 5: For all considered scenarios the AOD/AOA distributions are modelled by a wrapped Gaussian distribution, the ZOD/ZOA distributions are modelled by a Laplacian distribution and the delay distribution is modelled by an exponential distribution.  NOTE 6: For UMa and frequencies below 6 GHz, use *fc* = 6 when determining the values of the frequency-dependent LSP values.  NOTE 7: For UMi and frequencies below 2 GHz, use fc = 2 when determining the values of the frequency-dependent LSP values.  NOTE 8: For satellite (e.g.GEO/LEO), the departure angle spreads are zeros, i.e. µlgASD and µlgZSD are –∞, and corresponding standard deviations are zeros. | | | | | | | | | | |

**<Unchanged parts are omitted>**