**3GPP TSG RAN WG1 Meeting #122 R1-2506405**

**Bengaluru, India, Aug 25th – 29th, 2025**

**Source: Moderator (Interdigital, Inc.)**

**Title: Summary #2 of discussions for maintenance of Rel-19 7-24 GHz Channel Modeling SI**

**Agenda item: 8.8**

**Document for: Discussion**

# Introduction

In this contribution, moderator summarizes issues identified by the submitted contributions for RAN1 #122 agenda 8.8 regarding maintenance of channel model enhancement for 7 – 24 GHz SI.

# Suggested proposals for agreement/conclusion

##### Proposal #1D:

(Replace previous agreement in RAN1#122) Adopt the following TP to TR38.901

* ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
* ***Summary of change:*** Clarify the polarization equation for handheld UT
* ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

===== Start of TP for TR38.901=====

7.3.2 Polarized antenna modelling

**Handheld UT Model:**

*< Unchanged parts are omitted >*

Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~

, (7.3-6)

(7.3-7)

(7.3-8)

where the 3D-rotation angles, , and , are obtained according to the orientation and polarization direction of each UT antenna *u*, the zenith and azimuth angles mapping between and are based on equations (7.1-7) and (7.1-8) using the same 3D-rotation angles, , and , and ~~then~~ rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).

*< Unchanged parts are omitted >*

===== End of TP for TR38.901=====

##### Proposal #12:

Adopt the following TP to TR38.901

* ***Reason for change***: spelling mistake for “probability” and “vegetation” in Table 7.8-1A of Clause 7.8.
* ***Summary of chang***: Correct the spelling mistake for “probability” and “vegetation” in Table 7.8-1A.
* ***Consequences if not approved***: Spelling mistake in TR.

===== Start of TP for TR38.901=====

7.8.1 Large scale calibration

*<unchanged text omitted>*

Table 7.8-1A: Simulation assumptions for large scale calibration

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| --- | --- |
| **Parameter** | **Values** |
| Scenarios | UMa, UMi-Street Canyon, SMa |
| Carrier Frequency | 7 GHz |
| BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt in Table 7.8-1 for UMa and UMi-Street Canyon |
| BS antenna configurations | Mg = Ng = 1; (M,N,P) = (10, 1, 1), dV = 0.5λ |
| BS port mapping | Mp = 1, Np = 1, i.e., 10 elements are mapped to a single port  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization |
| BS Tx power | 49 dBm for SMa |
| Bandwidth | 20 MHz |
| UT distribution | For SMa, 20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. |
| LOS probability | For SMa, 0% veg~~a~~etation |
| O2I penetration loss | For SMa, Low-loss A model |
| O2I car penetration loss | For SMa, non-metallic car window |
| Wrapping method | For UMa, UMi-Street Canyon, SMa:  - geographical distance based wrapping (mandatory)  - radio distance (optional) |

*<unchanged text omitted>*

===== End of TP for TR38.901=====

##### Proposal #6:

Adopt the following TP to TR38.901

* ***Reason for change***: -25dB threshold to remove weak powered clusters may remove more than necessary number of clusters in case of LOS scenarios.
* ***Summary of chang***: Clarify the equation 7.5-6 is used for weak power cluster removal for all cases, NLOS and LOS.
* ***Consequences if not approved***: Removal of too many weak powered clusters in case of LOS scenarios.

===== Start of TP for TR38.901=====

7.5 Fast fading model

**<Unchanged parts omitted>**

Step 6: Generate cluster powers .

**<Unchanged parts omitted>**

Assign the power of each ray within a cluster as *Pn/ M*, where *M* is the number of rays per cluster.

Remove clusters with less than -25 dB power compared to the maximum cluster power based on equation ~~(7.5-8), in case of LOS condition, and based on equation~~ (7.5-6)~~, otherwise,~~. The scaling factors need not be changed after cluster elimination.

===== End of TP for TR38.901=====

##### Proposal #10-2:

Adopt the following TP to TR38.901

* ***Reason for change***: The reference handheld UT antenna model after antenna placement has majority of the antenna field pattern strength in domain and therefore field strength is concentrated in polarization domain. This may not be able to reflect UE antenna design.
* ***Summary of chang***: Add optional polarization rotation of 45 degree to the reference UT antenna model
* ***Consequences if not approved***: Reference handheld UT antenna model captured in TR is unable to reflect antenna design that has antenna field strength in both polarization domain.

===== Start of TP for TR38.901=====

7.3.2 Polarized antenna modelling

*<unchanged text omitted>*

**Handheld UT Model:**

*<unchanged text omitted>*

For cases when a candidate antenna placement location is used for one antenna field pattern (e.g., single polarization):

- The polarization direction is indicated by the arrow in Figure 7.3-7, which is parallel with the plane of the handheld UT and perpendicular to the direction from the UT center to the candidate antenna location.

- Optionally, polarization direction can additionally rotate 45 degrees about the direction from the UT center to the candidate antenna location (i.e. rotated using the direction from the UT center to the candidate antenna location as the rotational axis). An example for candidate antenna location (6) is given in Figure 7.3-8.

*<unchanged text omitted>*

===== End of TP for TR38.901=====

##### Proposal #13:

Approve draft CR in R1-256407 and endorse the final CR 0028 for TR38.901 in R1-2506543.

# Summary of issues

## 3.1 Correction in UT antenna modeling text [1]

Huawei has notes that equation 7.3-3 notation for UT are slightly different and suggests writing correct notations.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-x)  (7.3-x)  (7.3-x)  where , and are obtained according to the orientation and polarization direction of each UT antenna, and then rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

Huawei’s proposal seems to be clarifying the description to avoid ambiguity. From the current description it is not clear if equation 7.3-3a and 7.3-3b should have been applied for double prime local coordinate system to prime local coordinate system for antenna elements or 7.1-16 and 7.1-17 should have been applied. Use of equation 7.3-3a and 7.3-3b only allows polarization to be shifted by slant angles, and cannot be rotated based on alpha, beta, and gamma. Therefore, moderator thinks Huawei’s suggestion is correct.

##### Proposal #1:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
  + ***Summary of change:*** Clarify the polarization equation for handheld UT
  + ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-6)  (7.3-7)  (7.3-8)  where , and are obtained according to the orientation and polarization direction of each UT antenna, and then rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

##### Proposal #1A:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
  + ***Summary of change:*** Clarify the polarization equation for handheld UT
  + ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-6)  (7.3-7)  (7.3-8)  where , and are the 3D-rotation angles for translating to , that are obtained according to the orientation and polarization direction of each UT antenna, and then further rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

##### Proposal #1B:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
  + ***Summary of change:*** Clarify the polarization equation for handheld UT
  + ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-6)  (7.3-7)  (7.3-8)  where , and are the 3D-rotation angles for translating to , that are obtained according to the orientation and polarization direction of each UT antenna, and ~~then~~ rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

##### Proposal #1C:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
  + ***Summary of change:*** Clarify the polarization equation for handheld UT
  + ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-6)  (7.3-7)  (7.3-8)  where the 3D-rotation angles, , and , are are obtained according to the orientation and polarization direction of each UT antenna *u*, and ~~then~~ rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

#### Round #1 Discussion

Please provide comments on Proposal #1, especially if companies have strong concerns about the proposal.

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| **Company** | **Comments** |
| Nokia | We support the clarification of the transformation. |
| CATT | Support.  Considering that , and are not clearly defined for each UT antenna, it is also suggested to add the corresponding definition or illustration . |
| vivo | Support |
| Moderator | The 3D-rotation angles are described in section 7.1.3. Added text to clarify that these are 3D-rotation angles in Proposal 1A. |
| Sharp | Support Proposal 1A |
| ZTE | We do not support this change.  There are multiple implementation methods to achieve polarization transformation, including one-step and two-step rotation approaches.  In the proposed method, the polarization transformation considering the orientation must be applied twice: once in equation (7.3-6), accounting for the orientation and polarization direction of each UT antenna, and again in equation (7.1-11), considering the overall UT rotation.  In alternative implementations, the antenna orientation, polarization direction, and UT rotation can all be incorporated into equation (7.1-11) based on the LCS of each UT antenna and the GCS, leaving equation (7.3-6) unchanged.  The proposed change limits implementation flexibility.  If polarization ambiguity is a concern, a clarification of the polarization direction can be added. Once defined, the LCS of each UT antenna or rotation angles (, and ) can be calculated accordingly. |
| Moderator | @ZTE: In terms of being able to perform the implementation in single step (from double prime LCS directly to GCS) vs two steps (double prime LCS to single prime LCS, single prime LCS to GCS), I don’t believe the clarification of the text description is changing them.  In fact the current TR in v19.0.0 text already stated two steps  Step 1)  “Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation (7.3-3),”  Step 2)  “and then rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).”  The only thing the suggested TP from Huawei is suggesting is the clarification for equation (7.3-3).  If companies can generated the same results using a single step approach with the existing specification text, then moderator thinks the same could apply to the proposed TP as well.  Maybe the additional edit could be to remove the text “and then further” to acknowledge the description does not necessarily be taken in multiple steps.  @ZTE: Please check Proposal 1B. |
| Nokia2 | In general, the provided is correct, however, in addition to the rotation angle Psi, the whole procedure also includes the rotation of the reference pattern following the equations (7.1-7) and (7.1-8). That is not described above. Maybe one forward, way could be to referee to equation (7.1-15) and explain that 3D rotation angles are per UE antenna location, e.g.,  … using equation,  , (7.3-6)  where is defined by Clause 7.1.3 equations (7.1-15) - (7.1-17) and θ’’ and φ’’ - by the equations (7.1-7) and (7.1-8) according to the 3D-rotation angles , and obtained according to the orientation and polarization direction of each UT antenna u, and further rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11). |
| Moderator | Updated proposal to 1C based on comments from Nokia. |
| End of discussion | |

#### Summary of Tuesday Online Session

Proposal #1C agreed with removal of redundant second ‘are’ in the changed text.

#### Round #2 Discussion

It has come to Moderator attention that Nokia wanted to put additional clarification for theta and phi calculation that were missing from Proposal 1D. As such, I have re-opening the discussion to check with companies if they are ok with making amendments to the existing agreement.

##### Proposal #1D:

* (Replace previous agreement in RAN1#122) Adopt the following TP to TR38.901
  + ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
  + ***Summary of change:*** Clarify the polarization equation for handheld UT
  + ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

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| 7.3.2 Polarized antenna modelling  **Handheld UT Model:**  < Unchanged parts are omitted >  Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~  , (7.3-6)  (7.3-7)  (7.3-8)  where the 3D-rotation angles, , and , are obtained according to the orientation and polarization direction of each UT antenna *u*, the zenith and azimuth angles mapping between and are based on equations (7.1-7) and (7.1-8) using the same 3D-rotation angles, , and , and ~~then~~ rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).  < Unchanged parts are omitted > |

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| **Company** | **Comments** |
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## 3.2 [CLOSED] Correction of angle description for near field propagation equation [3][11]

Two companies have noted that the angle description for near field propagation equation is missing. Therefore, suggest updates to clarify how the angles are derived. The following are two TP proposals.

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| 7.6.13 Near-field channel model <Unrelated parts are omitted>  - To model the antenna element-wise antenna field patterns additionally, the is given by:  (7.6-49)  where and are the respective antenna element-wise elevation arrival angles and azimuth arrival angles for ray *m* of cluster *n* between the reference point at TRP side and receive antenna element *u*, and and are the respective antenna element-wise elevation departure angles and azimuth departure angles for ray *m* of cluster *n* between the transmit antenna element *s* and the reference point at UT side.  <Unrelated parts are omitted> |

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| **TR 38.901 [1]**  **7.6.13 Near-field channel model**  …  - To model the antenna element-wise antenna field patterns additionally, the is given by:  (7.6-49)  where , are the ray-wise angular domain parameters of ray *m* cluster *n* between the transmit antenna element *s* and receive antenna element *u*.  … |

Based on the two TPs, the first TP seem to be more inclusive change and therefore moderator suggests to take the first TP as basis for change.

##### Proposal #2:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** In the current TR 38.901 [1], antenna element-wise angular-domain parameters are introduced to additionally model the antenna element-wise field patterns for the NLOS channel impulse response in the near-field channel model. However, the definitions of these antenna element-wise angular-domain parameters are missing, leading to ambiguity in their interpretation.
  + ***Summary of change:*** Add definitions for the antenna element-wise angular-domain parameters in equation 7.6-49 of TR 38.901 [1], which are introduced for modelling the antenna element-wise field patterns.
  + ***Consequences if not approved:*** The expression for the angular-domain parameters in equation 7.6-49 of TR 38.901 [1] remains undefined, resulting in ambiguity and potential inconsistency in implementation.

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| 7.6.13 Near-field channel model *<Unrelated parts are omitted>*  - To model the antenna element-wise antenna field patterns additionally, the is given by:  (7.6-49)  where and are the respective antenna element-wise elevation arrival angles and azimuth arrival angles for ray *m* of cluster *n* between the reference point at TRP side and receive antenna element *u*, and and are the respective antenna element-wise elevation departure angles and azimuth departure angles for ray *m* of cluster *n* between the transmit antenna element *s* and the reference point at UT side.  *<Unrelated parts are omitted>* |

##### Proposal #2A:

* Adopt the following TP to TR38.901
  + ***Reason for change:*** In the current TR 38.901 [1], antenna element-wise angular-domain parameters are introduced to additionally model the antenna element-wise field patterns for the NLOS channel impulse response in the near-field channel model. However, the definitions of these antenna element-wise angular-domain parameters are missing, leading to ambiguity in their interpretation.
  + ***Summary of change:*** Add definitions for the antenna element-wise angular-domain parameters in equation 7.6-49 of TR 38.901 [1], which are introduced for modelling the antenna element-wise field patterns.
  + ***Consequences if not approved:*** The expression for the angular-domain parameters in equation 7.6-49 of TR 38.901 [1] remains undefined, resulting in ambiguity and potential inconsistency in implementation.

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| 7.6.13 Near-field channel model *<Unrelated parts are omitted>*  - To model the antenna element-wise antenna field patterns additionally, the is given by:  (7.6-49)  where and are the ~~respective~~ antenna element-wise elevation arrival angles and azimuth arrival angles, respectively, for ray *m* of cluster *n* for ~~between the reference point at TRP side and~~ receive antenna element *u*, and and are the ~~respective~~ antenna element-wise elevation departure angles and azimuth departure angles, respectively, for ray *m* of cluster *n* for ~~between the~~ transmit antenna element *s* ~~and the reference point at UT side~~.  *<Unrelated parts are omitted>* |

#### Round #1 Discussion

Please provide comments on Proposal #2, especially if companies have strong concerns about the proposal.

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| **Company** | **Comments** |
| Nokia | The version proposed by the moderator looks OK. |
| CATT | Support |
| vivo | Support |
| Sharp | If we adopt this option, we are not clear on how we generate the AOA, ZOA with respect to the reference point at the TRP side and receive antenna element u. Similarly, how do we generate the AOD, ZOD between the between the transmit antenna element *s* and the reference point at UT side. Can we please clarify how to generate antenna element wise AOA, ZOA with respect to the reference point at the TRP side and how to generate the AOD, ZOD between the between the transmit antenna element *s* and the reference point at UT side.  Our understanding is that AOA, AOD, ZOA, ZOD are generated for per ray m and per cluster n and not for every antenna element s at the TX and every antenna element u at the RX. Does the current formulation imply that AOA, AOD, ZOA, ZOD needs to be generated per ray m, per cluster n, per TX antenna element s and per RX antenna element u. |
| Nokia2 | We would like to revise our previous comment.  Now also share a concern by Sharp. The non-direct paths are quite vague, and there is no agreed reference reflection point towards which to measure the exact antenna field pattern for any element u or s in either end. The NLOS ray directions are the same for all paths, so the radiation pattern is also assumed to be the same for all elements.  Therefore, we do not support this change. |
| Moderator | Updated based on Sharp and Nokia’s comments. From moderator understanding, we are not changing angle generation procedure. The description is simply to explain what the notation refers to.  Please check if Proposal 2A is acceptable. |
| End of discussion | |

#### Summary of Tuesday Online Session

Proposal #2A agreed.

#### == Discussion CLOSED ==

## 3.3 [CLOSED] Typo Corrections [1][3][6][9]

Companies have provided corrections for several typos in the TR. The corrections should be straightforward and moderator assumes no critical issues from accepting the TPs.

##### Proposal #3:

* Adopt the following TP to TR38.901
  + ***Reason for change***: (1) max subscript typo in Table 7.3-2 has been identified and it may lead to incorrect understanding of angle range; (2) incorrect copy of equation 7.3 to 7.3-3a has been identified and it may lead to incorrect implementation of antenna polarization model 1; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are the same as these of ZOD, which is not correct. In addition, there is an typo in Appendix A.5 for angle scaling.; (4) incorrect section referenced in Note of Table 7..7.5.1-1.; (5) Typo of “antenna” in Table 7.8-2A.
  + ***Summary of change***: (1) removal of max subscript from horizontal cut of radiation power pattern in Table 7.3-2; (2) correction of sin theta prime to cos theta prime in equation 7.3-3a; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are changed to correct values. In Appendix A.5, P\_m is changed to P\_n.; (4) correcting section reference from Annex A.3 to A.5 in in Note of Table 7..7.5.1-1; (5) Correct typo for “antenna” in Table 7.8-2A.
  + ***Consequences if not approved***: (1) ambiguous math notation for range of angles; (2) incorrect angle calculation for polarization model 1; (3) Incorrect scaling of ZOA for CDL models. (4) incorrect reference of the equations used to derivation of the scaling value for CDL model angle changes. (5) mis-spelled word in TR.

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| 7.3.0 Antenna array structure **< Unchanged text omitted >**  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) |  | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |   **< Unchanged text omitted >**  7.3.2 Polarized antenna modelling  **< Unchanged text omitted >**  **Model-1**:  In case of polarized antenna elements assume is the polarization slant angle where degrees corresponds to a purely vertically polarized antenna element and degrees correspond to a pair of cross-polarized antenna elements. Then the antenna element field components in and direction are given by  , (7.3-3)  where  , (7.3-3a)  . (7.3-3b)  **< Unchanged text omitted >** 7.7.5.1 CDL extension: Scaling of angles **< Unchanged text omitted >**  Table 7.7.5.1-1: Scale factor values for each CDL model   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CDL Type** | **Desired AOD Spread（°）** | **Scale Factor (AOD)** | **Desired AOA Spread（°）** | **Scale Factor (AOA)** | **Desired ZOA Spread（°）** | **Scale Factor (ZOA)** | **Desired ZOD Spread（°）** | **Scale Factor (ZOD)** | | CDL-A | 5 | 0.0680 | 30 | 0.3531 | 5 | 0.2397 ~~0.0352~~ | 1 | 0.0352 | | 10 | 0.1360 | 45 | 0.5268 | 10 | 0.4802 ~~0.1056~~ | 3 | 0.1056 | | 15 | 0.2041 | 60 | 0.6981 | 15 | 0.7225 ~~0.1761~~ | 5 | 0.1761 | | 25 | 0.3405 |  |  |  |  |  |  | | CDL-B | 5 | 0.1238 | 30 | 0.5417 | 5 | 0.6519 ~~0.1940~~ | 1 | 0.1940 | | 10 | 0.2475 | 45 | 0.8081 | 10 | 1.3018 ~~0.5822~~ | 3 | 0.5822 | | 15 | 0.3710 | 60 | 1.0709 | 15 | 1.9480 ~~0.9705~~ | 5 | 0.9705 | | 25 | 0.6168 |  |  |  |  |  |  | | CDL-C | 5 | 0.1281 | 30 | 0.4307 | 5 | 0.6476 ~~0.3643~~ | 1 | 0.3643 | | 10 | 0.2568 | 45 | 0.6447 | 10 | 1.2971 ~~1.0929~~ | 3 | 1.0929 | | 15 | 0.3864 | 60 | 0.8585 | 15 | 1.9504 ~~1.8219~~ | 5 | 1.8219 | | 25 | 0.6513 |  |  |  |  |  |  | | CDL-D | 5 | 0.3231 | 30 | 9.8888 | 5 | 4.3268 ~~0.4477~~ | 1 | 0.4477 | | 10 | 0.6652 | 45 | N/A | 10 | 8.8868 ~~1.3469~~ | 3 | 1.3469 | | 15 | 1.0594 | 60 | N/A | 15 | 14.0344 ~~2.2579~~ | 5 | 2.2579 | | 25 | 5.8637 |  |  |  |  |  |  | | CDL-E | 5 | 0.3950 | 30 | 2.9733 | 5 | 6.9195 ~~0.9714~~ | 1 | 0.9714 | | 10 | 0.8009 | 45 | N/A | 10 | 14.8378 ~~2.9180~~ | 3 | 2.9180 | | 15 | 1.2330 | 60 | N/A | 15 | 27.2849 ~~4.8774~~ | 5 | 4.8774 | | 25 | 2.3627 |  |  |  |  |  |  | | NOTE: Values of Table 7.7.5.1-1 were computed based on scaling factor calculation method described in Annex A.~~3~~5. | | | | | | | | |   **< Unchanged text omitted >** 7.8.2 Full calibration **< Unchanged text omitted >**  Table 7.8-2A: Simulation assumptions for full calibration   |  |  | | --- | --- | | **Parameter** | **Values** | | Scenarios | UMa, UMi-Street Canyon, SMa | | Carrier Frequency | 7 GHz,  (optional) 15 GHz | | BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt as in Table 7.8-1 for UMa and UMi-Street Canyon | | BS antenna configurations | Config 3 for UMi, UMa, SMa at 7 GHz: Mg = Ng = 1, M = 8, N = 16, P = 2, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated  (optional) Config 4 for UMa at 7 and 15 GHz: Mg = Ng = 1, M = 64, N = 16, P = 2, Mg = 1, Ng = 1, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated | | BS Polarized antenna modelling | Model-2 in Clause 7.3.2 | | BS port mapping | Config 3 for UMi, UMa, SMa at 7 GHz: Mp = 8, Np = 16, each antenna element is mapped to one port  (optional) Config 4 for UMa at 7 and 15 GHz: Mp = 16, Np = 16  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization | | BS Tx power | 49 dBm for SMa | | Bandwidth | 20 MHz for 7 GHz  (optional) 200 MHz for 7 and 15 GHz | | UT attachment | Based on RSRP (formula) from BS port 0 | | UT distribution | For SMa,  20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. | | UT array orientation | Config B, C: Ω*UT,* uniformly distributed on [0,360] degree, Ω*UT,*= 45 degree, Ω*UT,* = 0 degree  Config D: Ω*UT,* = 0 degree, Ω*UT,*= 0 degree, Ω*UT,* = 0 degree | | UT antenna configurations | Config B for 7 GHz: 4 antenna port with single polarization for calibration based on handheld device antenna model using candidate antenna locations (1,7,3,5) as described in Clause 7.3  (optional) Config C for 15 GHz: 16 antenna port with dual polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3  (only for metric 5) Config D: 8 antenna port with single polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3 | | UT antenna pattern | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | UT Polarized antenna modelling | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | O2I penetration loss | For SMa, low-loss A model | | SCS assumption | 30 kHz | | Additional metrics | 5) A~~n~~ntenna field pattern of handheld UT, and , in UT LCS using UT antenna configuration D |   **< Unchanged text omitted >** A.5 Calculation of scaling factor for changing CDL model angular spread The following expression for the computing scaling factor, , to achieve a specific angular spread, AS, in degrees is given by  (A-5)  (A-6)  where is the power for the *n*th cluster path, is the input cluster path angle (either AOA, AOD, ZOA, ZOD) given in degrees, is the power for the input LOS path, and is the input LOS path angle (either AOA, AOD, ZOA, ZOD) given in degrees. If input LOS path does not exist, is assumed.  **< Unchanged text omitted >** |

##### Proposal #3A:

* Adopt the following TP to TR38.901
  + ***Reason for change***: (1) max subscript typo in Table 7.3-2 has been identified and it may lead to incorrect understanding of angle range; (2) incorrect copy of equation 7.3 to 7.3-3a has been identified and it may lead to incorrect implementation of antenna polarization model 1; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are the same as these of ZOD, which is not correct. In addition, there is an typo in Appendix A.5 for angle scaling.; (4) incorrect section referenced in Note of Table 7..7.5.1-1.; (5) Typo of “antenna” in Table 7.8-2A. (6) Table 7.8-7 is enumerated twice, and Table 7.8-8 and 7.8-9 appears before Table 7.8-7 and therefore require changes to the enumeration.
  + ***Summary of change***: (1) removal of max subscript from horizontal cut of radiation power pattern in Table 7.3-2; (2) correction of sin theta prime to cos theta prime in equation 7.3-3a; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are changed to correct values. In Appendix A.5, P\_m is changed to P\_n.; (4) correcting section reference from Annex A.3 to A.5 in in Note of Table 7..7.5.1-1; (5) Correct typo for “antenna” in Table 7.8-2A. (6) Table 7.8-7 in Clause 7.8.3 is changed to Table 7.8-6A. Table 7.8-8 and 7.8-9 are changed to Table 7.8-6B and 7.8-6C.
  + ***Consequences if not approved***: (1) ambiguous math notation for range of angles; (2) incorrect angle calculation for polarization model 1; (3) Incorrect scaling of ZOA for CDL models. (4) incorrect reference of the equations used to derivation of the scaling value for CDL model angle changes. (5) mis-spelled word in TR. (6) Duplicate Table numbers and wrong ordering of Tables.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7.3.0 Antenna array structure **< Unchanged text omitted >**  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) |  | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |   **< Unchanged text omitted >**  7.3.2 Polarized antenna modelling  **< Unchanged text omitted >**  **Model-1**:  In case of polarized antenna elements assume is the polarization slant angle where degrees corresponds to a purely vertically polarized antenna element and degrees correspond to a pair of cross-polarized antenna elements. Then the antenna element field components in and direction are given by  , (7.3-3)  where  , (7.3-3a)  . (7.3-3b)  **< Unchanged text omitted >** 7.7.5.1 CDL extension: Scaling of angles **< Unchanged text omitted >**  Table 7.7.5.1-1: Scale factor values for each CDL model   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CDL Type** | **Desired AOD Spread（°）** | **Scale Factor (AOD)** | **Desired AOA Spread（°）** | **Scale Factor (AOA)** | **Desired ZOA Spread（°）** | **Scale Factor (ZOA)** | **Desired ZOD Spread（°）** | **Scale Factor (ZOD)** | | CDL-A | 5 | 0.0680 | 30 | 0.3531 | 5 | 0.2397 ~~0.0352~~ | 1 | 0.0352 | | 10 | 0.1360 | 45 | 0.5268 | 10 | 0.4802 ~~0.1056~~ | 3 | 0.1056 | | 15 | 0.2041 | 60 | 0.6981 | 15 | 0.7225 ~~0.1761~~ | 5 | 0.1761 | | 25 | 0.3405 |  |  |  |  |  |  | | CDL-B | 5 | 0.1238 | 30 | 0.5417 | 5 | 0.6519 ~~0.1940~~ | 1 | 0.1940 | | 10 | 0.2475 | 45 | 0.8081 | 10 | 1.3018 ~~0.5822~~ | 3 | 0.5822 | | 15 | 0.3710 | 60 | 1.0709 | 15 | 1.9480 ~~0.9705~~ | 5 | 0.9705 | | 25 | 0.6168 |  |  |  |  |  |  | | CDL-C | 5 | 0.1281 | 30 | 0.4307 | 5 | 0.6476 ~~0.3643~~ | 1 | 0.3643 | | 10 | 0.2568 | 45 | 0.6447 | 10 | 1.2971 ~~1.0929~~ | 3 | 1.0929 | | 15 | 0.3864 | 60 | 0.8585 | 15 | 1.9504 ~~1.8219~~ | 5 | 1.8219 | | 25 | 0.6513 |  |  |  |  |  |  | | CDL-D | 5 | 0.3231 | 30 | 9.8888 | 5 | 4.3268 ~~0.4477~~ | 1 | 0.4477 | | 10 | 0.6652 | 45 | N/A | 10 | 8.8868 ~~1.3469~~ | 3 | 1.3469 | | 15 | 1.0594 | 60 | N/A | 15 | 14.0344 ~~2.2579~~ | 5 | 2.2579 | | 25 | 5.8637 |  |  |  |  |  |  | | CDL-E | 5 | 0.3950 | 30 | 2.9733 | 5 | 6.9195 ~~0.9714~~ | 1 | 0.9714 | | 10 | 0.8009 | 45 | N/A | 10 | 14.8378 ~~2.9180~~ | 3 | 2.9180 | | 15 | 1.2330 | 60 | N/A | 15 | 27.2849 ~~4.8774~~ | 5 | 4.8774 | | 25 | 2.3627 |  |  |  |  |  |  | | NOTE: Values of Table 7.7.5.1-1 were computed based on scaling factor calculation method described in Annex A.~~3~~5. | | | | | | | | |   **< Unchanged text omitted >** 7.8.2 Full calibration **< Unchanged text omitted >**  Table 7.8-2A: Simulation assumptions for full calibration   |  |  | | --- | --- | | **Parameter** | **Values** | | Scenarios | UMa, UMi-Street Canyon, SMa | | Carrier Frequency | 7 GHz,  (optional) 15 GHz | | BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt as in Table 7.8-1 for UMa and UMi-Street Canyon | | BS antenna configurations | Config 3 for UMi, UMa, SMa at 7 GHz: Mg = Ng = 1, M = 8, N = 16, P = 2, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated  (optional) Config 4 for UMa at 7 and 15 GHz: Mg = Ng = 1, M = 64, N = 16, P = 2, Mg = 1, Ng = 1, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated | | BS Polarized antenna modelling | Model-2 in Clause 7.3.2 | | BS port mapping | Config 3 for UMi, UMa, SMa at 7 GHz: Mp = 8, Np = 16, each antenna element is mapped to one port  (optional) Config 4 for UMa at 7 and 15 GHz: Mp = 16, Np = 16  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization | | BS Tx power | 49 dBm for SMa | | Bandwidth | 20 MHz for 7 GHz  (optional) 200 MHz for 7 and 15 GHz | | UT attachment | Based on RSRP (formula) from BS port 0 | | UT distribution | For SMa,  20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. | | UT array orientation | Config B, C: Ω*UT,* uniformly distributed on [0,360] degree, Ω*UT,*= 45 degree, Ω*UT,* = 0 degree  Config D: Ω*UT,* = 0 degree, Ω*UT,*= 0 degree, Ω*UT,* = 0 degree | | UT antenna configurations | Config B for 7 GHz: 4 antenna port with single polarization for calibration based on handheld device antenna model using candidate antenna locations (1,7,3,5) as described in Clause 7.3  (optional) Config C for 15 GHz: 16 antenna port with dual polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3  (only for metric 5) Config D: 8 antenna port with single polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3 | | UT antenna pattern | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | UT Polarized antenna modelling | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | O2I penetration loss | For SMa, low-loss A model | | SCS assumption | 30 kHz | | Additional metrics | 5) A~~n~~ntenna field pattern of handheld UT, and , in UT LCS using UT antenna configuration D |   **< Unchanged text omitted >** 7.8.3 Calibration of additional features The calibration parameters for the calibration of oxygen absorption, large bandwidth and large antenna array, spatial consistency, and blockage can be respectively found in Table 7.8-3, 7.8-4, 7.8-5, and 7.8-6. Unspecified parameters in these tables are the same as those in Tables 7.8-1 and 7.8-2. When P=2, X-pol (+/-45 degree) is used for BS antenna configuration 1 and X-pol (0/+90 degree) is used for UT antenna configuration. The calibration results based on TR 38.900 V14.0.0 can be found in R1-1700990.  The additional calibration parameters for the calibration of near field channel modeling, BS side spatial non-stationarity, and UT side spatial non-stationarity can be respectively found in Table 7.8-~~7~~6A, 7.8-~~8~~6B, and 7.8-~~9~~6C. For the assumption on the aperture size of the antenna array, the following guidance is considered:  - Up to 1.5 m for UMa with maximum antenna elements in the array is 5k for single Polarization.  - Up to 1 m for UMi with maximum antenna elements in the array is 2.22k for single Polarization.  - Up to 0.71 m for Indoor factory with maximum antenna elements in the array is 1.12k for single Polarization.  - Up to 0.25 (for rectangular antenna array), 0.5 (for linear antenna array) m for Indoor office with maximum antenna elements in the array is 256, 80 for single Polarization, respectively.  The additional calibration results can be found in R1-2504791.  **< Unchanged text omitted >**  Table 7.8-~~7~~6A: Simulation assumptions for calibration for near field channel modeling  **< Unchanged text omitted >**  Table 7.8-~~8~~6B: Simulation assumptions for calibration for BS side spatial non-stationarity  **< Unchanged text omitted >**  Table 7.8-~~9~~6C: Simulation assumptions for calibration for UT side spatial non-stationarity  **< Unchanged text omitted >** A.5 Calculation of scaling factor for changing CDL model angular spread The following expression for the computing scaling factor, , to achieve a specific angular spread, AS, in degrees is given by  (A-5)  (A-6)  where is the power for the *n*th cluster path, is the input cluster path angle (either AOA, AOD, ZOA, ZOD) given in degrees, is the power for the input LOS path, and is the input LOS path angle (either AOA, AOD, ZOA, ZOD) given in degrees. If input LOS path does not exist, is assumed.  **< Unchanged text omitted >** |

##### Proposal #3B:

* Adopt the following TP to TR38.901
  + ***Reason for change***: (1) max subscript typo in Table 7.3-2 has been identified and it may lead to incorrect understanding of angle range; (2) incorrect copy of equation 7.3 to 7.3-3a has been identified and it may lead to incorrect implementation of antenna polarization model 1; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are the same as these of ZOD, which is not correct. In addition, there is an typo in Appendix A.5 for angle scaling.; (4) incorrect section referenced in Note of Table 7..7.5.1-1.; (5) Typo of “antenna” in Table 7.8-2A. (6) Table 7.8-7 is enumerated twice, and Table 7.8-8 and 7.8-9 appears before Table 7.8-7 and therefore require changes to the enumeration. (7) Tdoc number R1-2404960 in Clause 4 is a mistake.
  + ***Summary of change***: (1) removal of max subscript from horizontal cut of radiation power pattern in Table 7.3-2; (2) correction of sin theta prime to cos theta prime in equation 7.3-3a; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are changed to correct values. In Appendix A.5, P\_m is changed to P\_n.; (4) correcting section reference from Annex A.3 to A.5 in in Note of Table 7..7.5.1-1; (5) Correct typo for “antenna” in Table 7.8-2A. (6) Table 7.8-7 in Clause 7.8.3 is changed to Table 7.8-6A. Table 7.8-8 and 7.8-9 are changed to Table 7.8-6B and 7.8-6C. (7) Correcting Tdoc number typo in Clause 4 from R1-2404960 to R1-2504960.
  + ***Consequences if not approved***: (1) ambiguous math notation for range of angles; (2) incorrect angle calculation for polarization model 1; (3) Incorrect scaling of ZOA for CDL models. (4) incorrect reference of the equations used to derivation of the scaling value for CDL model angle changes. (5) mis-spelled word in TR. (6) Duplicate Table numbers and wrong ordering of Tables. (7) Reference to wrong Tdoc.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4 Introduction **< Unchanged text omitted >**  Subsequently, at the TSG RAN #102 meeting the Study Item Description "Study on channel modelling enhancements for 7-24GHz for NR" was approved [24]. The findings from this study are also captured in the present technical report. Channel modeling was further updated by considering new measurements and information in the literature. An overview of the information sources is available in tdoc R1-2~~4~~504960 [25].  **< Unchanged text omitted >** 7.3.0 Antenna array structure **< Unchanged text omitted >**  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) |  | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |   **< Unchanged text omitted >**  7.3.2 Polarized antenna modelling  **< Unchanged text omitted >**  **Model-1**:  In case of polarized antenna elements assume is the polarization slant angle where degrees corresponds to a purely vertically polarized antenna element and degrees correspond to a pair of cross-polarized antenna elements. Then the antenna element field components in and direction are given by  , (7.3-3)  where  , (7.3-3a)  . (7.3-3b)  **< Unchanged text omitted >** 7.7.5.1 CDL extension: Scaling of angles **< Unchanged text omitted >**  Table 7.7.5.1-1: Scale factor values for each CDL model   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **CDL Type** | **Desired AOD Spread（°）** | **Scale Factor (AOD)** | **Desired AOA Spread（°）** | **Scale Factor (AOA)** | **Desired ZOA Spread（°）** | **Scale Factor (ZOA)** | **Desired ZOD Spread（°）** | **Scale Factor (ZOD)** | | CDL-A | 5 | 0.0680 | 30 | 0.3531 | 5 | 0.2397 ~~0.0352~~ | 1 | 0.0352 | | 10 | 0.1360 | 45 | 0.5268 | 10 | 0.4802 ~~0.1056~~ | 3 | 0.1056 | | 15 | 0.2041 | 60 | 0.6981 | 15 | 0.7225 ~~0.1761~~ | 5 | 0.1761 | | 25 | 0.3405 |  |  |  |  |  |  | | CDL-B | 5 | 0.1238 | 30 | 0.5417 | 5 | 0.6519 ~~0.1940~~ | 1 | 0.1940 | | 10 | 0.2475 | 45 | 0.8081 | 10 | 1.3018 ~~0.5822~~ | 3 | 0.5822 | | 15 | 0.3710 | 60 | 1.0709 | 15 | 1.9480 ~~0.9705~~ | 5 | 0.9705 | | 25 | 0.6168 |  |  |  |  |  |  | | CDL-C | 5 | 0.1281 | 30 | 0.4307 | 5 | 0.6476 ~~0.3643~~ | 1 | 0.3643 | | 10 | 0.2568 | 45 | 0.6447 | 10 | 1.2971 ~~1.0929~~ | 3 | 1.0929 | | 15 | 0.3864 | 60 | 0.8585 | 15 | 1.9504 ~~1.8219~~ | 5 | 1.8219 | | 25 | 0.6513 |  |  |  |  |  |  | | CDL-D | 5 | 0.3231 | 30 | 9.8888 | 5 | 4.3268 ~~0.4477~~ | 1 | 0.4477 | | 10 | 0.6652 | 45 | N/A | 10 | 8.8868 ~~1.3469~~ | 3 | 1.3469 | | 15 | 1.0594 | 60 | N/A | 15 | 14.0344 ~~2.2579~~ | 5 | 2.2579 | | 25 | 5.8637 |  |  |  |  |  |  | | CDL-E | 5 | 0.3950 | 30 | 2.9733 | 5 | 6.9195 ~~0.9714~~ | 1 | 0.9714 | | 10 | 0.8009 | 45 | N/A | 10 | 14.8378 ~~2.9180~~ | 3 | 2.9180 | | 15 | 1.2330 | 60 | N/A | 15 | 27.2849 ~~4.8774~~ | 5 | 4.8774 | | 25 | 2.3627 |  |  |  |  |  |  | | NOTE: Values of Table 7.7.5.1-1 were computed based on scaling factor calculation method described in Annex A.~~3~~5. | | | | | | | | |   **< Unchanged text omitted >** 7.8.2 Full calibration **< Unchanged text omitted >**  Table 7.8-2A: Simulation assumptions for full calibration   |  |  | | --- | --- | | **Parameter** | **Values** | | Scenarios | UMa, UMi-Street Canyon, SMa | | Carrier Frequency | 7 GHz,  (optional) 15 GHz | | BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt as in Table 7.8-1 for UMa and UMi-Street Canyon | | BS antenna configurations | Config 3 for UMi, UMa, SMa at 7 GHz: Mg = Ng = 1, M = 8, N = 16, P = 2, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated  (optional) Config 4 for UMa at 7 and 15 GHz: Mg = Ng = 1, M = 64, N = 16, P = 2, Mg = 1, Ng = 1, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated | | BS Polarized antenna modelling | Model-2 in Clause 7.3.2 | | BS port mapping | Config 3 for UMi, UMa, SMa at 7 GHz: Mp = 8, Np = 16, each antenna element is mapped to one port  (optional) Config 4 for UMa at 7 and 15 GHz: Mp = 16, Np = 16  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization | | BS Tx power | 49 dBm for SMa | | Bandwidth | 20 MHz for 7 GHz  (optional) 200 MHz for 7 and 15 GHz | | UT attachment | Based on RSRP (formula) from BS port 0 | | UT distribution | For SMa,  20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. | | UT array orientation | Config B, C: Ω*UT,* uniformly distributed on [0,360] degree, Ω*UT,*= 45 degree, Ω*UT,* = 0 degree  Config D: Ω*UT,* = 0 degree, Ω*UT,*= 0 degree, Ω*UT,* = 0 degree | | UT antenna configurations | Config B for 7 GHz: 4 antenna port with single polarization for calibration based on handheld device antenna model using candidate antenna locations (1,7,3,5) as described in Clause 7.3  (optional) Config C for 15 GHz: 16 antenna port with dual polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3  (only for metric 5) Config D: 8 antenna port with single polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3 | | UT antenna pattern | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | UT Polarized antenna modelling | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 | | O2I penetration loss | For SMa, low-loss A model | | SCS assumption | 30 kHz | | Additional metrics | 5) A~~n~~ntenna field pattern of handheld UT, and , in UT LCS using UT antenna configuration D |   **< Unchanged text omitted >** 7.8.3 Calibration of additional features The calibration parameters for the calibration of oxygen absorption, large bandwidth and large antenna array, spatial consistency, and blockage can be respectively found in Table 7.8-3, 7.8-4, 7.8-5, and 7.8-6. Unspecified parameters in these tables are the same as those in Tables 7.8-1 and 7.8-2. When P=2, X-pol (+/-45 degree) is used for BS antenna configuration 1 and X-pol (0/+90 degree) is used for UT antenna configuration. The calibration results based on TR 38.900 V14.0.0 can be found in R1-1700990.  The additional calibration parameters for the calibration of near field channel modeling, BS side spatial non-stationarity, and UT side spatial non-stationarity can be respectively found in Table 7.8-~~7~~6A, 7.8-~~8~~6B, and 7.8-~~9~~6C. For the assumption on the aperture size of the antenna array, the following guidance is considered:  - Up to 1.5 m for UMa with maximum antenna elements in the array is 5k for single Polarization.  - Up to 1 m for UMi with maximum antenna elements in the array is 2.22k for single Polarization.  - Up to 0.71 m for Indoor factory with maximum antenna elements in the array is 1.12k for single Polarization.  - Up to 0.25 (for rectangular antenna array), 0.5 (for linear antenna array) m for Indoor office with maximum antenna elements in the array is 256, 80 for single Polarization, respectively.  The additional calibration results can be found in R1-2504791.  **< Unchanged text omitted >**  Table 7.8-~~7~~6A: Simulation assumptions for calibration for near field channel modeling  **< Unchanged text omitted >**  Table 7.8-~~8~~6B: Simulation assumptions for calibration for BS side spatial non-stationarity  **< Unchanged text omitted >**  Table 7.8-~~9~~6C: Simulation assumptions for calibration for UT side spatial non-stationarity  **< Unchanged text omitted >** A.5 Calculation of scaling factor for changing CDL model angular spread The following expression for the computing scaling factor, , to achieve a specific angular spread, AS, in degrees is given by  (A-5)  (A-6)  where is the power for the *n*th cluster path, is the input cluster path angle (either AOA, AOD, ZOA, ZOD) given in degrees, is the power for the input LOS path, and is the input LOS path angle (either AOA, AOD, ZOA, ZOD) given in degrees. If input LOS path does not exist, is assumed.  **< Unchanged text omitted >** |

Subsequently, at the TSG RAN #102 meeting the Study Item Description "Study on channel modelling enhancements for 7-24GHz for NR" was approved [24]. The findings from this study are also captured in the present technical report. Channel modeling was further updated by considering new measurements and information in the literature. An overview of the information sources is available in tdoc R1-2404960 [25].

#### Round #1 Discussion

Please provide comments on Proposal #3, especially if companies have strong concerns about the proposal.

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| --- | --- |
| **Company** | **Comments** |
| Nokia | OK with the corrections. |
| CATT | OK |
| vivo | Support |
| Moderator | There seems to be an issue with Table number for table 7.8-7, 7.8-8, and 7.8-9. Updated the fixes in Proposal 3A. |
| Sharp | Support |
| Moderator | Huawei has pointed out Tdoc number in Clause 4 is wrong and needs update. Moderator has updated this in Proposal 3B. |
| End of discussion | |

#### Summary of Tuesday Online Session

Proposal #3B agreed.

#### == Discussion CLOSED ==

## 3.4 [CLOSED] Correction of CDL angle scaling description [13]

Qualcomm suggest to splitting the angle scaling and subpath angle generation into two part for clarity.

|  |
| --- |
| 7.7.5 Extension for MIMO simulations  Extended MIMO link-level channel models can be constructed according to two alternative methods described in the following.  7.7.5.1 CDL extension: Scaling of angles  The angle values of CDL models are fixed, which is not very suitable for MIMO simulations for several reasons; The PMI statistics can become biased, and a fixed precoder may perform better than open-loop and on par with closed-loop or reciprocity beamforming. Furthermore, a CDL only represents a single channel realization. The predefined angle values in the CDL models can be generalized by introducing angular translation and scaling. By translation, mean angle can be changed to and angular spread can be changed to match by scaling.  The translated and scaled cluster (and ray () angles can be obtained according to the following equation: (7.7-5)  (7.7-5a)  (7.7-5b)  (7.7-5c)  (7.7-5)  **< Unchanged text omitted >** |

##### Proposal #4:

* Adopt the following TP to TR38.901
  + ***Reason for change***: Breaking up the cluster and ray scaling angles for CDL angle scaling, such that other WG may be able to reference the TR easily. Also improves readability of the angle scaling for CDL models.
  + ***Summary of change***: introduce an intermediate variable to represent cluster angles, which are the angles being scaled by the model.
  + ***Consequences if not approved***: Difficult for WGs to identify scaled angle component in CDL models.

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| --- |
| 7.7.5.1 CDL extension: Scaling of angles The angle values of CDL models are fixed, which is not very suitable for MIMO simulations for several reasons; The PMI statistics can become biased, and a fixed precoder may perform better than open-loop and on par with closed-loop or reciprocity beamforming. Furthermore, a CDL only represents a single channel realization. The predefined angle values in the CDL models can be generalized by introducing angular translation and scaling. By translation, mean angle can be changed to and angular spread can be changed to match by scaling. The translated and scaled ray angles can be obtained according to the following equation:  (7.7-5)  (7.7-5a)  (7.7-5b)  (7.7-5c)  (7.7-5d)  in which:  **< Unchanged text omitted >**  - is the desired rms cluster angular spread,  - is the scaled CDL cluster angle of the *n*th cluster,  - is the resulting scaled ray angle that corresponds to *m*th subpath angle of *n*th cluster,  **< Unchanged text omitted >**  Alternatively, for CDL-D and CDL-E, if maintaining the LOS angle is desired, the translated and scaled ray angles can be obtained according to the following equation instead of using equation (7.7-5) and (7.7-5a):  (7.7-6)  (7.7-6a)  (7.7-6b)  in which:  - is the LOS path angle of the model.  - is the scaled CDL cluster angle of the nth cluster,  **< Unchanged text omitted >** |

#### Round #1 Discussion

Please provide comments on Proposal #4.

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| --- | --- |
| **Company** | **Comments** |
| Nokia | The change does not look to be significant, and it does not change the procedure. However, we are OK because the clarity, indeed, might be improved. |
| CATT | Based on our ran4 feedback, although cluster-level angles are indeed utilized, the present formulation poses no technical issues. |
| vivo | We are supportive of it, but can follow the majority. |
| Sharp | Same comment as Vivo. |
| MediaTek | We support this improvement. Although there is no technical issue now, it is good to have the accurate formulation. |
| QC | For better context, we hear from our RAN4 colleagues that as part of updates to the spatial channel model that RAN4 is working on, they want to be able to reference an equation that captures the cluster angles obtained after scaling. Since we directly captured changes to the ray angles, such an equation doesn’t currently exist. Qualcomm’s RAN4 team is working on a mirror TP in RAN4, but since changes to 38.901 are to be handled by RAN1, they are not able to do it directly.  There now appears to be some progress on this issue in RAN4. Please see below: |
| End of discussion | |

#### Summary of Tuesday Online Session

Proposal #4 agreed.

#### == Discussion CLOSED ==

## 3.5 [CLOSED] Addition of Isotropic Antenna for UT [3]

CATT is proposing to explicitly add isotropic antenna as part of the UT antenna model description. The changes are summarized in the following TP. Moderator thinks the suggestions for edit may not seem essential, but acceptable due to the fact isotropic is tested as part of channel model calibration. With that said, moderator thinks the TR should be still ok without the TP as well.

|  |
| --- |
| 7.3.0 Antenna array structure <Unrelated parts are omitted>  **UT antenna model:**  <Unrelated parts are omitted>  - The antenna radiation power pattern of each antenna element for handheld UT is isotropic or the antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2.  <Unrelated parts are omitted> |

##### Proposal #5:

* Adopt the following TP to TR38.901
  + ***Reason for change***: Clause 7.3.0 of TR 38.901 [1] introduces the antenna array structures for UT considered for calibration in this SI. However, the isotropic UT antenna pattern used in calibration in clauses 7.8.1, 7.8.2, and 7.8.3 is not specified, leading to inconsistency between these clauses and clause 7.3.0.
  + ***Summary of chang***: Add a description of the isotropic UT antenna pattern in clause, 7.3.0 to align with the calibration assumptions in clauses 7.8.1, 7.8.2 and 7.8.3.
  + ***Consequences if not approved***: Calibration would be limited to directional UT antenna patterns, causing inconsistency across clauses and potentially impacting the reproducibility of simulation results.

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| 7.3.0 Antenna array structure <Unrelated parts are omitted>  **UT antenna model:**  <Unrelated parts are omitted>  - The antenna radiation power pattern of each antenna element for handheld UT is isotropic or the antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2.  <Unrelated parts are omitted> |

#### Round #1 Discussion

Please provide comments on Proposal #5.

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| --- | --- |
| **Company** | **Comments** |
| Nokia | We do not support this change.  Firstly, isotropic radiation pattern for candidate UE antenna locations is used only in a single Additional feature calibration (near field), and 7.8.1, 7.8.2 are not using this model. For Near Field such a choice may be acceptable to avoid calibration of multiple features together, i.e., directional antennas and near filed.  Secondly, the omni-directional radiation pattern is a theoretical abstraction, that cannot be achieved in practice for individual UE antennas. Antenna at target 6G frequencies have higher directivity even then a dipole. Therefore, we should not indicate omni-directional antennas as an acceptable model on the same level as the proposed directional model. |
| CATT | From a completeness standpoint, it should be supplemented. |
| vivo | Since an isotropic UT antenna element was only agreed for calibration purpose, the revision is not necessary. |
| Sharp | We share the same views as Nokia and Vivo.  Table 7.8.1 : UT antenna configurations clearly state isotropic antenna gain pattern  Table 7.8.2 : UT antenna pattern clearly states isotropic  Table 7.8.3 : unspecified parameters are used from Table 7.8.1 and Table 7.8.2 as per TR 38.901 Rel-19.  Thus, we don’t feel there is any ambiguity here as was pointed out by CATT in their TDOC. |
| ZTE | No need to define the isotropic pattern for this section. |
| End of discussion | |

#### Summary of Round #1 Discussion

Given the comments from companies, moderator suggests not pursuing the proposal.

#### == Discussion CLOSED ==

## 3.6 Cluster removal threshold correction [5]

vivo is raising concerns on excessive removal of clusters for LOS cases. Currently the TR removes clusters below -25dB threshold after application of LOS scaling factor. Since LOS components are typically high powered, the likelihood of NLOS clusters to be removed by the -25dB threshold increases.

A graph of cluster distribution

AI-generated content may be incorrect. A graph of cluster number distribution

AI-generated content may be incorrect.

Figure 1: The ratio distribution of cluster number in UMi scenario, The ratio distribution of cluster number in indoor office scenario

From moderator understanding, the clarification to remove clusters after the LOS scaling was intentionally agreed in the last RAN1 meeting. Therefore, the moderator is unsure whether this proposal is an essential correction. With that said, it would be beneficial to get companies input on the proposal.

##### Proposal #6:

* Adopt the following TP to TR38.901
  + ***Reason for change***: -25dB threshold to remove weak powered clusters may remove more than necessary number of clusters in case of LOS scenarios.
  + ***Summary of chang***: Clarify the equation 7.5-6 is used for weak power cluster removal for all cases, NLOS and LOS.
  + ***Consequences if not approved***: Removal of too many weak powered clusters in case of LOS scenarios.

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| **7.5 Fast fading model**  Step 6: Generate cluster powers .  Cluster powers are calculated assuming a single slope exponential power delay profile. Power assignment depends on the delay distribution defined in Table 7.5-6. With exponential delay distribution the cluster powers are determined by  (7.5-5)  where  is the per cluster shadowing term in [dB]. Normalize the cluster powers so that the sum of all cluster powers is equal to one, i.e.,  (7.5-6)  *In the case of LOS condition* an additional specular component is added to the first cluster. Power of the single LOS ray is:  (7.5-7)  and the cluster powers are not normalized as in equation (7.5-6) , but:  (7.5-8)  where δ(.) is Dirac's delta function and *KR* is the Ricean *K*-factor as generated in Step 4 converted to linear scale. These power values are used *only* in equations (7.5-9) and (7.5-14), but *not* in equation (7.5-22).  **<Unchanged parts omitted>**  Assign the power of each ray within a cluster as *Pn/ M*, where *M* is the number of rays per cluster.  Remove clusters with less than -25 dB power compared to the maximum cluster power based on equation ~~(7.5-8), in case of LOS condition, and based on equation~~ (7.5-6)~~, otherwise,~~. The scaling factors need not be changed after cluster elimination. |

#### Round #1 Discussion

Please provide comments on Proposal #6.

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| **Company** | **Comments** |
| Moderator | Updated proposal #6 to correct for incorrect reasons for change and contents. |
| vivo | We suggest having the modification.  The most critical issue after the cluster number decreasing is the influence to the MIMO performance. The MIMO performance is dependent on the rank number of the communication link. That is, decreasing cluster number will also decrease the maximum rank of the communication link, resulting on a decreasing the MIMO performance.  Moreover, the evaluation result of MIMO or other technology will be overturned. As a result, these technologies should be reevaluated in order to compare with the performance under the new scenario in 6G, which introduces extra workload. |
| Sharp | It is true that we never had an explicit agreement on the text that was added to the TR and the clarification text in our view to use 7.5-8 for LOS and 7.5-6 for NLOS was added when we had extensive discussions regarding the reduction of number of cluster issue. However, we think that companies never had a chance to thoroughly investigate the impact of this change. Secondly, based on measurements we introduced 7.6.15 with the goal that nothing is affected in Section 7.5 and legacy procedure remains untouched. Thus, if a lower number of clusters is desired in LOS, Section 7.6.15 can be used in conjuction with eq. (7.5-6). Thus, we are supportive of proposal #6. |
| Moderator | Just to provide information on what was added in the V19.0.0, was the clarify which equation(s) to use for the -25dB threshold application. The existing text left the application completely ambiguous as it did not mention which equation was used.  With this said, the text for removal of clusters was placed AFTER the LOS power re-normalization, and therefore implicitly hinted that cluster removal was performed LOS power re-normalization. The text updated in V19.0.0 was intended to be crystal clear which equations to be used.  Please find the text from V18.0.0 below. Note that this is the last text for Step 5 and provided after all the power normalization is performed.  “Remove clusters with less than -25 dB power compared to the maximum cluster power. The scaling factors need not be changed after cluster elimination.”  So really the key question that should be asked is whether the cluster removal behavior in v18.0.0 is the same as v19.0.0. Moderator assumes this is the case, and the text is just a clarification.  From moderator understanding, what vivo is suggesting is a change of behavior for v19.0.0.    With that said, it could be helpful if companies can comment what companies think the behavior for cluster removal is based on text from v18.0.0? |
| Sharp | From our point of view the cluster removal in v18.0.0 for both LOS and NLOS was based on eq (7.5-6) even though the text “Remove clusters with less than -25 dB power compared to the maximum cluster power. The scaling factors need not be changed after cluster elimination” appeared after eq (7.5-8). In case our understanding is not aligned with other companies it will still be better to add a clear text as proposed by FL to resolve the ambiguity. |
| Nokia3 | We would like to support the proposal by VIVO. The cluster removal should be based on (7.5-6) only. |
| Moderator | @vivo and @Nokia:  Just to clarify, is it correct that in your understanding TR38.901 v18.0.0 removes weak clusters prior to LOS power re-normalization? |
| End of Round #1 Discussion | |

#### Summary of Round #1 Discussion

From feedback received it seems companies may have different interpretation of TR38.901.

* *Interpretation 1)* TR38.901 v18.0.0 applies weak cluster removal after LOS power scaling (i.e. apply weak cluster removal with based on 7.5-8 for LOS case, 7.5-6 for NLOS case)
* *Interpretation 2)* TR38.901 v18.0.0 applies weak cluster removal before LOS power scaling (i.e. apply weak cluster removal with based always on 7.5-6)

The changes that were introduced to v19.0.0 potentially foresaw this confusion and suggested to clarify based on interpretation 1. However, it seems at least vivo and Nokia suggests to change v19.0.0 to be aligned with interpretation 2.

With this said, from moderator perspective, v18.0.0 does seem to hint more towards interpretation 1 as the cluster removal is described after all the power scaling is performed.

Moderator asks companies to provide further inputs on the interpretation & what to do with Proposal #6.

#### Round #2 Discussion

Please provide further comments on Proposal #6.

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| **Company** | **Comments** |
| vivo | Our simulation is based on the Interpretation-1. It is common understanding that companies are taking Interpretation-1 for their simulation so far. |
| Moderator | @vivo: If your understanding that v18.0.0 is interpretation-1, and since v19.0.0 is implementing interpretation-1 just bit more precisely, why do you wish to propose Proposal #6 which changes the cluster removal procedure? Is the proposal #6 from your end, irrespective what v18.0.0 or v19.0.0 was doing? Essentially, you are proposing to introduce new behavior for Rel-19 based on technical finding that you have? |
| Sharp | Our previous comment was misinterpreted. Sorry for my wording earlier. Our interpretation is ***Interpretation 2.*** |
| Nokia4 | Our Rel-18 interpretation was Interpretation 2 above, and it is not changing in rel-19. From this perspective, we believe that Rel-19 version that slipped off from our attention was a mistake.  Proposed modification is necessary. |
| vivo | Maybe we misunderstood both interpretations. What we did in our investigated simulation is, we remove weak cluster(s) by comparison with the strongest cluster in NLOS rays other than LOS ray. However, the power scaling is done before the cluster removing.  There are three options to implement the cluster removing and power scaling under the LOS condition.  Option-1: Remove weak cluster(s) by comparison with the strongest cluster in NLOS rays. Assuming the remaining number of clusters is X, based on 7.5.6, the X clusters are power scaled.  Option-2: Scale the cluster power based on 7.5.6 and then remove weak cluster(s) by comparison with the strongest cluster in NLOS rays. The remaining number of clusters is X.  Option-3: Scale the cluster power based on 7.5.8 and then remove weak cluster(s) by comparison with the power of LOS ray. The remaining number of clusters is Y.  Our simulation is based on Option-2.  Note: Y could be much smaller than X.  In our understanding, if we keep “(7.5-8) in case of LOS condition”, the weak cluster(s) will be removed if its power is -25dB lower than LOS ray in case of LOS condition. |
| Moderator | @vivo: Understood. From moderator understanding option-1 is really not on the table. The TR explicitly states that powers are not scaled due to weak cluster removal.  The question being asked is between option 2 (interpretation 2) and option 3 (interpretation 1). |
|  |  |

## 3.7 [CLOSED] Other Proposals [12]

SKT has provided a number of proposals to improve the channel modeling and its applicability for 6G studies.

* Proposal 1. Provide an FR3 O2I/O2O loss maintenance table with (a) material penetration loss per canonical materials (standard/low-E glass, concrete, drywall, coated façade), (b) frequency trend exponents across 8/12/16/20/24 GHz grid points, and (c) O2I excess-loss dual-slope option for deep-indoor. Tables reuse 38.901 notations where possible.
* Proposal 2. Introduce an informative near-field/XL-MIMO annex: (i) a Fresnel boundary check (based on aperture size and carrier), (ii) optional cluster visibility maps along the array, and (iii) guidance for per-subarray parameter draws (birth/death rates) to emulate non-stationarity, with default OFF switch for Rel-19/Rel-20 evaluations.
* Proposal 3. Add representative FR3 indoor scenarios (Office-Open, Office-Dense, Retail-Atrium) with recommended delay/angle spread ranges and K-factor presets, anchored to recent FR3 measurement statistics and mapped onto 38.901 InH/Indoor-Factory nomenclature for compatibility. ResearchGatearXiv
* Proposal 4. Define FR3 blockage states (Clear/Partial/Deep) with (i) per-scenario occurrence probabilities, (ii) log-normal attenuation ranges, and (iii) sojourn/transition rates for pedestrian and vehicular dynamics, provided as a light-weight Markov option (default OFF) for reproducibility across companies.
* Proposal 5. Update UMa/UMi FR3 path-loss/foliage options by (i) adding foliage excess loss vs. seasonality (leaf-on) presets and (ii) clarifying cross-polarization ratio (XPR) ranges for street canyons vs. open squares; keep 38.901 reuse principle and offer these as scenario flags.
* Proposal 6. Publish an FR3 validation & reproducibility package: (i) fixed random seeds, (ii) band center set {8, 12, 16, 20, 24 GHz}, (iii) scenario catalog IDs (UMa/UMi/O2I/Indoor variants), and (iv) CSV schema (snapshot-ID, band, SNR, PL/σ, DS/AS, XPR, BLK-state, throughput). This mirrors prior ISAC reproducibility efforts while focusing on FR3 comm KPIs.

From moderator’s opinion, the proposals seem to be difficult to resolve as part of maintenance of the 7-24 GHz channel modeling enhancement SI. Moderator suggests to see if the issues can be discussed and resolved as part of the 6G SI.

#### Round #1 Discussion

Please provide comments on Proposals from SKT. Moderator’s recommendation to not move forward with the proposal as part of maintenance of the 7-24 GHz channel modeling enhancement SI.

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| --- | --- |
| **Company** | **Comments** |
| vivo | It seems out of scope, and should be discussed in 11.2 other than 8.8. |
| Sharp | Strongly not supportive. This falls outside the scope of maintenance work and should have been addressed during the Rel-19 7-24 GHz channel modeling discussions. |
| End of discussion | |

#### Summary of Round #1 Discussion

Given the comments from companies, moderator suggests not pursuing the proposal.

#### == Discussion CLOSED ==

## 3.8 [CLOSED] Inclusion of Updated Calibration Results

Companies have presented updated calibration results. Moderator suggests updating the calibration Tdoc in the TR.

##### Proposal #8:

* Adopt the following TP to TR38.901
  + ***Reason for change***: Companies have provided updated channel model calibration results based on TR 38.901 v19.0.0. The updated calibration results is uncaptured in the TR.
  + ***Summary of chang***: Update the calibration result Tdoc from R1-2504791 to R1-2506406 in Section 7.8.
  + ***Consequences if not approved***: outdated calibration results are present in the TR.

|  |
| --- |
| 7.8 Channel model calibration7.8.1 Large scale calibration **<Unchanged parts omitted>**  Additional calibration parameters can be found in Table 7.8-1A. It is assumed that parameters from Table 7.8-1 is used if unspecified by the additional calibration parameters in Table 7.8-1A. In addition, calibration of UMa and UMi-Street Canyon at 6 GHz carrier frequency using simulation assumptions in Table 7.8-1 with updated channel modeling is part of the additional calibration. The calibration results based on additional calibration parameters can be found in ~~R1-250 2504791~~R1-2506406.  **<Unchanged parts omitted>** 7.8.2 Full calibration **<Unchanged parts omitted>**  The calibration results based on additional calibration parameters can be found in ~~R1-2504791~~ R1-2506406.  **<Unchanged parts omitted>** 7.8.3 Calibration of additional features **<Unchanged parts omitted>**  The additional calibration results can be found in ~~R1-2504791~~ R1-2506406.  **<Unchanged parts omitted>** |

#### Summary of Tuesday Online Session

Proposal #8 agreed.

#### == Discussion CLOSED ==

## 3.9 [CLOSED] Additional Clarifications

It has come to the attention of the moderator that handheld UT antenna radiation pattern orientation clarification could be useful for companies to correctly generate the final UT antenna pattern for handheld UTs. The suggested clarification would be to clarify that antenna radiation pattern defined in 7.3-2 is directed in x’’-axis, which is and direction. The actual antenna radiation pattern should be rotated based on the directional vector already described in the TR.

##### Proposal #9:

* Adopt the following TP to TR38.901
  + ***Reason for change***: Ambiguous orientation antenna radiation power pattern for pattern defined in Table 7.3-2.
  + ***Summary of chang***: Clarify that antenna radiation power pattern in Table 7.3-2 is oriented in and direction and final antenna field pattern for each antenna element should be rotated according to descriptions in the TR.
  + ***Consequences if not approved***: Ambiguous antenna radiation power pattern orientation could lead to incorrect implementation of the final handheld UT antenna field patterns among companies.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7.3.0 Antenna array structure *<unchanged text omitted>*  **UT antenna model:**  *<unchanged text omitted>*  - The antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2 which assumes antenna is assumed to be oriented in and direction. Antenna radiation power pattern is rotated based on directional vector described above.  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) |  | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |   *<unchanged text omitted>* |

##### Proposal #9A:

* Adopt the following TP to TR38.901
  + ***Reason for change***: Ambiguous orientation antenna radiation power pattern for pattern defined in Table 7.3-2.
  + ***Summary of chang***: Clarify that antenna radiation power pattern in Table 7.3-2 is oriented in and direction and final antenna field pattern for each antenna element should be rotated according to descriptions in the TR.
  + ***Consequences if not approved***: Ambiguous antenna radiation power pattern orientation could lead to incorrect implementation of the final handheld UT antenna field patterns among companies.

|  |
| --- |
| 7.3.0 Antenna array structure *<unchanged text omitted>*  **UT antenna model:**  *<unchanged text omitted>*  - The antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2 which assumes antenna is ~~assumed~~ to be oriented in and direction~~. Antenna radiation power pattern is rotated based on directional vector described above~~.  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT  *<unchanged text omitted>* |

#### Round #1 Discussion

Please provide comments on Proposal #9.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia2 | We do not think that the proposed change is essential because max gain direction is clearly defined by the equations. The angles are also clearly defined in the TR in Figure 7.1.1.  Also not very clear what is meant by pattern rotation?  Secondly, the langue require some further updates as well, i.e., “which **assumes** antenna is **assumed**”.  Therefore, we prefer not to update the definition. |
| Moderator | Updated the text to above unnecessary text in Proposal 9A. |
|  |  |

#### Summary of Tuesday Online Session

Proposal #9A agreed.

#### == Discussion CLOSED ==

## 3.10 Handheld UT Antenna Model Update

While there was no specific Tdoc submitted for handheld UT antenna model issue. Issue came up in offline discussions regarding the current handheld UT antenna radiation power pattern.

The current radiation power pattern has different power values for different when or . In reality, this is not possible as different azimuth values are actually the same point in space when point is zenith or nadir.

Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Vertical cut of the radiation power pattern (dB) |  |
| Horizontal cut of the radiation power pattern (dB) |  |
| 3D radiation power pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5.3 dBi |
| NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |

Sinc the radiation power pattern is assumed to symmetric from the center of maximum direction gain axis, a perfectly symmetric radiation power pattern can be generated by the following.

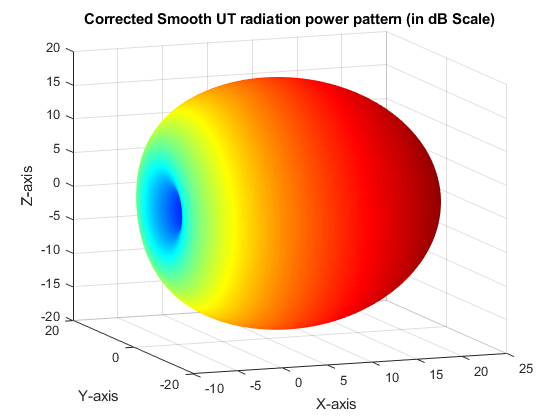
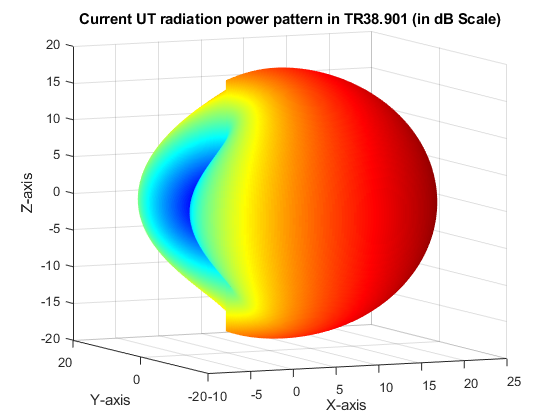
|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Vertical cut of the radiation power pattern (dB) | Radiation power pattern should be same as the Horizontal cut with maximum power at |
| Horizontal cut of the radiation power pattern (dB) |  |
| 3D radiation power pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5.3 dBi |
| NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |

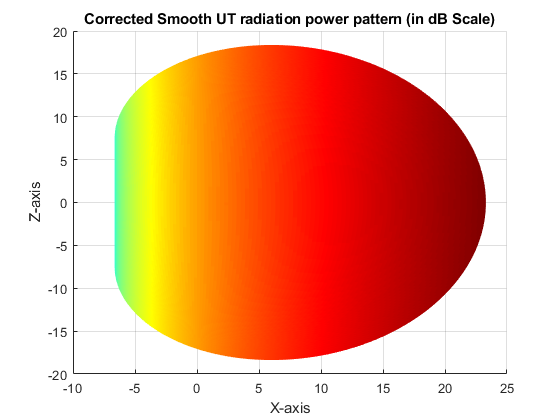
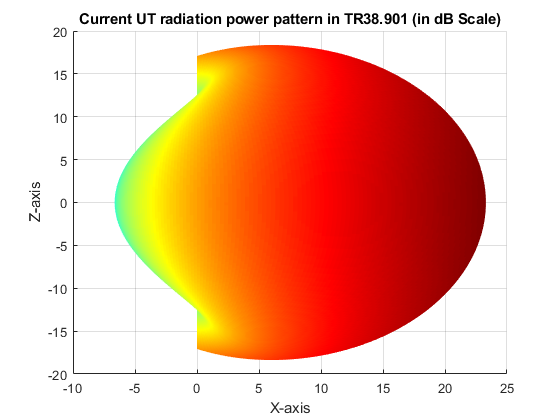
The resulting UT radiation power pattern is nearly identical for most azimuth and zenith angles, but does not have inconsistent radiation power pattern around zenith and nadir.

A graph of a graph of a number of colors

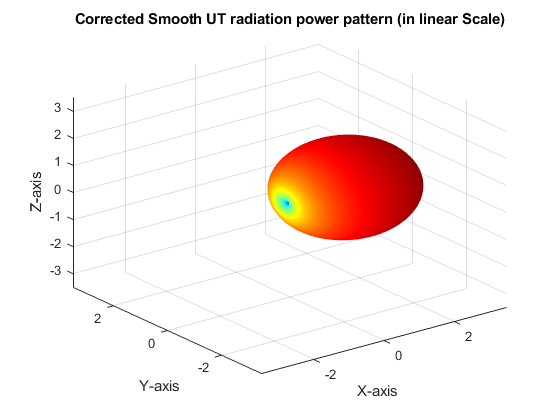
AI-generated content may be incorrect.A graph of a smooth and smooth

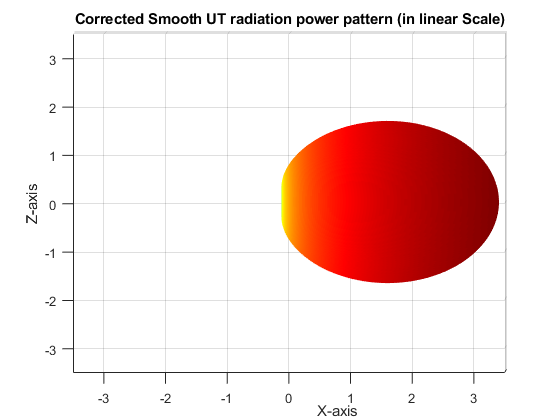
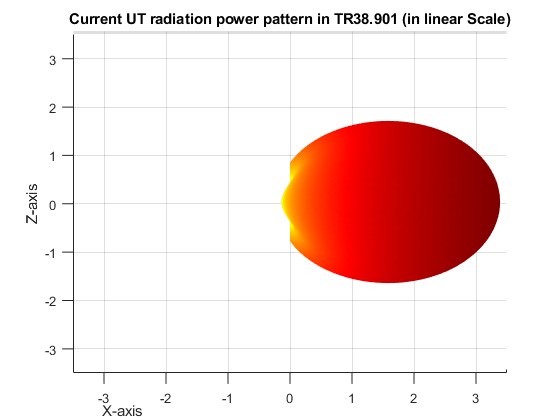
AI-generated content may be incorrect.





A graph of a red oval with a yellow dot

AI-generated content may be incorrect.



As seen in power pattern figure above, the current UT radiation power power pattern shows a range of power values for different azimuth angles when zenith angle is 0 or 180. The corrected smooth UT radiation power pattern has identical power values for all azimuth angles when zenith angle is 0 or 180. This removes the odd shape near zenith and nadir of the spherical shape of the radiation power pattern.

**Please note that given that the issue was not brought up from Tdoc submissions and it is a late change for the TR. Careful consideration should be taken before approval of the proposal.**

##### Proposal #10:

* Adopt the following TP to TR38.901
  + ***Reason for change***: handheld UT antenna radiation power pattern exhibits unrealistic power deviation when and when is any value. The radiation power should be identical irrespective of azimuth angle , but exihibits different power values based on azimuth angle
  + ***Summary of chang***: Update the UT antenna radiation power pattern such that is completely symmetric with respect to direction center axis. Use the horizontal cut of the radiation power pattern to also apply to vertical cut of the radiation power pattern. For radiation power values at non-horizontal plane, calculate the radial distance from x’’-axis (in Y-Z plain) and use that as y’’-axis value for obtain the effective power value in horizontal plane (X-Y plane).
  + ***Consequences if not approved***: Unrealistic radiation power pattern definition near the zenith and nadir for handheld UT antenna.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7.3.0 Antenna array structure *<unchanged text omitted>*  **UT antenna model:**  *<unchanged text omitted>*  - The antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2.  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) | Radiation power pattern should be same as the Horizontal cut with maximum power at | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | | |

#### Round #1 Discussion

Please provide comments on Proposal #10.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Sharp | Doesn’t this effect the calibration results? If we adopt these changes won’t it impact the calibrations results that used the previous defined radiation patterns for the UT. Does this imply companies will have to redo calibration again if this change is adopted? |
| ZTE | The intention is clear but there may be another thing that this kind of description of pattern is also applied for BS side UE antenna pattern. Maybe we can kept it since the impacts on simulation is limited. |
| Moderator | @Sharp: Moderator suspects the overall calibration (other than UT antenna field pattern calibration) should be largely unimpacted as the overall shape of the antenna field is not changed much. However, UT antenna field pattern calibration (depending on how the results are produced) could be changed slightly as the effects are directly shown in the excel sheet in (theta, phi) 2D domain.  @ZTE: BS antenna field pattern doesn’t have this problem as large as the UT antenna field pattern since the half-power beamwidth is much smaller. For the BS antenna the power variation across different azimuth angles only ranges from -15dB to -22dB, which are already small enough that the variation doesn’t cause too much of an issue. For the UT antenna power variation is from -1dB to -22dB, which is more than factor of 100 times difference. |
| Moderator | Huawei has pointed out that the vertical cut of the radiation power pattern is only half shape defined and therefore can keep the definition as is. |
| Nokia2 | Maybe hard to adjust the radiation pattern at this stage because it will be hard to report finalization of calibration without using the new pattern.  Additionally, if we think about the realistic radiation patterns that are rather irregular in any case, so smoothing the pattern may not add more realism in the simulations either. |
| Moderator | Just to clarify, even if we update the model, moderator thinks we should not perform another round of calibrations. The submitted calibrations will clear state that calibration was performed based on v19.0.0.  It would be unreasonable to keep continuing calibrations every time new changes are introduced for various reasons. |
| End of Round #1 Discussion | |

#### Summary of Round #1 Discussion

##### Proposal #10A:

* Adopt the following TP to TR38.901
  + ***Reason for change***: handheld UT antenna radiation power pattern exhibits unrealistic power deviation when and when is any value. The radiation power should be identical irrespective of azimuth angle , but exihibits different power values based on azimuth angle
  + ***Summary of chang***: Update the UT antenna radiation power pattern such that is completely symmetric with respect to direction center axis. Use the horizontal cut of the radiation power pattern to also apply to vertical cut of the radiation power pattern. For radiation power values at non-horizontal plane, calculate the radial distance from x’’-axis (in Y-Z plain) and use that as y’’-axis value for obtain the effective power value in horizontal plane (X-Y plane).
  + ***Consequences if not approved***: Unrealistic radiation power pattern definition near the zenith and nadir for handheld UT antenna.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 7.3.0 Antenna array structure *<unchanged text omitted>*  **UT antenna model:**  *<unchanged text omitted>*  - The antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2.  Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT   |  |  | | --- | --- | | **Parameter** | **Values** | | Vertical cut of the radiation power pattern (dB) |  | | Horizontal cut of the radiation power pattern (dB) |  | | 3D radiation power pattern (dB) |  | | Maximum directional gain of an antenna element *GE,max* | 5.3 dBi | | NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | | |

##### Proposal #10-2:

* Adopt the following TP to TR38.901
  + ***Reason for change***: The reference handheld UT antenna model after antenna placement has majority of the antenna field pattern strength in domain and therefore field strength is concentrated in polarization domain. This may not be able to reflect UE antenna design.
  + ***Summary of chang***: Add optional polarization rotation of 45 degree to the reference UT antenna model
  + ***Consequences if not approved***: Reference handheld UT antenna model captured in TR is unable to reflect antenna design that has antenna field strength in both polarization domain.

|  |
| --- |
| 7.3.2 Polarized antenna modelling *<unchanged text omitted>*  **Handheld UT Model:**  *<unchanged text omitted>*  For cases when a candidate antenna placement location is used for one antenna field pattern (e.g., single polarization):  - The polarization direction is indicated by the arrow in Figure 7.3-7, which is parallel with the plane of the handheld UT and perpendicular to the direction from the UT center to the candidate antenna location.  - Optionally, polarization direction can additionally rotate 45 degrees about the direction from the UT center to the candidate antenna location (i.e. rotated using the direction from the UT center to the candidate antenna location as the rotational axis). An example for candidate antenna location (6) is given in Figure 7.3-8.  *<unchanged text omitted>* |

#### Round #2 Discussion

Please provide comments on Proposal #10A.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia4 | We acknowledge that there is singularity in a single point of the selected radiation pattern. However, we do not find it significant, because the probability of the ray coming exactly in this direction is extremely low considering that the simulations are in floating numbers in any case. Additionally, even if happens, it should not break simulations and a reasonable value of gain will be provided.  Other reasons to mention are, that this pattern nicely aligned with the BS pattern, and that we already have many simulations provided with the old pattern.  Overall, we think that this change is not essential and the can keep the original radiation pattern.  **Additionally, we would like to bring to the attention of the other companies a potentially annoying finding:** If one checks the powers of the F\_theta and F\_phi contributed for calibration, it can be observed that **F\_theta power is considerably lower than of F\_phi.**  For example for antenna #1 is shown below the difference is over 5dB, but it is the same for all candidate locations! Moreover the splits are all the same for all of the antennas. **That is what we do not observe in practice.**    There are mupliple potential way to address this issue. One of them would be to change the orientation of the reference UE antenna as it is shown in our original conribution:  A diagram of a radioactivity  Description automatically generated  In this case the polarization components can be nicely split into both polarization components with similar power. Again for antenna#1 with rotation angels (-25, 0, 90)    However, in this case, the polarization direction of the reference pattern will be aligned with the maximum gain direction, and we cannot use Figure 7.3-7 as a reference anymore: .  Therefore, an easier solution is to allow other polarization directions, e.g., 45 degrees to the plane of the device that used in for dual polarized antennas, like it is shown in Figure 7.3-8:  Then we are getting more realistic polarization component split as well:    **Change proposal:**  For cases when a candidate antenna placement location is used for one antenna field pattern (e.g., single polarization):   * Polarization direction is indicated by the arrow in Figure 7.3-7, which isparallel with the plane of the handheld UT and perpendicular to the direction from the UT center to the candidate antenna location. * Additionally, polarization direction can rotate 45 degrees about the direction from the UT center to the candidate antenna location (i.e. rotated using the direction from the UT center to the candidate antenna location as the rotational axis). An example for candidate antenna location (6) is given in Figure 7.3-8. |
| Moderator | Added Proposal #10-2 based on Nokia’s inputs. |
| Moderator | Nokia has expressed concerns on Proposal #10A over the email reflector. It doesn’t seem to be something that could be resolved quickly, if so, the moderator would like to suggest not pursue Proposal #10A. |
|  |  |

## 3.11 [CLOSED] Editorial – avoiding duplicate use of K variable

NTT Docomo noted on the email reflector that variable K is being used for Rician factor and number of blockers in the TR. The suggestion to change the variable K used for number of blockers so that it does not get confused with K definition in Section 3.3.

##### Proposal #11:

* Adopt the following TP to TR38.901
  + ***Reason for change***: variable K is being used for Rician factor and number of blockers in the TR. However, Clause 3.3. definition for K clearly describes K being Rician factor. Causing potential confusion.
  + ***Summary of chang***: Update variable K used for number of blockers in Clause 7.6.4 to Kblock.
  + ***Consequences if not approved***: Ambiguous usage of K variable for two different functionality.

|  |
| --- |
| 7.6.4.1 Blockage model A Model A adopts a stochastic method for capturing human and vehicular blocking.  Step a: Determine the number of blockers.  Multiple 2-dimensional (2D) angular blocking regions, in terms of centre angle, azimuth and elevation angular span are generated around the UT. There is one self-blocking region, and = 4 non-self-blocking regions, where may be changed for certain scenarios (e.g., higher blocker density). Note that the self-blocking component of the model is important in capturing the effects of human body blocking.  *<unchanged text omitted>* 7.6.4.2 Blockage model B Model B adopts a geometric method for capturing e.g., human and vehicular blocking.  Step a: Determine blockers  A number, *,* ofblockers are modelled as rectangular screens that are physically placed on the map. Each screen has the dimension by height () and width (), with the screen centre at coordinate .  Note:  - The number of blockers (), their vertical and horizontal extensions ( and ), locations , density, and movement pattern (if non-stationary) are all simulation assumptions, to allow different blocking scenarios to be constructed depending on the need of the particular simulation study.  Recommended parameters for typical blockers are provided in Table 7.6.4.2-5.  - The blocking effect diminishes with increasing distance to the blocker. For implementation purposes it may be sufficient to consider only the nearest blockers or the blockers closer than some distance from a specific UT.  *<unchanged text omitted>* |

#### Round #1 Discussion

Please provide comments on Proposal #11.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| End of discussion | |

#### Summary of Tuesday Online Session

Proposal #11 agreed with additional edit to change K to Kblock in the last sentence.

#### == Discussion CLOSED ==

## 3.12 Editorial – Additional Typo Correction

Sharp has noted that there are some additional typo that should be corrected.

##### Proposal #12:

* Adopt the following TP to TR38.901
  + ***Reason for change***: spelling mistake for “probability” and “vegetation” in Table 7.8-1A of Clause 7.8.
  + ***Summary of chang***: Correct the spelling mistake for “probability” and “vegetation” in Table 7.8-1A.
  + ***Consequences if not approved***: Spelling mistake in TR.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 7.8.1 Large scale calibration *<unchanged text omitted>*  Table 7.8-1A: Simulation assumptions for large scale calibration   |  |  | | --- | --- | | **Parameter** | **Values** | | Scenarios | UMa, UMi-Street Canyon, SMa | | Carrier Frequency | 7 GHz | | BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt in Table 7.8-1 for UMa and UMi-Street Canyon | | BS antenna configurations | Mg = Ng = 1; (M,N,P) = (10, 1, 1), dV = 0.5λ | | BS port mapping | Mp = 1, Np = 1, i.e., 10 elements are mapped to a single port  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization | | BS Tx power | 49 dBm for SMa | | Bandwidth | 20 MHz | | UT distribution | For SMa, 20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. | | LOS probability | For SMa, 0% veg~~a~~etation | | O2I penetration loss | For SMa, Low-loss A model | | O2I car penetration loss | For SMa, non-metallic car window | | Wrapping method | For UMa, UMi-Street Canyon, SMa:  - geographical distance based wrapping (mandatory)  - radio distance (optional) |   *<unchanged text omitted>* |

#### Round #1/2 Discussion

Please provide comments on Proposal #12.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Sharp | Just spelling errors and should be fine to adopt these changes. |

## 3.13 Approval of draft CR

The following proposal to agree to the draft CR and endorse the final CR.

##### Proposal #13:

Approve draft CR in R1-256407 and endorse the final CR 0028 for TR38.901 in R1-2506543.

# Summary of Agreements/Conclusions from RAN1 #122

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change***: (1) max subscript typo in Table 7.3-2 has been identified and it may lead to incorrect understanding of angle range; (2) incorrect copy of equation 7.3 to 7.3-3a has been identified and it may lead to incorrect implementation of antenna polarization model 1; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are the same as these of ZOD, which is not correct. In addition, there is an typo in Appendix A.5 for angle scaling.; (4) incorrect section referenced in Note of Table 7..7.5.1-1.; (5) Typo of “antenna” in Table 7.8-2A. (6) Table 7.8-7 is enumerated twice, and Table 7.8-8 and 7.8-9 appears before Table 7.8-7 and therefore require changes to the enumeration. (7) Tdoc number R1-2404960 in Clause 4 is a mistake.
* ***Summary of change***: (1) removal of max subscript from horizontal cut of radiation power pattern in Table 7.3-2; (2) correction of sin theta prime to cos theta prime in equation 7.3-3a; (3) In TR38.901, for angle scaling of CDL models, the scaling factors of ZOA in Table 7.7.5.1-1 are changed to correct values. In Appendix A.5, P\_m is changed to P\_n.; (4) correcting section reference from Annex A.3 to A.5 in in Note of Table 7..7.5.1-1; (5) Correct typo for “antenna” in Table 7.8-2A. (6) Table 7.8-7 in Clause 7.8.3 is changed to Table 7.8-6A. Table 7.8-8 and 7.8-9 are changed to Table 7.8-6B and 7.8-6C. (7) Correcting Tdoc number typo in Clause 4 from R1-2404960 to R1-2504960.
* ***Consequences if not approved***: (1) ambiguous math notation for range of angles; (2) incorrect angle calculation for polarization model 1; (3) Incorrect scaling of ZOA for CDL models. (4) incorrect reference of the equations used to derivation of the scaling value for CDL model angle changes. (5) mis-spelled word in TR. (6) Duplicate Table numbers and wrong ordering of Tables. (7) Reference to wrong Tdoc.

===== Start of TP for TR38.901=====

4 Introduction

**< Unchanged text omitted >**

Subsequently, at the TSG RAN #102 meeting the Study Item Description "Study on channel modelling enhancements for 7-24GHz for NR" was approved [24]. The findings from this study are also captured in the present technical report. Channel modeling was further updated by considering new measurements and information in the literature. An overview of the information sources is available in tdoc R1-2~~4~~504960 [25].

**< Unchanged text omitted >**

7.3.0 Antenna array structure

**< Unchanged text omitted >**

Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Vertical cut of the radiation power pattern (dB) |  |
| Horizontal cut of the radiation power pattern (dB) |  |
| 3D radiation power pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5.3 dBi |
| NOTE: For UT antenna modelling of handheld devices, optional antenna imbalance can be modelled. If modelled, randomized loss is applied per UT antenna port and randomized loss can be applied independently for the UL and DL directions. No imbalance is modelled by default. | |

**< Unchanged text omitted >**

7.3.2 Polarized antenna modelling

**< Unchanged text omitted >**

**Model-1**:

In case of polarized antenna elements assume is the polarization slant angle where degrees corresponds to a purely vertically polarized antenna element and degrees correspond to a pair of cross-polarized antenna elements. Then the antenna element field components in and direction are given by

, (7.3-3)

where

, (7.3-3a)

. (7.3-3b)

**< Unchanged text omitted >**

7.7.5.1 CDL extension: Scaling of angles

**< Unchanged text omitted >**

Table 7.7.5.1-1: Scale factor values for each CDL model

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CDL Type** | **Desired AOD Spread（°）** | **Scale Factor (AOD)** | **Desired AOA Spread（°）** | **Scale Factor (AOA)** | **Desired ZOA Spread（°）** | **Scale Factor (ZOA)** | **Desired ZOD Spread（°）** | **Scale Factor (ZOD)** |
| CDL-A | 5 | 0.0680 | 30 | 0.3531 | 5 | 0.2397 ~~0.0352~~ | 1 | 0.0352 |
| 10 | 0.1360 | 45 | 0.5268 | 10 | 0.4802 ~~0.1056~~ | 3 | 0.1056 |
| 15 | 0.2041 | 60 | 0.6981 | 15 | 0.7225 ~~0.1761~~ | 5 | 0.1761 |
| 25 | 0.3405 |  |  |  |  |  |  |
| CDL-B | 5 | 0.1238 | 30 | 0.5417 | 5 | 0.6519 ~~0.1940~~ | 1 | 0.1940 |
| 10 | 0.2475 | 45 | 0.8081 | 10 | 1.3018 ~~0.5822~~ | 3 | 0.5822 |
| 15 | 0.3710 | 60 | 1.0709 | 15 | 1.9480 ~~0.9705~~ | 5 | 0.9705 |
| 25 | 0.6168 |  |  |  |  |  |  |
| CDL-C | 5 | 0.1281 | 30 | 0.4307 | 5 | 0.6476 ~~0.3643~~ | 1 | 0.3643 |
| 10 | 0.2568 | 45 | 0.6447 | 10 | 1.2971 ~~1.0929~~ | 3 | 1.0929 |
| 15 | 0.3864 | 60 | 0.8585 | 15 | 1.9504 ~~1.8219~~ | 5 | 1.8219 |
| 25 | 0.6513 |  |  |  |  |  |  |
| CDL-D | 5 | 0.3231 | 30 | 9.8888 | 5 | 4.3268 ~~0.4477~~ | 1 | 0.4477 |
| 10 | 0.6652 | 45 | N/A | 10 | 8.8868 ~~1.3469~~ | 3 | 1.3469 |
| 15 | 1.0594 | 60 | N/A | 15 | 14.0344 ~~2.2579~~ | 5 | 2.2579 |
| 25 | 5.8637 |  |  |  |  |  |  |
| CDL-E | 5 | 0.3950 | 30 | 2.9733 | 5 | 6.9195 ~~0.9714~~ | 1 | 0.9714 |
| 10 | 0.8009 | 45 | N/A | 10 | 14.8378 ~~2.9180~~ | 3 | 2.9180 |
| 15 | 1.2330 | 60 | N/A | 15 | 27.2849 ~~4.8774~~ | 5 | 4.8774 |
| 25 | 2.3627 |  |  |  |  |  |  |
| NOTE: Values of Table 7.7.5.1-1 were computed based on scaling factor calculation method described in Annex A.~~3~~5. | | | | | | | | |

**< Unchanged text omitted >**

7.8.2 Full calibration

**< Unchanged text omitted >**

Table 7.8-2A: Simulation assumptions for full calibration

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Scenarios | UMa, UMi-Street Canyon, SMa |
| Carrier Frequency | 7 GHz,  (optional) 15 GHz |
| BS antenna downtilting | Mechanical downtilt of 95 degrees for SMa for ISD = 1299m  Mechanical downtilt of 92 degrees for SMa for ISD = 1732m  Electrical downtilt as in Table 7.8-1 for UMa and UMi-Street Canyon |
| BS antenna configurations | Config 3 for UMi, UMa, SMa at 7 GHz: Mg = Ng = 1, M = 8, N = 16, P = 2, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated  (optional) Config 4 for UMa at 7 and 15 GHz: Mg = Ng = 1, M = 64, N = 16, P = 2, Mg = 1, Ng = 1, dH = dV = 0.5λ … calibration metrics 1), 2), 3), 4) are calibrated |
| BS Polarized antenna modelling | Model-2 in Clause 7.3.2 |
| BS port mapping | Config 3 for UMi, UMa, SMa at 7 GHz: Mp = 8, Np = 16, each antenna element is mapped to one port  (optional) Config 4 for UMa at 7 and 15 GHz: Mp = 16, Np = 16  Mp and Np are the number of vertical, horizontal TXRUs within a panel and polarization |
| BS Tx power | 49 dBm for SMa |
| Bandwidth | 20 MHz for 7 GHz  (optional) 200 MHz for 7 and 15 GHz |
| UT attachment | Based on RSRP (formula) from BS port 0 |
| UT distribution | For SMa,  20% of UT outdoor, 80% of UT indoor. Among indoor UT, 90% of indoor UT are within residential buildings, and 10% of indoor UT in commercial buildings. Indoor UTs are uniformly distributed across all floors for a building type. |
| UT array orientation | Config B, C: Ω*UT,* uniformly distributed on [0,360] degree, Ω*UT,*= 45 degree, Ω*UT,* = 0 degree  Config D: Ω*UT,* = 0 degree, Ω*UT,*= 0 degree, Ω*UT,* = 0 degree |
| UT antenna configurations | Config B for 7 GHz: 4 antenna port with single polarization for calibration based on handheld device antenna model using candidate antenna locations (1,7,3,5) as described in Clause 7.3  (optional) Config C for 15 GHz: 16 antenna port with dual polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3  (only for metric 5) Config D: 8 antenna port with single polarization based on handheld device antenna model using candidate antenna locations in (1,2,3,4,5,6,7,8) as described in Clause 7.3 |
| UT antenna pattern | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 |
| UT Polarized antenna modelling | Config B, C, D: Based on directional antenna for handheld UT described in Clause 7.3 |
| O2I penetration loss | For SMa, low-loss A model |
| SCS assumption | 30 kHz |
| Additional metrics | 5) A~~n~~ntenna field pattern of handheld UT, and , in UT LCS using UT antenna configuration D |

**< Unchanged text omitted >**

7.8.3 Calibration of additional features

The calibration parameters for the calibration of oxygen absorption, large bandwidth and large antenna array, spatial consistency, and blockage can be respectively found in Table 7.8-3, 7.8-4, 7.8-5, and 7.8-6. Unspecified parameters in these tables are the same as those in Tables 7.8-1 and 7.8-2. When P=2, X-pol (+/-45 degree) is used for BS antenna configuration 1 and X-pol (0/+90 degree) is used for UT antenna configuration. The calibration results based on TR 38.900 V14.0.0 can be found in R1-1700990.

The additional calibration parameters for the calibration of near field channel modeling, BS side spatial non-stationarity, and UT side spatial non-stationarity can be respectively found in Table 7.8-~~7~~6A, 7.8-~~8~~6B, and 7.8-~~9~~6C. For the assumption on the aperture size of the antenna array, the following guidance is considered:

- Up to 1.5 m for UMa with maximum antenna elements in the array is 5k for single Polarization.

- Up to 1 m for UMi with maximum antenna elements in the array is 2.22k for single Polarization.

- Up to 0.71 m for Indoor factory with maximum antenna elements in the array is 1.12k for single Polarization.

- Up to 0.25 (for rectangular antenna array), 0.5 (for linear antenna array) m for Indoor office with maximum antenna elements in the array is 256, 80 for single Polarization, respectively.

The additional calibration results can be found in R1-2504791.

**< Unchanged text omitted >**

Table 7.8-~~7~~6A: Simulation assumptions for calibration for near field channel modeling

**< Unchanged text omitted >**

Table 7.8-~~8~~6B: Simulation assumptions for calibration for BS side spatial non-stationarity

**< Unchanged text omitted >**

Table 7.8-~~9~~6C: Simulation assumptions for calibration for UT side spatial non-stationarity

**< Unchanged text omitted >**

A.5 Calculation of scaling factor for changing CDL model angular spread

The following expression for the computing scaling factor, , to achieve a specific angular spread, AS, in degrees is given by

(A-5)

(A-6)

where is the power for the *n*th cluster path, is the input cluster path angle (either AOA, AOD, ZOA, ZOD) given in degrees, is the power for the input LOS path, and is the input LOS path angle (either AOA, AOD, ZOA, ZOD) given in degrees. If input LOS path does not exist, is assumed.

**< Unchanged text omitted >**

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change***: Companies have provided updated channel model calibration results based on TR 38.901 v19.0.0. The updated calibration results is uncaptured in the TR.
* ***Summary of chang***: Update the calibration result Tdoc from R1-2504791 to R1-2506406 in Section 7.8.
* ***Consequences if not approved***: outdated calibration results are present in the TR.

===== Start of TP for TR38.901=====

7.8 Channel model calibration

7.8.1 Large scale calibration

**<Unchanged parts omitted>**

Additional calibration parameters can be found in Table 7.8-1A. It is assumed that parameters from Table 7.8-1 is used if unspecified by the additional calibration parameters in Table 7.8-1A. In addition, calibration of UMa and UMi-Street Canyon at 6 GHz carrier frequency using simulation assumptions in Table 7.8-1 with updated channel modeling is part of the additional calibration. The calibration results based on additional calibration parameters can be found in ~~R1-250 2504791~~R1-2506406.

**<Unchanged parts omitted>**

7.8.2 Full calibration

**<Unchanged parts omitted>**

The calibration results based on additional calibration parameters can be found in ~~R1-2504791~~ R1-2506406.

**<Unchanged parts omitted>**

7.8.3 Calibration of additional features

**<Unchanged parts omitted>**

The additional calibration results can be found in ~~R1-2504791~~ R1-2506406.

**<Unchanged parts omitted>**

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change***: Breaking up the cluster and ray scaling angles for CDL angle scaling, such that other WG may be able to reference the TR easily. Also improves readability of the angle scaling for CDL models.
* ***Summary of change***: introduce an intermediate variable to represent cluster angles, which are the angles being scaled by the model.
* ***Consequences if not approved***: Difficult for WGs to identify scaled angle component in CDL models.

===== Start of TP for TR38.901=====

7.7.5.1 CDL extension: Scaling of angles

The angle values of CDL models are fixed, which is not very suitable for MIMO simulations for several reasons; The PMI statistics can become biased, and a fixed precoder may perform better than open-loop and on par with closed-loop or reciprocity beamforming. Furthermore, a CDL only represents a single channel realization. The predefined angle values in the CDL models can be generalized by introducing angular translation and scaling. By translation, mean angle can be changed to and angular spread can be changed to match by scaling. The translated and scaled ray angles can be obtained according to the following equation:

(7.7-5)

(7.7-5a)

(7.7-5b)

(7.7-5c)

(7.7-5d)

in which:

**< Unchanged text omitted >**

- is the desired rms cluster angular spread,



- is the scaled CDL cluster angle of the *n*th cluster,



- is the resulting scaled ray angle that corresponds to *m*th subpath angle of *n*th cluster,



**< Unchanged text omitted >**

Alternatively, for CDL-D and CDL-E, if maintaining the LOS angle is desired, the translated and scaled ray angles can be obtained according to the following equation instead of using equation (7.7-5) and (7.7-5a):

(7.7-6)

(7.7-6a)

(7.7-6b)

in which:

- is the LOS path angle of the model.

- is the scaled CDL cluster angle of the nth cluster,



**< Unchanged text omitted >**

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change:*** Ambiguous application of antenna polarization for the handheld UT antenna.
* ***Summary of change:*** Clarify the polarization equation for handheld UT
* ***Consequences if not approved:*** Polarization application for handheld UT is ambiguous and can lead to companies with different implementation.

===== Start of TP for TR38.901=====

7.3.2 Polarized antenna modelling

**Handheld UT Model:**

< Unchanged parts are omitted >

Each polarized field component of the reference radiation pattern and should be rotated according to the orientation and polarization direction of the each of UT antennae to get , using equation ~~(7.3-3),~~

, (7.3-6)

(7.3-7)

(7.3-8)

where the 3D-rotation angles, , and , are obtained according to the orientation and polarization direction of each UT antenna *u*, and ~~then~~ rotated based on the orientation of the UT in the global coordinate system to get and using Clause 7.1.3 equation (7.1-11).

< Unchanged parts are omitted >

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change:*** In the current TR 38.901 [1], antenna element-wise angular-domain parameters are introduced to additionally model the antenna element-wise field patterns for the NLOS channel impulse response in the near-field channel model. However, the definitions of these antenna element-wise angular-domain parameters are missing, leading to ambiguity in their interpretation.
* ***Summary of change:*** Add definitions for the antenna element-wise angular-domain parameters in equation 7.6-49 of TR 38.901 [1], which are introduced for modelling the antenna element-wise field patterns.
* ***Consequences if not approved:*** The expression for the angular-domain parameters in equation 7.6-49 of TR 38.901 [1] remains undefined, resulting in ambiguity and potential inconsistency in implementation.

===== Start of TP for TR38.901=====

7.6.13 Near-field channel model

*<Unrelated parts are omitted>*

- To model the antenna element-wise antenna field patterns additionally, the is given by:

(7.6-49)

where and are the antenna element-wise elevation arrival angles and azimuth arrival angles, respectively, for ray *m* of cluster *n* for receive antenna element *u*, and and are the antenna element-wise elevation departure angles and azimuth departure angles, respectively, for ray *m* of cluster *n* for transmit antenna element *s*.

*<Unrelated parts are omitted>*

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change***: variable K is being used for Rician factor and number of blockers in the TR. However, Clause 3.3. definition for K clearly describes K being Rician factor. Causing potential confusion.
* ***Summary of chang***: Update variable K used for number of blockers in Clause 7.6.4 to Kblock.
* ***Consequences if not approved***: Ambiguous usage of K variable for two different functionality.

===== Start of TP for TR38.901=====

7.6.4.1 Blockage model A

Model A adopts a stochastic method for capturing human and vehicular blocking.

Step a: Determine the number of blockers.

Multiple 2-dimensional (2D) angular blocking regions, in terms of centre angle, azimuth and elevation angular span are generated around the UT. There is one self-blocking region, and = 4 non-self-blocking regions, where may be changed for certain scenarios (e.g., higher blocker density). Note that the self-blocking component of the model is important in capturing the effects of human body blocking.

*<unchanged text omitted>*

7.6.4.2 Blockage model B

Model B adopts a geometric method for capturing e.g., human and vehicular blocking.

Step a: Determine blockers

A number, *,* ofblockers are modelled as rectangular screens that are physically placed on the map. Each screen has the dimension by height () and width (), with the screen centre at coordinate .

Note:

- The number of blockers (), their vertical and horizontal extensions ( and ), locations , density, and movement pattern (if non-stationary) are all simulation assumptions, to allow different blocking scenarios to be constructed depending on the need of the particular simulation study.

Recommended parameters for typical blockers are provided in Table 7.6.4.2-5.

- The blocking effect diminishes with increasing distance to the blocker. For implementation purposes it may be sufficient to consider only the nearest blockers or the blockers closer than some distance from a specific UT.

*<unchanged text omitted>*

===== End of TP for TR38.901=====

**Agreement**

Adopt the following TP to TR38.901

* ***Reason for change***: Ambiguous orientation antenna radiation power pattern for pattern defined in Table 7.3-2.
* ***Summary of chang***: Clarify that antenna radiation power pattern in Table 7.3-2 is oriented in and direction and final antenna field pattern for each antenna element should be rotated according to descriptions in the TR.
* ***Consequences if not approved***: Ambiguous antenna radiation power pattern orientation could lead to incorrect implementation of the final handheld UT antenna field patterns among companies.

===== Start of TP for TR38.901=====

7.3.0 Antenna array structure

*<unchanged text omitted>*

**UT antenna model:**

*<unchanged text omitted>*

- The antenna radiation power pattern of each antenna element for handheld UT is generated according to Table 7.3-2 which assumes antenna is oriented in and direction.

Table 7.3-2: Radiation power pattern of a single antenna element for handheld UT

*<unchanged text omitted>*

===== End of TP for TR38.901=====

# Reference

1. R1-2505224, “Maintenance issues on 7-24 GHz channel modeling”, Huawei, HiSilicon
2. R1-2505225, “Calibration results for 7-24GHz channel modeling”, Huawei, HiSilicon
3. R1-2505238, “Maintenance of FR3 Channel Modellin”, InterDigital, Inc.
4. R1-2505294, “Maintenance on channel modelling enhancements for 7-24GHz”, CATT
5. R1-2505385, “Maintenance on 7-24GHz channel modeling”, vivo
6. R1-2505499, “Remaining issues on 7-24 GHz channel model”, ZTE Corporation, Sanechips
7. R1-2505549, “Remaining issues on channel modelling enhancements for 7-24 GHz for NR”, Samsung
8. R1-2505653, “Maintenance on channel model enhancements for 7-24 GHz for NR”, Sharp
9. R1-2505730, “Text proposals and calibration results for 7-24GHz channel modeling”, OPPO
10. R1-2505766, “Calibration results for 7-24 GHz channel model”, Intel
11. R1-2505884, “Maintenance and Calibration of Channel Model for 7-24 GHz”, Apple
12. R1-2505978, “Discussion on R19 FR3 Channel Model Maintenance”, SK Telecom
13. R1-2506187, “Maintenance on channel modelling enhancements for 7-24GHz for NR”, Qualcomm Incorporated
14. R1-2506374, “Calibration results for 7-24 GHz channel model”, Ericsson
15. R1-2506382, “Updated Calibration Simulation Results for Channel Modelling Enhancements for 7-24GHz for NR”, Nokia Germany