**3GPP TSG RAN WG1 #122 R1-250xxxx**

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

**Agenda item: 8.7**

**Source: Moderator (Xiaomi)**

**Title: Summary on channel modelling for ISAC**

**Document for:** **Discussion/Decision**

# Introduction

The study item on channel modelling for ISAC was completed at RAN #108. The outcomes of the study were included in TR 38.901 v19.0.0. This document summarizes all text proposals submitted by companies for maintenance in RAN1 #122.

The new/revised proposals/questions in current round for discussion is tagged with [FL1]. Note: Some proposals without update are still marked with early round number. If any company didn’t provide a comment yet, or prefer to update the comments, feel free to continue comment on them.

Further, the proposals in this document are tagged and color coded respectively

* + [H] Proposal: Text proposals that sounds critical and should be resolved.
  + [M] Proposal: Text proposals which helps to make TR 38.901 better.

The following email thread is assigned for discussion of the study item (agenda 8.7):

[122-R19-ISAC] Email discussion on channel modelling for ISAC – Yingyang (Xiaomi)

* To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc

# Proposed online proposals

# Proposed offline proposals

Refers to the latest proposals for the issues in section 4 with [FLx]

# Text proposals to TR 38.901 v19.0.0

## Abbreviations

TP #4.1-1 (IDCC)

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| The current CR [2] includes a list of abbreviations in Section 3.3, but the readability of the document can be further improved by defining additional terms.  **Observation-2: The list of abbreviations in the current CR [2] is incomplete.**  **Proposal-1: Adopt the proposed Text Proposal 1 in the CR to include abbreviations for the terms ISAC and RP.**  *\* \* \* \*Start of Text Proposal 1\* \* \* \**  3.3 Abbreviations  ZSD Zenith angle Spread of Departure  STX Sensing Transmitter  SRX Sensing Receiver  ST Sensing Target  SPST Scattering Point of a ST  RCS Radar Cross-Section  EO Environment Object  UAV Unmanned Aerial Vehicle  AGV Automated Guided Vehicles  ISAC Integrated Sensing and Communication  RP Reference Point  *\* \* \* \*End of Text Proposal 1\* \* \* \** |

[Moderator’s note]: The changes make it clear for reader to understand the meaning of ISAC and RP.

### [FL1][M] Proposal 4.1

* TP #4.1-1 is agreed for TR 38.901 v19.0.0

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to include TP #4.1-1. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree to include TP #4.1-1. |

## ISAC scenarios

### Min-3D distance

TP #4.2-1 (CATT, CICTCI)

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| **Proposal 4: Clearly specify the minimum 3D distances between pairs of STX/SRX and sensing target in Table 7.9.1-3 and Table 7.9.6.1-2 for human (indoor and outdoor) sensing scenarios of TR 38.901.**  The corresponding TP for Proposal 4 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.9.1 Scenarios  <Unrelated part omitted>  **Table 7.9.1-3: Evaluation parameters for Human (indoor and outdoor) sensing scenarios**   |  |  |  | | --- | --- | --- | | **Parameters** | **Indoor Values** | **Outdoor Values** | | Minimum 3D distances between pairs of STX/SRX and sensing target | For TRP monostatic and TRP-TRP bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 0 m (as specified in TR 38.859)  For UE monostatic and UE-UE bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 1 m (as specified in TR 38.901) | For TRP monostatic and TRP-TRP bistatic sensing modes, the minimum 2D distances between STX/SRX pairs and the sensing target are 10 m for UMi scenarios and 35 m for UMa scenarios ( as specified in TR 38.901)  For UE monostatic and UE-UE bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 1 m (as specified in TR 38.901) | | Minimum 3D distance between sensing targets | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1m | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1m | | NOTE 1: N=0 may be considered for the evaluation of false alarm | | | |

TP #4.2-2 (QC)

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| For automotive sensing, the table 7.9.1-2 (Evaluation parameters for Automotive sensing scenarios) and Table 7.9.6.1-3 (Simulation assumptions for large scale calibration for Automotive sensing targets), for the “Minimum 3D distances between pairs of STX/SRX and sensing target” row, different options have been agreed:   * **Table 7.9.1-2**  |  |  | | --- | --- | | Minimum 3D distances between pairs of STX/SRX and sensing target | For Highway, Urban Grid  - Min distances based on min TRP/UE distances defined in TR37.885  For UMi, UMa, RMa, SMa  - Min distances based on min TRP/UE distances defined in TR38.901 |  * **Table 7.9.6.1-3**  |  |  | | --- | --- | | Minimum 3D distances between pairs of STX/SRX and sensing target | 10 m |   The above introduces unnecessary complications and variations across the evaluation scenario and the calibration also. Furthermore, the problem arises from the “10m” minimum distance in the Table 7.9.6.1-3, which is not aligned with the way the UTs and the sensing targets are dropped in TR37.885.  **Proposal 5: The minimum distance between pairs of STX/SRX and sensing target should be:**  **- Min distances based on min TRP/UE distances defined in TR37.885** |

### [FL1][M] Question 4.2-1

Please provide your views on whether TP #4.2-1 and/or #4.2-2 is agreeable?

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposals. |
| Samsung | Yes | Both TPs are fine |
| CATT, CICTCI | Yes | Agree with the proposals. |

### Size of EO type-1

TP #4.2-3 (IDCC)

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| In Section 7.9.2.0 of the current CR [2], an introduction to EO Type 1 is given, noting its similar characteristics to the ST. To improve readability, it can also be mentioned that EO Type 1 has similar size to the ST.  **Observation-3: The current description of EO Type 1 in the CR [2] highlights that it has similar characteristics to the ST.**  **Proposal-2: Adopt the proposed Text Proposal 2 in the CR to explicitly highlight that EO Type 1 has a similar size to the ST.**  *\* \* \* \*Start of Text Proposal 2\* \* \* \**  7.9.2.0 Introduction  The channel model for ISAC in Clause 7.9 is designed based on the channel model defined in the previous clauses within Clause 7 taking into account the known properties, e.g., location, Radar Cross-Section (RCS), polarization etc. of one or more physical objects. A physical object is categorized as a sensing target (ST) or an environment object (EO). A ST is an object of interest for sensing. An EO is a non-target object with known location. Two types of EO are supported in the ISAC channel model. A first type of EO (type-1 EO) has similar size and characteristics ~~as~~ to a ST and is modelled in the same way as a ST.  *\* \* \* \* End of Text Proposal 2\* \* \* \** |

[Moderator’s note]: Though we usually say same size in the discussions. The only agreement found is cited below

Agreement

EO is a non-target object with known location.

* FFS other known parameters of the EO
* FFS details on EO modelling

The following options for EO modelling are considered for further study

* + Option 1: EO is modelled different from a sensing target
    - Applicable at least for an EO having extremely large size (referred as EO type-2 for discussion purpose)
    - FFS modeled similar to section 7.6.8 ground reflection in TR 38.901
    - FFS EO modelling impacts the target channel and/or the background channel
  + Option 2: EO is modeled same/similar as a sensing target
    - Applicable for an EO having comparable physical characteristics as a sensing target, (referred as EO type-1 for discussion purpose)
    - FFS Applicable for EO type-2
    - FFS EO modelling impacts the target channel and/or the background channel
  + Option 3: EO is modeled and its location is determined from a stochastic clutter generated following the cluster generation in TR 38.901
    - FFS details
  + Option 4: EO is not modelled
  + Other options are not precluded
  + Note: it is not precluded that multiple options can be supported in the channel modelling

Therefore, the current TP correctly reflect the agreement. On the other hand, open to quickly check more views from companies.

### [FL1][M] Question 4.2-2

Please provide your views on whether TP #4.2-3 is agreeable?

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | The current text in the CR only mentions “characteristics”, as opposed to “physical characteristics”. This is the reason we added “size” for improved understanding. Agree to include TP #4.2-3. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree to include TP #4.2-3. |

## RCS model

### Definition of RCS model 1 or 2

TP #4.3-1 (Samsung)

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| Proposal Adopt the following TP to clarify the meaning of RCS model 1 and RCS model 2  7.9.2.1 RCS of sensing target  ==============================Unchanged Text Omitted ===================================  The RCS related coefficient of a SPST for a pair of incident/scattered angles is composed of a first component which is included in the large-scale parameters (described in Step 15 in Clause 7.9.4.1), and a second component and third component which are both included in the small-scale parameters (described in Step 10 in Clause 7.9.4.1), i.e., . is a deterministic value for the SPST. can be fixed to 1 or can be angular dependent. *RCS model 1 and model 2 correspond to angular-independent and angular-dependent characteristics with respect to , respectively.* follows log-normal distribution. The mean and standard deviation used to characterize satisfied a fixed relation.  (7.9.2-1)  A first RCS model is to characterize a ST as single SPST with component of the monostatic RCS values fixed to 1. is the mean of linear monostatic RCS values at the SPST. For UAV of small size and human with RCS model 1, the values/pattern, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  ==============================Unchanged Text Omitted =================================== |

TP #4.3-2 (QC)

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| ------------------------------------------------------------- START OF TEXT PROPOSAL-----------------------------------------  A first RCS model, called RCS model 1, characterizes a ST as single SPST with component of the monostatic RCS values fixed to 1. is the mean of linear-domain monostatic RCS values at the SPST. For UAV of small size and human with RCS model 1, the angle-dependent value of, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  (7.9.2-2)  where,  - . is the bistatic angle between the incident ray and scattering ray within the plane defined by incident angle () and scattering angle ().  - is for the effect of forward scattering and is set to .  The logarithmic values of of the RCS values for the different STs are provided in Table 7.9.2.1-1.  **Table 7.9.2.1-1: Parameters for RCS for the STs with angle-independent monostatic RCS values**   |  |  |  | | --- | --- | --- | | **Sensing target** | **(dBsm)** | **(dB)** | | UAV with small size | -12.81 | 3.74 | | Human with RCS model 1 | -1.37 | 3.94 |   A second RCS model, called RCS model 2, splits a ST into single or multiple SPSTs, and adopts an angular dependent component of the monostatic RCS values for each SPST. For UAV with large size and human, single SPST is modelled. For vehicle and AGV, both models with single and multiple SPSTs are provided. For vehicle and AGV modelled with multiple scattering points, the recommended five scattering points are located at the front, left, back, right and roof side of the vehicle. The orientation of a ST in LCS is provided as follows.  - The face of a human, the front of a vehicle, a UAV with large size or an AGV is facing the direction with azimuth angle and zenith angle . The front of the AGV is the short edge of AGV in horizontal direction.  - The top of the ST is facing the direction with zenith angle .  For UAV of large size with single SPST, human with RCS model 2 with single SPST, vehicle with single/multiple SPSTs, and AGV with single/multiple SPSTs, the angle-dependent value of, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  (7.9.2-3)  with defined by  -------------------------------------------------------- END OF TEXT PROPOSAL--------------------------------------------- |

[Moderator’s note] Let’s focus on definition of RCS model 1 and RCS model 2. Other revisions from Qualcomm are editorial and can be discussed in section 4.9.2.

When RCS model is defined, the wording is the first RCS model and the second RCS model. Then, RCS model 1 or 2 is used in some other descriptions. Companies are encouraged to comment on whether further definition is necessary.

### [FL1][M] Question 4.3-1

Whether the issue should be solved? If yes, which TP from TP #4.3-1 or #4.3-2 is preferred, or any suggestion for revisions?

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to adopt TP #4.3-2. |
| Samsung | Yea | Both TPs are fine |
| CATT, CICTCI | Yea | Both TPs are fine |

### Alignment of with

TP #4.3-2 (Apple)

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| **Issue 2:** In Section 7.9.2.1 (RCS of a sensing target), the RCS related coefficient of a SPST for a pair of incident/scattered angles is composed of a first component which is included in the large-scale parameters, and a second component and third component which are both included in the small-scale parameters, i.e., . However, in Section 7.9.6.2 (Full Calibration), in the tables, the parameter “RCS for each scattering point” is defined as A, B1 and B2 e.g. in Table 7.9.6.2-1, Component A: -12.81 dBsm, Component B1: 0 dB, Component B2: 3.74 dB for standard deviation.  Section 7.9.2.1  The RCS related coefficient of a SPST for a pair of incident/scattered angles is composed of a first component which is included in the large-scale parameters (described in Step 15 in Clause 7.9.4.1), and a second component and third component which are both included in the small-scale parameters (described in Step 10 in Clause 7.9.4.1), i.e., **.**  Table 7.9.6.2-1  Table 7.9.6.2-1: Simulation assumptions for full calibration for UAV sensing targets   |  |  | | --- | --- | | Parameters | Values | | Scenario | UMa-AV | | Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic | | Target type | UAV of small size (0.3m x 0.4m x 0.2m) | | RCS for each scattering point | Component A: -12.81 dBsm  Component B1: 0 dB  Component B2: 3.74 dB for standard deviation  The same values are used for monostatic RCS and bistatic RCS | | Fast fading model | TR 36.777 Annex B.1.3 |   ***Proposal 2: Update parameter component names in the Tables in Section 7.9.6.2 to the parameter component names in 7.9.2.1 i.e.*** |

[Moderator’s note] It is helpful to align the naming of same parameters

### [FL1][H] Proposal 4.3-2

* Update parameter component names in the Tables in Section 7.9.6.2 to align with the parameter component names in 7.9.2.1 i.e. respectively replacing with .

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposal. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree with the proposal. |

## Reference TR

### Height of two aerial UEs

TP #4.4-1 (Xiaomi)

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| * **Reason for Change:** In Table 7.9.3-1, the definition on the first aerial UE is missing. * **Summary of change:** The definition of the first and second aerial UEs are provided. * **Consequences if not approved:** Confusion exists on the generation of channel between two aerial UEs.   ==============================Unchanged Text Omitted ===================================  The following updates compared to the reference TRs are identified to generate ISAC channel.  ==============================Unchanged Text Omitted ===================================  - On Case 9 in Table 7.9.3-1, the LOS probability between two aerial UEs is generated by Table 7.9.3-5. are respectively the height of the first and the second aerial UEs, .  ==============================Unchanged Text Omitted =================================== |

TP #4.4-2 (IDCC)

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| In the current CR [2], reference channel models and required updates are provided in Section 7.9.3, including for scenarios with aerial UEs. However, the criteria for determining aerial UE1 and aerial UE2 in UMi-AV, UMa-AV, and RMa-AV scenarios is missing.  **Observation-4: In table 7.9.3-1, ISAC channel model between a pair of aerial UEs is specified. However, the criteria for determining aerial UE1 and aerial UE2 is missing.**  **Observation-5: The following agreement was made in RAN1#121 for generating channel between two aerial UEs. This agreement includes a criterion for determining aerial UE1 and aerial UE2 in UMi-AV, UMa-AV, RMa-AV scenarios based on their height.**   |  | | --- | | **Agreement**  To generate the channel between a first aerial UE with height h1 and a second aerial UE with height h2, abs(h1-hBS) <= abs(h2-hBS),   * The LOS probability between the two aerial UEs is generated by:   … |   **Proposal-3: Adopt the proposed Text Proposal 3 in the CR which captures the previously made agreement from RAN1#121 regarding generating channel between two aerial UEs with clarification on the height-based criteria.**  *\* \* \* \*Start of Text Proposal 3\* \* \* \**  7.9.3 Reference channel models and required updates  Table 7.9.3-1: Reference TRs to generate channel for ISAC   |  |  |  |  | | --- | --- | --- | --- | | 9 | aerial UE | aerial UE | For sensing scenario UMi-AV, UMa-AV, RMa-AV  - Reuse TRP-aerial UE link of UMi-AV in Annex A and B of TR 36.777 by setting height of TRP equal to the height of the first aerial UE for FR1 (see note 4)  - Reuse the channel model of scenario UMa-AV, UMi-AV, and RMa-AV of FR1 for FR2  - The corresponding parameter values in FR2 are used | | NOTE 1: ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0  NOTE 2: ASD and ZSD statistics updated to be the same as ASA and ZSA  NOTE 3: Indoor office scenario can be categorized into 5 sub-indoor scenarios defined in TR38.808.  NOTE 4: First aerial UE height is h1, second aerial UE height is h2, where abs(h1-hBS) <= abs(h2-hBS) | | | |   *\* \* \* \* End of Text Proposal 3\* \* \* \** |

[Moderator’s note] Both two TPs are to address an agreement that is not fully captured in the TR. Therefore, the general principle should be agreeable.

### [FL1][H] Question 4.4-1

* Please indicate which TP from TP #4.4-1 and #4.4-2 is preferred, or any suggestion for revision?

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| **Company** | **TP ?** | **Comments** |
| IDCC | Yes | Either TP #4.4-1 or #4.4-2 related to clarifying aerial UE heights is fine with us. In addition, the proposal #4.4-2 TP 3 to add “Reuse” before “TRP-aerial UE link of UMi-AV in Annex A…” is needed for conveying the correct meaning. |
| Samsung |  | Both TPs are fine |
| CATT, CICTCI | Yea | Both TPs are fine |

### Table for reference TR

TP #4.4-3 (CATT,CICTCI)

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| **Proposal 5: Clarify the shadowing models of TRP to terrestrial UE and TRP to vehicle UE link for Highway and Urban Grid scenarios.**  The corresponding TP for Proposal 5 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.9.3 Reference channel models and required updates  <Unrelated part omitted>  Table 7.9.3-1: Reference TRs to generate channel for ISAC   |  |  |  |  | | --- | --- | --- | --- | | **Case** | **Tx/Rx** | **Rx/Tx** | **Reference TR to define the channel model** | | 2 | TRP | terrestrial UE | For sensing scenario UMi, UMa, RMa, InH, InF, UMi-AV, UMa-AV, and RMa-AV  - TRP-UE link of scenario UMi, UMa, RMa, InH, and InF in Clause 7 of TR 38.901  For sensing scenario Highway and Urban grid  - P2B(B2P) link of scenario Highway and Urban grid in Clause 6 of TR 37.885  For sensing scenario HST  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 for FR1 and TRP-UE link of scenario UMa in Clause 7 of TR 38.901 for FR2 | | 3 | TRP | vehicle UE | For sensing scenario Highway and Urban grid  - V2B(B2V) link of scenario Highway and Urban grid in Clause 6 of TR 37.885  For sensing scenario UMi, UMa, and RMa  - TRP-UE link of scenario UMi, UMa, and RMa in Clause 7 of TR 38.901 |   **Proposal 6: Add supplementary explanations regarding the value selection of parameter *ZOD offset* when P2P link, V2P link or V2V link specified** **in Clause 6 of TR 37.885 is adopted as the reference channel model.**  The corresponding TP for Proposal 6 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  <Unrelated part omitted>  **7.9.3 Reference channel models and required updates**  <Unrelated part omitted>  **Table 7.9.3-1: Reference TRs to generate channel for ISAC**   |  |  |  |  | | --- | --- | --- | --- | | **Case** | **Tx/Rx** | **Rx/Tx** | **Reference TR to define the channel model** | | 5 | terrestrial UE | terrestrial UE | For sensing scenario UMi, UMa, RMa, InH, InF, UMi-AV, UMa-AV, and RMa-AV:  - UE-UE link of scenario UMi, UMa, InH, and InF following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  - TRP-UE link of scenario RMa defined in Clause 7 of TR 38.901 by setting hBS =1.5m (see note 2)  For sensing scenario Highway and Urban grid  - P2P link in Clause 6 of TR 37.885 (see note 4)  For sensing scenario HST  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 for FR1, e.g., hBS=1.5m, - UE-UE link of scenario UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858 for FR2 | | 6 | terrestrial UE | vehicle UE | For sensing scenario UMi, UMa, RMa  - UE-UE link of scenario UMi, UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  - TRP-UE link of scenario RMa defined in Clause 7 of TR 38.901 by setting hBS =1.5m  For sensing scenario Highway and Urban grid  - V2P link in Clause 6 of TR 37.885 (see note 4) | | <Unrelated part omitted> | | | | | 8 | vehicle UE | vehicle UE | For sensing scenario Highway and Urban grid  - V2V link of scenario Highway and Urban grid in Clause 6 of TR 37.885 (see note 4)  For sensing scenario UMi, UMa, and RMa  - UE-UE link of scenario UMi, UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  - TRP-UE link of scenario RMa defined in Clause 7 of TR 38.901 by setting hBS =1.5m | | <Unrelated part omitted> | | | | | 11 | RSU-type UE | normal UE | Highway and Urban grid  -V2V link in Clause 6 of TR 37.885, with antenna height at RSU is 5m (see note 4) | | 12 | RSU-type UE | RSU-type UE | Highway and Urban grid  -V2V link in Clause 6 of TR 37.885, with antenna height at RSU is 5m (see note 4) | | 13 | RSU-type UE | vehicle UE | Highway and Urban grid  -V2V link in Clause 6 of TR 37.885, with antenna height at RSU is 5m (see note 4) | | NOTE 1: ASA and ZSA statistics updated to be the same as ASD and ZSD; ZoD offset = 0  NOTE 2: ASD and ZSD statistics updated to be the same as ASA and ZSA  NOTE 3: Indoor office scenario can be categorized into 5 sub-indoor scenarios defined in TR38.808.  NOTE 4: ZoD offset of Highway scenario is equal to that of RMa scenario for FR1 and to that of UMa scenario for FR2 , respectively, and ZoD offset of Urban grid scenario is equal to that of UMa scenario | | | |   <Unrelated part omitted>  --------------------------------------- End of TP for TR 38.901 --------------------------------------- |

[Moderator’s note] Since the title of the table uses “Tx/Rx, Tx/Rx”, the transmitter and receiver are exchangeable. We don’t need to mention both P2B and B2P in the table.

### [FL1][M] Question 4.4-2

Please provide your views on whether TP #4.4-3 is agreeable?

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| **Company** | **Yes/No** | **Comments** |
| IDCC | No | Agree with the Moderator’s note. |
| Samsung | No | Agree with the Moderator’s note |
| CATT, CICTCI | Yes | This clarification is necessary. For example,  **Case1:**  When Tx=terrestrial UE, Rx=TRP, we need to mention the P2B link in 37.885, but there are no definitions of the shadowing model for P2B and V2B link.  *In TR 37.885*  *6.2.2     Shadowing model*  *For V2V, V2P, P2P, V2R, R2R links, the shadowing model in [13] is used. The LOS shadowing model in [13] applies to NLOSv.*  *For B2V, B2P, B2R links, the shadowing model associated with the used pathloss model in [15] is used.*  It is controversial which one is the correct understanding between the following two options:  Op1:For Tx=terrestrial UE, Rx=TRP, the shadowing model is not modeled.  Op2:For Tx=terrestrial UE, Rx=TRP, the shadowing model for B2P is modelled.  This clarification is for the choice of Op2.  **Case2:**  When Tx= TRP, Rx= terrestrial UE, we need to mention the B2P link in 37.885, but there are no definitions of the PL model for B2P and B2V link.  *In TR 37.885*  *6.2.1     Pathloss model*  *<Unrelated part omitted>*  *Pathloss in V2B, P2B, B2R link is given as follows:*  *-     LOS propagation type is used for V2B and B2R links in the highway scenario.*  *-     LOS/NLOS propagation types are used for V2B, P2B and B2R links in the urban scenario and spatial consistency is maintained following procedure in Subclause 7.6.3.3 in [15].*  *-     Derive propagation type based on probability formula*  *-     The effective environment height hE to 0.25m.*  ***Table 6.2.1-2: Pathloss for V2B, P2B, B2R links***   |  |  |  |  |  | | --- | --- | --- | --- | --- | |  | * ***Below 6 GHz*** | | * ***Above 6 GHz*** | | | * ***LOS*** | * ***NLOS*** | * ***LOS*** | * ***NLOS*** | | *V2B*  *P2B*  *B2R* | *Urban:*  *TR 38.901 UMa LOS*  *Highway:*  *TR 38.901 RMa LOS* | *Urban:*  *TR 38.901 UMa NLOS*  *Highway:*  *N/A* | *Urban:*  *TR 38.901 UMa LOS*  *Highway:*  *TR 38.901 UMa LOS* | *Urban:*  *TR 38.901 UMa NLOS*  *Highway:*  *N/A* |   *For above 6 GHz, oxygen absorption is modelled by introducing additional loss which is derived based on [15].*  It is controversial which one is the correct understanding between the following two options:  Op1:For Tx= TRP, Rx= terrestrial UE, the Pathloss model is not modeled.  Op2:For Tx= TRP, Rx= terrestrial UE, the Pathloss model for P2B is modelled.  This clarification is for the choice of Op2.  Or we can add an note to declare that the shadowing model use B2P and B2V link and the pathloss model use P2B and V2B link. |

TP #4.4-4 (Xiaomi)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| * **Reason for Change:** In Case 1, 2, 5 in Table 7.9.3-1, it is not crystal clear that sensing scenario UMi-AV, UMa-AV and RMa-AV should follow communication scenario UMi, UMa, RMa. * **Summary of change:** Group sensing scenario UMi/UMi-AV, UMa/UMa-AV, RMa/RMa-AV which implies the use of same reference TR of existing communication scenarios * **Consequences if not approved:** Confusion on the reference TRs for sensing scenario UMi-AV, UMa-AV and RMa-AV.   Table 7.9.3-1: Reference TRs to generate channel for ISAC   |  |  |  |  | | --- | --- | --- | --- | | **Case** | **Tx/Rx** | **Rx/Tx** | **Reference TR to define the channel model** | | 1 | TRP | TRP | For sensing scenario UMi/UMi-AV, UMa/UMa-AV, RMa/RMa-AV, InH, InF:  - TRP-TRP link of scenario UMi, UMa, InH, and InF following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  - For InF, hUE is changed to the same height as the BS  - TRP-UE link of scenario RMa defined in Clause 7 of TR 38.901 by setting hUE=35m (see note 1)  For sensing scenario Highway  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 by setting hUE=35m for FR1(see note 1)  - TRP-TRP link of scenario UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  For sensing scenario Urban grid  - TRP-TRP link of scenario UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  For sensing scenario HST  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 by setting hUE=35m for FR1 (see note 1)  - TRP-TRP link of scenario UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858 for FR2 | | 2 | TRP | terrestrial UE | For sensing scenario UMi/UMi-AV, UMa/UMa-AV, RMa/RMa-AV, InH, InF  - TRP-UE link of scenario UMi, UMa, RMa, InH, and InF in Clause 7 of TR 38.901  For sensing scenario Highway and Urban grid  - P2B link of scenario Highway and Urban grid in Clause 6 of TR 37.885  For sensing scenario HST  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 for FR1 and TRP-UE link of scenario UMa in Clause 7 of TR 38.901 for FR2 | | 5 | terrestrial UE | terrestrial UE | For sensing scenario UMi/UMi-AV, UMa/UMa-AV, RMa/RMa-AV, InH, InF:  - UE-UE link of scenario UMi, UMa, InH, and InF following the option based on TR 38.901 defined in Clause A.3 of TR 38.858  - TRP-UE link of scenario RMa defined in Clause 7 of TR 38.901 by setting hBS =1.5m (see note 2)  For sensing scenario Highway and Urban grid  - P2P link in Clause 6 of TR 37.885  For sensing scenario HST  - TRP-UE link of scenario RMa in Clause 7 of TR 38.901 for FR1, e.g., hBS=1.5m, - UE-UE link of scenario UMa following the option based on TR 38.901 defined in Clause A.3 of TR 38.858 for FR2 | |

[Moderator’s note] UMx and UMx-AV will follow same reference TR in the table, so it would be good to group them in the description.

### [FL1][M] Proposal 4.4-3

TP #4.4-4 is agreed for TR 38.901 v19.0.0?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to adopt TP #4.4-4. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree to adopt TP #4.4-4. |

### LOS condition

TP #4.4-5 (Xiaomi)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| * **Reason for Change:** In Table 7.9.3-4 and Table 7.9.3-5 in TR 38.901, it is not crystal clear that the column “Applicability range in terms of aerial UE height” is for sensing scenarios UMi-AV, UMa-AV, and RMa-AV. * **Summary of change:** Update UMi, UMa, and RMa to UMi-AV, UMa-AV, and RMa-AV in the column “Applicability range in terms of aerial UE height” in Table 7.9.3-4 and Table 7.9.3-5. * **Consequences if not approved:** Confusion on the scenarios in the column of “Applicability range in terms of aerial UE height”.   **Table 7.9.3-4: LOS condition determination for Case 7**   |  |  | | --- | --- | | **Reference scenario to determined LOS probability** | **Applicability range in terms of aerial UE height** | | UMi in Table 7.4.2-1 in TR 38.901 for sensing scenario UMi-AV/UMa-AV/RMa-AV | Sensing scenario Umi-AV, UMa-AV:  Sensing scenario RMa-AV: | | UMi-AV in Table B-1 in TR 36.777 for sensing scenario UMi-AV/UMa-AV  RMa-AV in Table B-1 in TR 36.777 for sensing scenario RMa-AV | Sensing scenario UMi-AV, UMa-AV:  Sensing scenario RMa-AV: |   **Table 7.9.3-5: LOS condition determination for Case 9**   |  |  | | --- | --- | | **Reference scenario to determined LOS probability** | **Applicability range in terms of aerial UE height** | | UMi in Table 7.4.2-1 in TR 38.901 for sensing scenario UMi-AV/UMa-AV/RMa-AV | Sensing scenario UMi-AV, UMa-AV:  Sensing scenario RMa-AV: | | UMi-AV in Table B-1 in TR 36.777 for sensing scenario UMi-AV/UMa-AV  RMa-AV in Table B-1 in TR 36.777 for sensing scenario RMa-AV | Sensing scenario UMi-AV, UMa-AV: ,  Sensing scenario RMa-AV: , | | UMa-AV in Table B-1 in TR 36.777 for aerial UE height in range (22.5m, 100m] for sensing scenario UMi-AV/UMa-AV  RMa-AV in Table B-1 in TR 36.777 for aerial UE height in range (10m, 40m] for sensing scenario RMa-AV | Sensing scenario UMi-AV, UMa-AV:  Sensing scenario RMa-AV: 1 | | LOS probability is 100% | Sensing scenario UMi-AV, UMa-AV: ,  Sensing scenario RMa-AV: , | |

[Moderator’s note] Confusion exists in the TP whether a scenario name in the table refers to the communication scenario or the sensing scenario.

### [FL1][H] Proposal 4.4-4

TP #4.4-5 is agreed for TR 38.901 v19.0.0.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to adopt TP #4.4-5. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree to adopt TP #4.4-5. |

## Target channel

### Path power generation

TP #4.5-1 (Samsung)

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| --- |
| Proposal: Adopt the following TP to clarify the interpretation of the RCS models and to ensure the appropriate application of RCS formula/value.  7.9.4.1 Target channel  ==============================Unchanged Text Omitted ===================================  Step 10: Obtain the power for all generated paths  The power of a path () is given by  (7.9.4-1)  where, are the second and third component of RCS at the SPST *p* for a path *and* are derived by the incident angle, i.e., AOA (), ZOA () of the ray in the STX-SPST link and the scattered angle, i.e., AOD (), ZOD () of the ray in the SPST-SRX link, referring to the RCS model defined in Clause 7.9.2.1 for the SPST.  *is equal to 1 in case of first RCS model and is derived based on and in case of second RCS model in Clause 7.9.2.1.* is independently determined for each path of a SPST of the same ST and of the different STs. of a path of a SPST keeps unchanged until it is updated.  ==============================Unchanged Text Omitted =================================== |

[Moderator’s note] The relation between and is already defined in 7.9.2.1, so further clarification in 7.9.4.1 is not necessary.

|  |
| --- |
| For UAV of large size with single SPST, human with RCS model 2 with single SPST, vehicle with single/multiple SPSTs, and AGV with single/multiple SPSTs, the values/pattern, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle (). |

### [FL1][M] Proposal 4.5-1

* Please provide your views on TP #4.5-1.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | No | Agree with the Moderator’s note. |
| Samsung | Yes | We consider this supplementary information necessary, in order to provide clarity for readers who are approaching this channel modelling for the first time. |
|  |  |  |

### Reciprocity of the target channel for CPM

TP #4.5-2 (Ericsson)

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| --- |
| **Coefficient generation:**  Step 13: Draw initial random phases for paths in set *R*.  The random initial phases for each ray *m* of a cluster *n* in a STX-ST link is generated using Step 9 of Clause 7.5, i.e.,  The random initial phases for each ray *m’* of a cluster *n’* in a ST-SRX link is generated using Step 9 of Clause 7.5 by replacing subscript *n, m* with *n’, m’*, i.e., .  For monostatic sensing mode, are respectively equal to , if and .  Draw random initial phases for each path in set *R* at SPST *p* and for four different polarisation combinations (θθ, θϕ, ϕθ, ϕϕ). The distribution for initial phases is uniform within (*-π, π*). are independently determined for each path of a SPST of the same ST and of the different STs. of a path of a SPST keeps unchanged until it is updated.  Step 14: Generate channel coefficients for paths in set *R* for each receiver and transmitter element pair *u, s*.  The channel coefficient for a path in set *R* is generated by  (7.9.4-4)  with the Doppler frequency defined as  (7.9.4-5)  where,  - is the polarization matrix of the SPST *p*.  (7.9.4-6)  if paths and are in set R for mono-static sensing mode and ). |

[Moderator’s note] Two changes are proposed in the TP to strictly maintain reciprocity of target channel for monostatic sensing.

### [FL1][H] Proposal 4.5-2

* Please provide your views on TP #4.5-2.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to include TP #4.5-2. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree with the proposal. |

### Less than 2 clusters after cluster dropping

TP #4.5-3 (Huawei)

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| --- |
| Step 11: Generate channel coefficients for each cluster *n* and each receiver and transmitter element pair *u, s*.  The method described below is used at least for *drop-based evaluations* irrespective of UT speeds. Relevant cases for drop-based evaluations are:  - Case 1: For low complexity evaluations  - Case 2: To compare with earlier simulation results,  - Case 3: When none of the additional modelling components are turned on.  - Case 4: When spatial consistency and/or blockage is modeled for MU-MIMO simulations  - Other cases are not precluded  ……  *For the two strongest clusters*, if exist, say *n* = 1 and 2, rays are spread in delay to three sub-clusters (per cluster), with fixed delay offset. The delays of the sub-clusters are  (7.5-26)  where  is cluster delay spread specified in Table 7.5-6. When intra-cluster delay spread is unspecified (i.e., N/A) the value 3.91 ns is used; it is noted that this value results in the legacy behaviour with 5 and 10 ns sub-cluster delays |

[Moderator’s note] The concern comes from an extreme case, that is, after cluster dropping by checking -25dB threshold, the remaining number of clusters can be less than 2. However, this is not a new issue for ISAC in moderator understanding.

### [FL1][M] Question 4.5-3

Please provide your views on whether TP #4.5-3 is agreeable?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | No | The original text reads fine to us – however if companies prefer to have this additional wording, we are OK to take it. |
| Samsung |  | We consider that the current text is clear. The TP may also cause additional confusion as to whether the corresponding cluster in question exists or not. |
|  |  |  |

## Background channel

### Missing square of in

Two companies discuss the issue of missing square of parameter in the formula in section 7.9.4.2.

TP #4.6-1 (Huawei)

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| --- |
| **Reason for change**:   * Under Clause 7.9.4.2 for mono-static sensing mode, the arrival angle is equal to the departure angle per the RAN1 meeting agreement. When generating the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5, the step of ray coupling between the arrival angle and the departure angle per Clause 7.5 should be skipped. * There is a typo in the equation in Step 4 of Clause 7.9.4.2.   **Summary of change**:   * Add ‘Skip step 8 of Clause 7.5’ as the second bullet statement under Step 4 of Clause 7.9.4.2. * Correct the typo.   **Consequences if not approved**:   * Mono-static background channel is generated incorrectly.   --------------------------------------------------Start of text proposal #1-----------------------------------------------  7.9.4.2 Background channel  For TRP-TRP, TRP-UE, UE-TRP and UE-UE bistatic sensing modes, following Step 1 in Clause 7.9.4.0, the background channel between a pair of STX and SRX is generated using Step 2 to Step12 of Clause 7.5 with parameters derived by Table 7.9.3-3. The absolute time of arrival in clause 7.6.9 is applied. The resulting channel is denoted as .  For TRP monostatic and UE monostatic sensing modes, the background channel between a pair of STX and SRX is generated using the following steps after Step 1 in Clause 7.9.4.0.  …….  Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - Skip step 8 of Clause 7.5.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0.  ……  ---------------------------------------------------End of text proposal #1----------------------------------------------- |

TP #4.6-2 (Apple)

|  |
| --- |
| **Issue 1:** In Section 7.9.4.2, in Step 4, the background channel replaces the d3D term in the absolute time of arrival formula by . Based on the Pythagoras theorem, the term is not squared.  ***Proposal 1: Add the missing square to parameter in the term in Section 7.9.4.2 step 4 as shown:*** |

TP #4.6-3 (Samsung)

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| --- |
| Proposal: Adopt the following TP to clarify the formula in Step 4 of Clause 7.9.4.2.  ==============================Unchanged Text Omitted ===================================  Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0.  ==============================Unchanged Text Omitted =================================== |

[Moderator’s note] Since the typo is identified in the calibration process and already solved in the source codes from the companies. It is suggested to directly agree on the following proposal to reflect it in the TR 38.901.

### [FL1][H] Proposal 4.6.1

* Add the missing square in the parameter in Section 7.9.4.2 step 4, i.e.,

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposal. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree with the proposal. |

### Exact formula for Gamma distribution

Two companies discuss the issue that proper formula for Gamma distribution is not defined in TR 38.901 v19.0.0 since there are two often used formulas.

TP #4.6-4 (NIST)

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| --- |
| 7.9.4.2. Background channel <omitted text>  Step 2: Generate 3 reference points (RPs) for the STX/SRX.  Draw the 2D distance between the STX/SRX and each RP, the height of each RP respectively from Gamma distribution and defined in Table 7.9.4.2-1/2. Note that the PDF of the Gamma distribution with parameters are defined as is the Gamma function. With uniform distribution within range , draw the LOS AOD (*ϕLOS,AOD*) between the STX/SRX and the first RP. The LOS AOD is further rotated by and to respectively derive the LOS AOD from the STX/SRX to the second and third RPs. Consequently, the 3D location of each RP can be calculated.  <omitted text> |

TP #4.6-5 (ZTE, section 2.1)

|  |
| --- |
| 7.9.4.2. Background channel <omitted text>  For TRP-TRP, TRP-UE, UE-TRP and UE-UE bistatic sensing modes, following Step 1 in Clause 7.9.4.0, the background channel between a pair of STX and SRX is generated using Step 2 to Step12 of Clause 7.5 with parameters derived by Table 7.9.3-3. The absolute time of arrival in clause 7.6.9 is applied. The resulting channel is denoted as .  For TRP monostatic and UE monostatic sensing modes, the background channel between a pair of STX and SRX is generated using the following steps after Step 1 in Clause 7.9.4.0.  Step 2: Generate 3 reference points (RPs) for the STX/SRX.  Draw the 2D distance between the STX/SRX and each RP, the height of each RP respectively from Gamma distribution and defined in Table 7.9.4.2-1/2. using the shape-rate parameterized Gamma distribution with offset . With uniform distribution within range , draw the LOS AOD (*ϕLOS,AOD*) between the STX/SRX and the first RP. The LOS AOD is further rotated by and to respectively derive the LOS AOD from the STX/SRX to the second and third RPs. Consequently, the 3D location of each RP can be calculated.  <omitted text> |

TP #4.6-6 (OPPO)

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| --- |
| 7.9.4.2 Background channel  **< Unchanged text omitted >**  Step 2: Generate 3 reference points (RPs) for the STX/SRX.  Draw the 2D distance between the STX/SRX and each RP, the height of each RP respectively from Gamma distribution and , where <,,> and <,,> are defined in Table 7.9.4.2-1/2, and the Gamma distribution has its probability density function given by for and .. With uniform distribution within range , draw the LOS AOD (*ϕLOS,AOD*) between the STX/SRX and the first RP. The LOS AOD is further rotated by and to respectively derive the LOS AOD from the STX/SRX to the second and third RPs. Consequently, the 3D location of each RP can be calculated.  **< Unchanged text omitted >** |

[Moderator’s note] Clarification on the exact definition of Gamma distribution which helps to avoid any confusions.

### [FL1][H] Question 4.6.2

Please indicate your preference on the TP #4.6-4/5/6, or any suggestion for revisions.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung | Yes | Both TPs are fine |
| CATT, CICTCI | Yes | Both TPs are fine. |
|  |  |  |

### Rays coupling for mono-static

TP #4.6-7 (QC)

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| --- | --- | --- | --- |
| With regards to the monostatic background channel,   * in the step 4 presented below, we observe that step 7 is updated to ensure that AOD and AoA for a given ray (n,m) are equal:  |  | | --- | | Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0. |   However, in step 8, there is random coupling between the AoD and the AoA angles within a cluster as shown below. However, such a step appears to be nulling the change in step 7, since after the random coupling is performed, the AoD and the AoA of a given ray will not be the same any more.   |  | | --- | | Step 8: Coupling of rays within a cluster for both azimuth and elevation  Couple randomly AOD angles *φn,m,AOD* to AOA angles *φn,m,AOA* within a cluster *n*, or within a sub-cluster in the case of two strongest clusters (see Step 11 and Table 7.5-3). Couple randomly ZOD angles  with ZOA angles using the same procedure. Couple randomly AOD angles *φn,m,AOD* with ZOD angles within a cluster *n* or within a sub-cluster in the case of two strongest clusters. |   **Proposal 1: In step 4 of the monostatic background channel, add that step 8 is not expected to be performed, and support the following TP:**   |  | | --- | | Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - Step 8 of Clause 7.5 is not applicable.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0. | |

TP #4.6-8 (CATT,CICTCI)

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| --- |
| **Proposal 1: Add a new note to ensure that the step 8 of Clause 7.5 in TR 38.901 will not be executed for background channel for TRP monostatic and UE monostatic sensing mode.**  The corresponding TP for Proposal 1 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.9.4.2 Background channel  <Unrelated part omitted>  Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  Note 1: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0.  Note 2: For TRP monostatic and UE monostatic sensing modes, Step 8 of Clause 7.5 is not performed.  <Unrelated part omitted>  --------------------------------------- End of TP to TR 38.901 --------------------------------------- |

TP #4.6-9 (ZTE)

|  |
| --- |
| Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - Step 8 of Clause 7.5 is skipped to avoid randomly coupling arrival angles and departure angles. |

TP #4.6-10 (Huawei)

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| --- |
| **Reason for change**:   * Under Clause 7.9.4.2 for mono-static sensing mode, the arrival angle is equal to the departure angle per the RAN1 meeting agreement. When generating the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5, the step of ray coupling between the arrival angle and the departure angle per Clause 7.5 should be skipped. * There is a typo in the equation in Step 4 of Clause 7.9.4.2.   **Summary of change**:   * Add ‘Skip step 8 of Clause 7.5’ as the second bullet statement under Step 4 of Clause 7.9.4.2. * Correct the typo.   **Consequences if not approved**:   * Mono-static background channel is generated incorrectly.   --------------------------------------------------Start of text proposal #1-----------------------------------------------  7.9.4.2 Background channel  For TRP-TRP, TRP-UE, UE-TRP and UE-UE bistatic sensing modes, following Step 1 in Clause 7.9.4.0, the background channel between a pair of STX and SRX is generated using Step 2 to Step12 of Clause 7.5 with parameters derived by Table 7.9.3-3. The absolute time of arrival in clause 7.6.9 is applied. The resulting channel is denoted as .  For TRP monostatic and UE monostatic sensing modes, the background channel between a pair of STX and SRX is generated using the following steps after Step 1 in Clause 7.9.4.0.  …….  Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - Skip step 8 of Clause 7.5.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0.  ……  ---------------------------------------------------End of text proposal #1----------------------------------------------- |

[Moderator’s note] As commented by QC, the intention for aligning AOD and AoA of a path is to model reciprocity, but it is destroyed by random coupling in Step 8. The generated Doppler frequency is not twice of the value that is determined by STX/SRX velocity and a path direction too.

The issue on skipping Step 8 was discussed during the calibration process, and is already implemented in the source codes. Therefore it is suggested to agree on it.

### [FL1][H] Question 4.6.3

* Please indicate which TP #4.6-7/8/9/10 is preferred?

|  |  |  |
| --- | --- | --- |
| **Company** | **TP ?** | **Comments** |
| Samsung |  | Before deciding the TP, we would like to clarify the meaning of coupling to avoid confusion between angle generation and coupling.  From our perspective, both random coupling or deterministic coupling is not critical. But RAN1 should be precise: in the agreements, the only consensus was that for monostatic background channels, the arrival angle generations reuse the generated departure angle. That is different from the coupling procedure. The random coupling step was originally introduced to capture the fine variations of rays within a cluster, not just to enforce specific angles. In this context, it seems need to present a clearer motivation and technical justification. |
| CATT, CICTCI |  | The approaches proposed by the above companies for Step 8 of Clause 7.5 are similar. Therefore, TP #4.6-7/8/9/10 is acceptable to us. |
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### Outdoor RPs issue

TP #4.6-11 (QC)

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| --- | --- | --- |
| In step 3, or any other step, of the monostatic background channel generation, it is not clear that the RPs should be outdoor UEs for outdoor scenarios (e.g. UMa, UMi), whereas for indoor scenarios (e.g. InH) the RPs should indoor UEs.   |  | | --- | | Step 3: Assign NLOS propagation condition to the channel between the STX/SRX and each of the 3 RPs. |   **Proposal 2: In step 3 of the monostatic background channel, clarify that the propagation condition of an RP should be outdoor (indoor) for outdoor (indoor) scenarios:**   |  | | --- | | Step 3: Assign NLOS propagation condition to the channel between the STX/SRX and each of the 3 RPs. Note: O2I is not applicable. | |

[Moderator] Sounds good to clarify this modelling detail?

### [FL1][M] Proposal 4.6-4

* TP #4.6-11 is agreed for TR 38.901 v19.0.0

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to include TP #4.6-11. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Agree to include TP #4.6-11. |

### Absolute delay model

TP #4.6-12 (vivo)

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| --- |
| 1. **The d3D in the step4 of mono-static background channel generation should be modified to d3D/c.**   The related text proposal is provided as following:  **----------------------------------------Start of Draft TP of TR 38.901 --------------------------------**  **7.9.4.2 Background channel**  Step 4: Generate the channel between the STX/SRX and each of the 3 RPs using Step 3 to Step12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80 and 90 degrees respectively for scenario UMi, UMa and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - The absolute time of arrival in clause 7.6.9 is applied with d3D/c replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  **---------------------------------------------- End of Draft TP --------------------------------------------** |

TP #4.6-13 (ZTE)

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| --- |
| - The absolute time of arrival in clause 7.6.9 is applied with replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs. |

[Moderator’s note] the two TPs are same and correct.

### [FL1][H] Proposal 4.6-5

* TP #4.6-12 and #4.6-13 are agreed for TR 38.901 v19.0.0

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to adopt TP #4.6-12 and TP #4.6-13. |
| Samsung | Yes |  |
| CATT, CICTCI | Yes | Both TPs are fine. |

## Additional model

### Polarization matrix in EO modelling

TP #4.7-1 (Vivo)

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| --- |
| 1. **The effective polarization matrix of the type-2 EO reflection ray is given by**   **where**  **and**  **.**    The related text proposal is provided as following:  **----------------------------------------Start of Draft TP of TR 38.901 --------------------------------**  **7.9.5.2 Type-2 environment object**  The ZoA and AoA from Rx to the reflection point are derived based on the location of Rx and reflection point.  (7.9.5-8)  (7.9.5-9)  **<Unchanged parts omitted>**  The effective polarization matrix of the type-2 EO reflection ray is given by  (7.9.5-10)  where,  - . represents the normal vector of the incident plane. , in which and . represents the spherical basis vector of incident ray in vertical direction. represents the spherical basis vector of incident ray in horizontal direction. .  - . represents the polar basis vector of scattering ray in vertical direction. represents the spherical basis vector of scattering ray in horizontal direction. . .  **---------------------------------------------- End of Draft TP --------------------------------------------** |

TP #4.7-2 (ZTE)

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| --- | --- | --- |
| **Proposal 2:**  One of the following two options can be endorsed for Type-2 environment object in TR 38.901:  **Option 1**: Modify the following procedure of the Type-2 environment object of section 7.9.5.2 for sensing in TR 38.901.   * Change the as  |  | | --- | | <Option 1 of Start of Changes> 7.9.5.2. Type-2 environment object <omitted text>  The effective polarization matrix of the type-2 EO reflection ray is given by  (7.9.5-10)  where,  - . represents the normal vector of the incident plane. , in which and . represents the spherical basis vector of incident ray in vertical direction. represents the spherical basis vector of incident ray in horizontal direction. .  - . represents the polar basis vector of scattering ray in vertical direction. represents the spherical basis vector of scattering ray in horizontal direction. . .  <Option 1 of End of Changes> |   **Option 2**: Modify the following procedures of the Type-2 environment object of section 7.9.5.2 for sensing in TR 38.901.   * Change the as * Change the as * Change the  as  |  | | --- | | <Option 2 of Start of Changes> 7.9.5.2. Type-2 environment object <omitted text>  The effective polarization matrix of the type-2 EO reflection ray is given by  (7.9.5-10)  where,  - . represents the normal vector of the incident plane. , in which and . represents the spherical basis vector of incident ray in vertical direction. represents the spherical basis vector of incident ray in horizontal direction. .  - . represents the polar basis vector of scattering ray in vertical direction. represents the spherical basis vector of scattering ray in horizontal direction. . .  <Option 2 of End of Changes> | |

[Moderator’s note] vivo’s TP is same as the Option 2 TP from ZTE. For simplicity, it is suggested to take this common view as way forward.

### [FL1][H] Proposal 4.7-1

* TP #4.7-1 is agreed for TR 38.901 v19.0.0

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposal. |
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### Low power cluster

TP #4.7-3 (Ericsson)

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| --- |
| 1. In Eq. 7.9.5-15 add the radical sign √ to and change to . 2. Clarify that a set of low-power clusters are generated between sensing Tx and each of all reference points for mono-static sensing mode. 3. Add the agreement to 38.901 on utilizing the same , as used for the first step to generate low-power clusters. 4. Clarify in TR that low-power clusters are generated with NLOS condition. 5. DS, ASA, ASD, ZSA, and ZSD of low-power clusters should be generated assuming NLOS condition according to Table 7.5-6, even if the first set of NLOS clusters are generated with LOS condition. 6. For mono-static sensing, use the same positions of reference points to generate legacy NLOS clusters and the new low-power clusters.   <Start of Changes> 7.9.5.5 Lower power clusters In addition to the clusters/rays in background channel generated in Clause 7.9.4.2, more clusters/rays can be generated between a sensing Tx and a sensing Rx for bi-static sensing or between a sensing Tx and a reference point r, where r=0, 1, 2 for mono-static sensing to simulate the weak rays in the background channel. The following procedure is applicable for bistatic sensing or for monostatic sensing.  Step 1: Generate a first background channel for bi-static sensing and for referenc point r for mono-static sensing according to Clause 7.9.4.2.  Step 2: Generate a second background channel for bi-static sensing and for reference point *r* for mono-static sensing according to Clause 7.9.4.2 including utilizing the same , and the same position of reference point r, if applicable, with the following revised parameters: 1) The number of clusters (N in Clause 7.5) is increased to 360; 2) The number of ray per cluster (M in Clause 7.5) is reduced to 1; 3) If LOS condition is assumed in Step 1, use NLOS condition to generate DS, ASA, ASD, ZSA, and ZSD values.  Step 3: The power of the clusters/rays in the second background channel is scaled down by , and is added to the first background channel, where, dB,  is the maximum power of the NLOS clusters in the first background channel for bi-static sensing and  is the maximum power of the NLOS clusters for reference point *r* in the first background channel. The final background channel is 7.9.5-15a for bi-static sensing mode and 7.9.5-15b for mono-static sensing.  (7.9.5-15a)  (7.9.5-15b)  <End of Changes> |

[Moderator’s note] Companies are encouraged to check the proposals/TPs from Ericsson.

### [FL1][H] Proposal 4.7-2

* Please provide your views on TP 4.7-3.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
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## Calibration

### STX/SRX selection

TP #4.8-1 (CATT,CICTCI)

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| --- | --- |
| **Proposal 2: Clarify the number of STX-SRX pairs to be selected for Highway FR1 scenario during large scale calibration in TR 38.901.**  The corresponding TP for Proposal 2 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.9.6.1 Large scale calibration  <Unrelated part omitted>  Table 7.9.6.1-3. Simulation assumptions for large scale calibration for Automotive sensing targets   |  | | --- | | NOTE 1: A single UT type is used per calibration, e.g., pedestrian type UT, RSU type UT, or vehicle type UT in TR37.885  NOTE 2: A vehicle with size L\*W\*H can be dropped with 5 scattering points (front/left/right/back/roof), respectively with locations (L/2,0,H/2), (0,W/2,H/2), (0,-W/2,H/2), (-L/2,0,H/2) and (0,0,H) in LCS. A vehicle with size L\*W\*H can be dropped with 1 scattering point with location (0,0,H/2) in LCS. In the case of vehicle with 5 scattering points, spatial consistency is enabled with the following assumptions:  - The correlation for LOS/NLOS condition of the 5 points is assumed equal to 1. LOS/NLOS condition can be calculated based on the distance of the STX/SRX to the centroid of the ST, then apply the LOS/NLOS condition to each of the 5 points.  - The correlation for stochastic cluster paths of the 5 points is assumed equal to 1. The stochastic cluster paths can be calculated between the STX/SRX and the centroid of the ST, then the stochastic cluster paths are added to each of the 5 points.  NOTE 3: For STX/SRX selection in Highway FR1 scenario, best N = 2 STX-SRX pairs to be selected for the target. |   <Unrelated part omitted>  --------------------------------------- End of TP for TR 38.901--------------------------------------- |

TP #4.8-2 (QC)

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| --- | --- | --- |
| **Proposal 3: The value for best sensing Tx-Rx pairs to be selected for the target should be set to**   * **N=2 for TRP-TRP monostatic** * **N=1 for TRP-TRP bistatic**   **Add in the Table 7.9.6.3-1 the following row:**   |  |  | | --- | --- | | STX/SRX selection | Best N = 4 STX-SRX pairs to be selected for the target, with the following exceptions for FR1:   * For TRP-TRP monostatic sensing, N=2 * For TRP-TRP bistatic sensing, N=1 | |

[Moderator’s note] This is true that, when full set of TRP are less than 4, it is impossible to select N=4 best pairs. On the other hand, the companies should already account such practical limitation in the source codes.

### [FL1][M] Proposal 4.8-1

* Whether the issue should be fixed? If yes, which TP from TP #4.8-1 and #4.8-2 is preferred, or any updates?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to fix the issue by adopting TP# 4.8-2. |
| Samsung | Yes | Both TPs are fine |
| CATT, CICTCI | Yes | Both TPs are fine. |

### Min-3D distance

TP #4.8-3 (CATT,CICTCI)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Proposal 4: Clearly specify the minimum 3D distances between pairs of STX/SRX and sensing target in Table 7.9.1-3 and Table 7.9.6.1-2 for human (indoor and outdoor) sensing scenarios of TR 38.901.**  The corresponding TP for Proposal 4 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.9.6 calibration   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Table 7.9.6.1-2. Simulation assumptions for large scale calibration for Human sensing targets**   |  |  |  | | --- | --- | --- | | **Parameters** | **Indoor Values** | **Outdoor Values** | | Minimum 3D distances between pairs of STX/SRX and sensing target | For TRP monostatic and TRP-TRP bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 0 m (as specified in TR 38.859)  For UE monostatic and UE-UE bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 1 m (as specified in TR 38.901) | For TRP monostatic and TRP-TRP bistatic sensing modes, the minimum 2D distances between STX/SRX pairs and the sensing target are 10 m for UMi scenarios and 35 m for UMa scenarios ( as specified in TR 38.901)  For UE monostatic and UE-UE bistatic sensing modes, the minimum 2D distance between STX/SRX pairs and the sensing target is 1 m (as specified in TR 38.901) |   <Unrelated part omitted>  --------------------------------------- End of TP for TR 38.901 --------------------------------------- | |

TP #4.8-4 (Xiaomi)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Table 7.9.6.1-2. Simulation assumptions for large scale calibration for Human sensing targets**   |  |  |  | | --- | --- | --- | | **Parameters** | **Indoor Values** | **Outdoor Values** | | Minimum 3D distances between pairs of STX/SRX and sensing target | Min distances defined in TR 38.901 | | |

[Moderator’s note] This is the same issue in section 4.2.1, but for different tables (scenario vs. calibration)

### [FL1][M] Question 4.8-2

Please provide your views on whether TP #4.8-3 and/or #4.-4 is agreeable?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to include TP#4.8-3. |
| Samsung | Yes | Prefer to TP #4.8-3 |
| CATT, CICTCI | Yes | Agree to include TP#4.8-3. |

### Coupling loss

TP #4.8-5 (Ericsson)

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| --- |
| Proposal: Companies to submit coupling loss results without adding a minus sign for calibration or change the calibration metric from coupling loss to coupling gain. |

TP #4.8-6 (Apple)

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| --- | --- | --- |
| Issue 3: In Section 7.9.6.1 and Table 7.9.6.1-1, a formula for the coupling loss is as shown below:   |  |  | | --- | --- | | Coupling loss for target channel | power scaling factor (pathloss, shadow fading, and RCS component A included): |   This results in a positive value. However, the values reported for calibration are negative as shown in the figure below. There should be a NOTE to capture this in the TR.  A graph with a line  AI-generated content may be incorrect.  ***Proposal 3: Add a note in the CR to indicate the coupling losses calculated from the formulas in Section 7.9.6.1 should be negative***. |

[Moderator’s note] Coupling loss is simulated as negative values since long time ago. The issue proposed by Ericsson exists but hopefully it doesn’t cause real confusion in simulations.

### [FL1][M] Question 4.8-3

Please provide your views on whether the issue of negative coupling loss should be resolved or not?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | We are in favor of resolving this to avoid confusion, but this should be done in an efficient way. A clarification note in the CR can be added. |
| CATT, CICTCI | Yes | Agree to include TP #4.8-6. |

### UT distribution for vehicle UE

TP #4.8-7 (QC)

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| --- | --- | --- |
| **Proposal 4: Both sensing target and UT distributions for vehicle type 2 should follow TS37.885:**   |  |  | | --- | --- | | UT Distribution | For Highway:  - Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR37.885.  - RSU-type UTs are uniformly allocated with 100m spacing in the middle of the freeway as per TR37.885.  For Urban grid:  - Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR37.885.  - Pedestrian type UT, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR37.885  - Total number of pedestrian UEs is 16 in the centre grid.  - Pedestrian UE is in the middle of the sidewalk  - The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘36.344’.  - N=1;  - RSU-type UT: the dropping is at the center of intersection per TR37.885.  see note 1 | |

[Moderator’s note] In TS36.885, it doesn’t include any minimum inter-vehicle distance. In TS 37.885, it is defined as 2m between rear bumper and front bumper of two vehicles. With current TR, the vehicles as sensing Tx/Rx may overlap in extreme case.

### [FL1][M] Question 4.8-4

Please provide your views on whether TP #4.2-3 is agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to include TP #4.2-3. |
|  |  |  |
|  |  |  |

### Duplicated Table 7.8-7

TP # 4.8-8 (CATT,CICTCI)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Proposal 3: Resolve the table numbering ambiguity in TR 38.901 by renumbering the second instance of Table 7.8-7 to Table 7.8-10 and updating all corresponding references within the document.**  The corresponding TP for Proposal 3 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  7.8.4 Calibration of the indoor factory scenario  <Unrelated part omitted>  For the InF, the calibration parameters can be found in Table 7.8-10. The calibration results can be found in R1-1909704.  It should be noted absolute delay model had not been agreed by the deadline, so companies were not able to submit CDF of first path excess delay for serving cell.  Table 7.8-10: Simulation assumptions for large scale calibration for the indoor factory scenario   |  |  | | --- | --- | | Parameter | Values | | Scenario | InF-SL, InF-DL, InF-SH, InF-DH |   Table 7.9.1-4: Evaluation parameters for AGV sensing scenarios   |  |  | | --- | --- | | **Parameters** | **Value** | | Applicable communication scenarios | InF (Table 7.8-10) |   Table 7.9.6.1-4. Simulation assumptions for large scale calibration for AGV sensing targets   |  |  | | --- | --- | | **Parameters** | **Values** | | Scenario | InF: 18 TRPs per the big hall: L = 300 m x W = 150 m  A diagram of a diagram  AI-generated content may be incorrect.  - X-axis is pointing down to the floor  - The antenna array is mounted in the Y-Z plane with boresight along the X-axis  - The X-axis/Y-axis/Z-axis refer to LCS  - 8 m for high BS scenario | | Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic | | Target type | Option 1: 0.5m x 1.0m x 0.5m | | BS Tx power | FR1: 24dBm  FR2: 23dBm | | UT height | 1.5m | | UT Distribution | Per Table 7.8-10 Indoor Factory.  Number of UTs: 30 | | Sensing target distribution | 100% indoor, 1 target uniformly distributed (across multiple drops) over the convex hull of the TRP deployment | | Component A of the RCS for each scattering point | -4.25 dBsm  see note | | NOTE: For calibration purposes, other value(s) are not precluded, | |   <Unrelated part omitted>  --------------------------------------- End of TP for TR 38.901 --------------------------------------- |

[Moderator’s note] One concern is changing title for Table 7.8-7 seems out of scope of ISAC, any views?

### [FL1][H] Question 4.8-5

Please provide your views on whether TP #4.8-8 is agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| CATT |  | We are open to addressing the issue of the Duplicated Table 7.8-7 under either 7-24 or the ISAC agenda item. |
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### Tdoc number for calibration results

TP # 4.8-9 (AT&T, Xiaomi)

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| --- |
| Reason for Change: In RAN #102, the study item for channel modelling for ISAC was agreed. The output of the study item was approved and incorporated into TR 38.901 in RP-251567. This CR captured a tdoc reference for the initial channel modelling calibrations for ISAC. However, some aspects of the channel model were not fully complete and some of the simulation assumptions were not fully defined until the end of RAN1#121. This led to some ambiguity in the results and the need for companies to update simulation results for ISAC channel model calibrations in [Post-121-ISAC-02] email discussion.  Summary of change: The tdoc reference to the channel model calibrations for ISAC is updated for large scale calibration, full calibration, and calibration results for additional features.  Consequences if not approved: The existing references in TR 38.901 for channel model calibration results would point to the initial results that were based on an incomplete and/or revised ISAC channel model and assumptions. ------------Start of 38.901 Text Proposal---------------------------7.9.6 Channel model calibration7.9.6.1 Large scale calibration For the purposes of large scale calibration without fast fading modelling for sensing targets UAV, human, automotive and AGV, the following calibration parameters are respectively provided in Table 7.9.6.1-1/2/3/4. Unspecified parameters in Table 7.9.6.1-2/3/4 are the same as those in Table 7.9.6.1-1. The calibration results based on TR 38.901 V19.0.0 can be found in R1-250xxxx.  … 7.9.6.2 Full calibration For the purpose of full calibration including the fast fading modelling for sensing scenarios UAV, human, automotive and AGV, the calibration parameters are respectively provided in Table 7.9.6.2-1/2/3/4. Unspecified parameters in the tables are the same as those in Table 7.9.6.1-1/2/3/4 for the same sensing target. If still not specified, the parameters in Table 7.9.6.2-1 are used. The calibration results based on TR 38.900 V19.0.0 can be found in R1-250xxxx.  … 7.9.6.3 Calibration of additional features The calibration parameters for the calibration of spatial consistency and type-2 EO can be respectively found in Table 7.9.6.3-1/2. Unspecified parameters in these tables are the same as those in Tables 7.9.6.1-2/3 and Tables 7.9.6.2-2/3. The calibration results based on TR 38.900 V19.0.0 can be found in R1-250xxxx. ------------End of 38.901 Text Proposal--------------------------- |

[Moderator’s note] The TP is generally necessary, with correct tdoc number included.

### [FL1][H] Proposal 4.8-6

TP #4.8-9 is agreed for TR 38.901 v19.0.0 with agreed tdoc number for calibration results?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposal. |
| CATT, CICTCI | Yes | Agree with the proposal. |
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## Typos

### Typos

TP #4.9-1 (OPPO)

TP-1 for Clause 7.9.4.1 of TR38.901 v19.0.0

|  |
| --- |
| 7.9.4.1 Target channel  **< Unchanged text omitted >**  Step 14: Generate channel coefficients for paths in set *R* for each receiver and transmitter element pair *u, s*.  The channel coefficient for a path in set *R* is generated by  (7.9.4-4)  with the Doppler frequency defined as  (7.9.4-5)  where,  - is the polarization matrix of the SPST *p*.  (7.9.4-6)  - is the polarization matrix of the ray in the STX-SPST link.  - for the LOS ray, if present,  - for NLOS ray generated by stochastic cluster,  (7.9.4-7)  - is the polarization matrix of the ray in the SPST-SRX link.  - for the LOS ray, if present,  - for NLOS ray generated by stochastic cluster,  (7.9.4-8)  - are the two elements in the main diagonal of combined matrix  - is the spherical unit vector at receiver for the link from SRX to SPST *p* of ST *k*, given by  (7.9.4-9)  - is the spherical unit vector at transmitter for the link from STX to SPST *p* of ST *k*, given by  (7.9.4-10)  - is the spherical unit vector at the scattering point for the link from SPST *p* of ST *k* to SRX, given by  (7.9.4-11)  - is the spherical unit vector at the scattering point for the link from SPST *p* of ST *k* to STX, given by  (7.9.4-12)  - are respectively the velocity of SRX, STX.  - *~~𝑣𝑘~~*~~,~~*~~𝑝𝑡~~* is the velocity of SPST *p* of ST *k*, *~~𝑣𝑘~~*~~,~~*~~𝑝𝑡~~*~~=~~*~~𝑣𝑚𝑎~~*~~,~~*~~𝑘𝑡~~*~~+~~*~~𝑣𝑚𝑖~~*~~,~~ *~~𝑘~~*~~,~~ *~~𝑝𝑡~~*, where *~~𝑣𝑚𝑎~~*~~,~~*~~𝑘𝑡~~* is the velocity of the ST k, *~~𝑣𝑚𝑖~~*~~,~~ *~~𝑘~~*~~,~~ *~~𝑝𝑡~~* is velocity due to micro motion of SPST p of ST k.  - denotes a reference point in time that defines the initial phase, e.g., .  The channel impulse response of SPST *p* of ST *k* is given by  (7.9.4-13)  **< Unchanged text omitted >** |

TP #4.9-2 (Xiaomi)

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| Section 7.9.4.1 in TR 38.901  - is the velocity of SPST *p* of ST *k*, *𝑣*, where is the velocity of the ST k, is velocity due to micro motion of SPST p of ST k. |

TP #4.9-3 (CATT, CICTCI)

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| **Reason for change:**  The expressions of velocity of SPST *p* of ST *k*, velocity of the ST k, and velocity due to micro motion of SPST p of ST k are not aligned with Formula 7.9.4-5.  **Summary of change:**  Update the expressions of the corresponding velocities in the description sentence below the Formula 7.9.4-12.  **Consequences if not approved:**  The expressions of velocities are not matched with corresponding Formula 7.9.4-5.  **Proposal 7: Update the expressions of the corresponding velocities in the description sentence below the Formula 7.9.4-12 to resolve the typo.**  The corresponding TP for Proposal 7 is as follows:  --------------------------------------- Start of TP for TR 38.901 ---------------------------------------  **7.9.4.1 Target channel**  <Unrelated part omitted>  - is the spherical unit vector at the scattering point for the link from SPST *p* of ST *k* to STX, given by  (7.9.4-12)  - are respectively the velocity of SRX, STX.  - is the velocity of SPST *p* of ST *k*, =+ where is the velocity of the ST k, is velocity due to micro motion of SPST p of ST k.  <Unrelated part omitted>  --------------------------------------- End of TP for TR 38.901 --------------------------------------- |

[Moderator’s note] TP #4.9-1 is super set of TP #4.9-2/3, so RAN1 can focus on TP #4.9-1 for discussion.

### [FL1][H] Proposal 4.9-1

* TP #4.9-1 is agreed for TR 38.901 v19.0.0

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| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree with the proposal. |
| CATT, CICTCI | Yes | Agree with the proposal. |
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### Typos

TP #4.9-4 (Xiaomi)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Sections 7.9.1 in TR 38.901  **Table 7.9.1-2: Evaluation parameters for Automotive sensing scenarios**   |  |  |  | | --- | --- | --- | | **Parameters** | | **Values** | | Applicable communication scenarios | | Highway, Urban Grid.  UMi, UMa, RMa, SMa | | Sensing transmitters and receivers properties | | STX/SRX locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenario.  Additional option: ISD between TRPs of Urban Grid is 250m | | Sensing target | LOS/NLOS | LOS and NLOS (including NLOSv) | | Outdoor/indoor | Outdoor | | Mobility (horizontal plane only) | Based on TR37.885 mobility for urban grid or highway scenario | | Distribution (horizontal) | Based on dropping in TR37.885 per urban grid or highway communication scenario | | Orientation | Lane direction in horizontal plane | | Physical characteristics (e.g., size) | Type 1/2 (passenger vehicle)  Type 3 (truck/bus)  Vehicle type distribution per TR 37.885 | | Minimum 3D distances between pairs of STX/SRX and sensing target | | For Highway, Urban Grid  - Min distances based on min TRP/UE distances defined in TR37.885  For UMi, UMa, RMa, SMa  - Min distances based on min TRP/UE distances defined in TR38.901 | | Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 10 m. | | Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | | Type-2 EO for Urban Grid  - up to 4 walls modelled as Type-2 EO, per building of size 413m x 230m x 20m. |   Table 7.9.1-3: Evaluation parameters for Human (indoor and outdoor) sensing scenarios   |  |  |  |  | | --- | --- | --- | --- | | **Parameters** | | **Indoor Values** | **Outdoor Values** | | Applicable communication scenarios | | Indoor office, indoor factory  Indoor room [TR38.808] | UMi, UMa, RMa, SMa | | Sensing transmitters and receivers properties | STX/SRX Locations | STX/SRX locations are selected among the TRPs and UE locations in the corresponding communication scenario | STX/SRX locations are selected among the TRPs and UE locations in the corresponding communication scenario | | STX/SRX Mobility for UEs | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/h | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/h | | Sensing target | LOS/NLOS | LOS and NLOS | LOS and NLOS | | Outdoor/indoor | Indoor | Outdoor | | 3D mobility | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/h  (horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/h  (horizontal plane with random direction straight-line trajectory) | | 3D distribution | *N* targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment  see note 1 | Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.  see note 1 | | Orientation | Random over the horizontal area | Random over the horizontal area | | Physical characteristics (e.g., size) | Size (Length x Width x Height):  Child: 0.2m x 0.3m x 1m  Adult Pedestrian: 0.5m x 0.5m x 1.75m | Size (Length x Width x Height):  Child: 0.2m x 0.3m x 1m  Adult Pedestrian: 0.5m x 0.5m x 1.75m | | Minimum 3D distances between pairs of STX/SRX and sensing target | | Min distances defined in TR 38.901 | Min distances defined in TR 38.901 | | Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1m | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1m | | NOTE 1: N=0 may be considered for the evaluation of false alarm | | | |   Section 7.9.2.1 in TR 38.901  A first RCS model is to characterize a ST as single SPST with component of the monostatic RCS values fixed to 1. is the mean of linear monostatic RCS values at the SPST. For UAV of small size and human with RCS model 1, the values/pattern, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  (7.9.2-2)  where,  - . is the angle between the incident ray and scattering ray within the plane defined by incident angle () and scattering angle ().  With defined by,      where,  - () are zenith angle and azimuth angle of the bisector the incidence and scattered rays, whose zenith angles and azimuths are () and ().  - . is the angle between the incident ray and scattering ray within the plane defined by incident angle () and scattering angle ().  Section 7.9.4.0 in TR 38.901  Step 1: Set environment, network layout, and antenna array parameters  a) Choose one of the sensing scenarios (ISAC-UAV, ISAC-Automotive, ISAC-Human, ISAC-AGV, ISAC-Objects creating hazards on roads/railways) and related communication scenarios (e.g. UMa, UMi-Street Canyon, RMa, InH-Office, Urban grid, Highway, or InF). Choose a global coordinate system and define zenith angle *θ*, azimuth angle *ϕ*, and spherical basis vectors , as shown in Figure 7.5-2.  Section 7.9.6.1 in TR 38.901  **Table 7.9.6.1-3. Simulation assumptions for large scale calibration for Automotive sensing targets**   |  |  | | --- | --- | | **Parameters** | **Values** | | UT Distribution | For Highway:  - Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885.  - RSU-type UTs are uniformly allocated with 100m spacing in the middle of the freeway as per TR36.885.  For Urban grid:  - Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885.  - Pedestrian type UT, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR36.885  - Total number of pedestrian UEs is 16 in the centre grid.  - Pedestrian UE is in the middle of the sidewalk  - The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘1132.75’.  - N=1;  - RSU-type UT: the dropping is at the center of intersection per TR36.885.  see note 1 | | …. | …. | | NOTE 1: A single UT type is used per calibration, e.g., pedestrian type UT, RSU type UT, or vehicle type UT Per TR37.885  NOTE 2: A vehicle with size L\*W\*H can be dropped with 5 scattering points (front/left/right/back/roof), respectively with locations (L/2,0,H/2), (0,W/2,H/2), (0,-W/2,H/2), (-L/2,0,H/2) and (0,0,H) in LCS. A vehicle with size L\*W\*H can be dropped with 1 scattering point with location (0,0,H/2) in LCS. In the case of vehicle with 5 scattering points, spatial consistency is enabled with the following assumptions:  - The correlation for LOS/NLOS condition of the 5 points is assumed equal to 1. LOS/NLOS condition can be calculated based on the distance of the STX/SRX to the centroid of the ST, then apply the LOS/NLOS condition to each of the 5 points.  - The correlation for stochastic cluster paths of the 5 points is assumed equal to 1. The stochastic cluster paths can be calculated between the STX/SRX and the centroid of the ST, then the stochastic cluster paths are added to each of the 5 points. | |   Section 7.9.6.2 in TR 38.901  **Table 7.9.6.3-2: Simulation assumptions for calibration of type-2 EO**   |  |  | | --- | --- | | UT distribution | - For pedestrian UT  - Pedestrian type UE, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR36.885.  - Total number of pedestrian UEs is 16 in the centre grid.  - Pedestrian UE is in the middle of the sidewalk  - The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘1132.75’.  - N=1;  - For RSU type UT  - The dropping is at the center of intersection per TR36.885. | |

[Moderator’s note] Revisions in TP 4.9-4 can be considered as errors correction to TR 38.901.

### [FL1][H] Question 4.9-2

Please provide your views on whether TP #4.9-4 is agreeable?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| IDCC | Yes | Agree to adopt TP #4.9-4. |
| CATT, CICTCI | Yes | Agree to adopt TP #4.9-4. |
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### Typos

TP #4.9-5 (QC)

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| ------------------------------------------------------------- START OF TEXT PROPOSAL--------------------------------------------  7.9.0 Introduction  The channel model for ISAC in Clause 7.9 is designed based on the channel model defined in the previous clauses within Clause 7 taking into account the known properties, e.g., location, Radar Cross-Section (RCS), polarization and etc. of one or more physical objects. A physical object is categorized as a sensing target (ST) or an environment object (EO). A ST is an object of interest for sensing. An EO is a non-target object with known location. Two types of EO are supported in the ISAC channel model. A first type of EO (type-1 EO) has similar characteristic as a ST and is modelled in the same way as a ST. In the following descriptions in Clause 7.9, only the related details on ST are described, which are also applicable to type-1 EO. A second type of EO (type-2 EO) is of large size and is modelled differently from a ST, as described in detail in Clause 7.9.5.2.  The large scale and small scale parameters of the channel between any two of sensing transmitter (STX), ST and sensing receiver (SRX) in a sensing scenario are obtained from the Technical Reports for the same communication scenario unless updates on the parameter values are specially described. The ST is considered as a receiver or transmitter, respectively, in the determination of a proper channel model for a STX-ST link or a ST-SRX link.  The common framework for the ISAC channel between a pair of STX and SRX is composed of a component for one or multiple target channel(s) and a component for a background channel (described in Clause 7.9.4.3 and 7.9.5.3). One or multiple STs can be modelled in the channel between one pair of STX and SRX. The target channel of ST *k* includes all multipath components impacted by ST *k,* , where *K* is the number of STs. The background channel includes other multipath components not belonging to any of the *K* target channel(s).  7.9.1 Scenarios  Sensing scenario X is defined as a scenario for sensing where STX and SRX are selected among the TRPs and UEs in the corresponding communication scenario X. X can be UMi/UMa/RMa/InH/InF/UMi-AV/UMa-AV/RMa-AV/Urban grid/Highway/High Speed Train (HST). Based on the type of ST of interest, the sensing scenarios can be grouped into UAV sensing scenarios (ISAC-UAV), Automotive sensing scenarios (ISAC-Automotive), Human sensing scenarios (ISAC-Human), Automated Guided Vehicles (AGV) sensing scenarios (ISAC-AGV), and Objects creating hazards on roads/railways sensing scenarios (ISAC-Objects creating hazards on roads/railways).  The detailed sensing scenario description in this clause can be used for channel model calibration.  **ISAC-UAV**  In the ISAC-UAV sensing scenarios, the sensing targets are outdoor UAVs below or above the buildings in urban or rural areas. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other UAVs. Details on ISAC-UAV scenarios are listed in Table 7.9.1-1.  **Table 7.9.1-1: Evaluation parameters for UAV sensing scenarios**   |  |  |  | | --- | --- | --- | | **Parameters** | | **Value** | | Applicable communication scenarios | | UMi, UMa, RMa, SMa [38.901]  UMi-AV, UMa-AV, RMa-AV [36.777] | | Sensing transmitters and receivers properties | STX/SRX Locations | STX/SRX locations are selected among the TRPs and UEs locations in the corresponding communication scenarios.  See note 1 | | Sensing target | LOS/NLOS | LOS and NLOS | | Outdoor/indoor | Outdoor | | 3D mobility | Horizontal velocity: uniform distribution between 0 and 180km/h, if horizontal velocity is not fixed to 0.  Vertical velocity: 0km/h, optional {20, 40} km/h  See note 2 and 3 | | 3D distribution | Horizontal plane:  Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.  *N* = {1, 2, 3, 4, 5}  See note 4  Vertical plane:  Option A: Uniform between 1.5m and 300m.  Option B: Fixed height value chosen from {25, 50, 100, 200, 300} m assuming vertical velocity is equal to 0. | | Orientation | Random in horizontal domain | | Physical characteristics (e.g., size) | Size:  Option 1: 1.6m x 1.5m x 0.7m  Option 2: 0.3m x 0.4m x 0.2m | | Minimum 3D distances between pairs of STX/SRX and sensing target | | Minimum distances based on minimum TRP/UE distances defined in TR36.777. | | Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a target  Option 2: 10 meters | | NOTE 1: This may include aerial UEs for UMi-AV, UMa-AV, RMa-AV communication scenarios. In this case, other STX/SRX properties (e.g. mobility) are also taken from the corresponding communication scenario.  NOTE 2: 3D mobility can be horizontal only or vertical only or a combination, for each sensing target  NOTE 3: Time-varying velocity may be considered for future evaluations.  NOTE 4: *N*=0 may be considered for the evaluation of false alarm | | |   **ISAC-Automotive**  In the ISAC-Automotive sensing scenarios, the sensing targets are vehicles such as cars, trucks, or buses traveling on roads and streets in urban and rural areas. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other vehicles and roadside UEs (RSU-type UEs). Details on ISAC-Automotive scenarios are listed in Table 7.9.1-2.  **Table 7.9.1-2: Evaluation parameters for Automotive sensing scenarios**   |  |  |  | | --- | --- | --- | | **Parameters** | | **Values** | | Applicable communication scenarios | | Highway, Urban Grid [37.885]  UMi, UMa, RMa, SMa [38.901] | | Sensing transmitters and receivers properties | | STX/SRX locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenario.  Additional option: ISD between TRPs of Urban Grid is 250m | | Sensing target | LOS/NLOS | LOS and NLOS (including NLOSv) | | Outdoor/indoor | Outdoor | | Mobility (horizontal plane only) | Based on TR37.885 mobility for urban grid or highway scenario | | Distribution (horizontal) | Based on dropping in TR37.885 per urban grid or highway communication scenario | | Orientation | Lane direction in horizontal plane | | Physical characteristics (e.g., size) | Type 1/2 (passenger vehicle)  Type 3 (truck/bus)  Vehicle type dimensions and distribution per TR37.885 | | Minimum 3D distances between pairs of STX/SRX and sensing target | | For Highway, Urban Grid  - Minimum distances based on minimum TRP/UE distances defined in TR37.885  For UMi, UMa, RMa, SMa  - Minimum distances based on minimum TRP/UE distances defined in TR38.901 | | Unchanged Text Omitted | | |   **ISAC-Human**  In the ISAC-Human sensing scenarios, the sensing targets are children and/or adult persons in indoor (room, office, factory) and outdoor (urban, rural) locations. Monostatic or bistatic sensing can be performed using TRPs and/or UEs in the corresponding communication scenarios. Details on ISAC-Human scenarios are listed in Table 7.9.1-3.  **Table 7.9.1-3: Evaluation parameters for Human (indoor and outdoor) sensing scenarios**   |  |  |  |  | | --- | --- | --- | --- | | **Parameters** | | **Indoor Values** | **Outdoor Values** | | Applicable communication scenarios | | Indoor office, indoor factory  Indoor room [TR38.808] | UMi, UMa, RMa, SMa [38.901] | | Unchanged Text Omitted | | | | | Sensing target | LOS/NLOS | LOS and NLOS | LOS and NLOS | | Outdoor/indoor | Indoor | Outdoor | | 3D mobility | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/h  (horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/h  (horizontal plane with random direction straight-line trajectory) | | 3D distribution | *N* targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment.  See note 1 | Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.  See note 1 | | Unchanged Text Omitted | | | | Minimum 3D distances between pairs of STX/SRX and sensing target | | Minimum distances defined in TR 38.901 | Minimum distances defined in TR 38.901 | | Unchanged Text Omitted | | | |   **ISAC-AGV**  In the ISAC-AGV sensing scenarios, the sensing targets are automated guided vehicles (AGVs) inside a factory. Monostatic or bistatic sensing can be performed using TRPs and/or UEs in the corresponding communication scenario. Details on ISAC-AGV sensing scenarios are listed in Table 7.9.1-4.  **Table 7.9.1-4: Evaluation parameters for AGV sensing scenarios**   |  |  |  | | --- | --- | --- | | **Parameters** | | **Value** | | Sensing target | LOS/NLOS | LOS and NLOS | | Outdoor/indoor | Indoor | | 3D mobility | Horizontal velocity with random straight-line trajectory  Option 1: Uniform distribution in the range of up to 30 km/h  Option 2: Fixed velocities {3, 10} km/h | | 3D distribution | Option A: Uniformly distributed over the horizontal area of the convex hull of the TRPBS deployment  Option B: Uniformly distributed in horizontal plane | | Orientation | Horizontal plane only | | Physical characteristics (e.g., size) | Size  Option 1: 0.5m x 1.0m x 0.5m  Option 2: 1.5 m x 3.0m x 1.5 m | | Minimum 3D distances between pairs of STX/SRX and sensing target | | Minimum distances based on minimum TRP/UE distances defined in TR38.901 | | Unchanged Text Omitted | | |   **ISAC-Objects creating hazards on roads/railways**  In the ISAC-Objects creating hazards on roads/railways sensing scenarios, the sensing targets are adult humans and children and animals in communication scenarios involving vehicles or high-speed trains. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other vehicles and roadside UEs (RSU-type UEs). Details on ISAC- Objects creating hazards on roads/railways sensing scenarios are listed in Table 7.9.1-5.  **Table 7.9.1-5: Evaluation parameters for objects creating hazards on roads/railways sensing scenarios**   |  |  | | --- | --- | | **Parameters** | **Value** | | Applicable communication scenarios | Highway, Urban grid, HST (TR 38.802)  UMi, UMa, RMa, SMa [38.901] | | Unchanged Text Omitted | | | Minimum 3D distances between pairs of STX/SRX and sensing target | For Highway, Urban Grid, HST  - Minimum distance is based on minimum TRP/UE distances defined in TR37.885 and TR38.802  For UMi, UMa, RMa, SMa  - Minimum distances based on minimum TRP/UE distances defined in TR38.901 | | Unchanged Text Omitted | |   7.9.2 Physical object model  7.9.2.0 Introduction  A ST is modelled with one or multiple scattering points. Each scattering point of a ST (SPST) is used to model the total scattering effects of some adjacent scattering centres at the ST. The impact of a SPST to the channel includes at least two aspects, i.e., the RCS (Radar Cross Section, 7.9.2.1) and the polarization matrix (7.9.2.2).  7.9.2.1 RCS of a sensing target  The RCS of a SPST is a scalar value defined in LCS of the ST and is dependent on both the incident angle and the scattered angle. The RCS values with same incident/scattered angles can be referred to as monostatic RCS values.  The RCS related coefficient of a SPST for a pair of incident/scattered angles is composed of a first component which is included in the large-scale parameters (described in Step 15 in Clause 7.9.4.1), and a second component and third component which are both included in the small-scale parameters (described in Step 10 in Clause 7.9.4.1), i.e., . is a deterministic value for the SPST. can be fixed to 1 or can be angular dependent. follows a log-normal distribution. The mean and standard deviation used to characterize satisfied a fixed relation.  (7.9.2-1)  A first RCS model, called RCS model 1, characterizes a ST as single SPST with component of the monostatic RCS values fixed to 1. is the mean of linear-domain monostatic RCS values at the SPST. For UAV of small size and human with RCS model 1, the angle-dependent value of, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  (7.9.2-2)  where,  - . is the bistatic angle between the incident ray and scattering ray within the plane defined by incident angle () and scattering angle ().  - is for the effect of forward scattering and is set to .  The logarithmic values of of the RCS values for the different STs are provided in Table 7.9.2.1-1.  **Table 7.9.2.1-1: Parameters for RCS for the STs with angle-independent monostatic RCS values**   |  |  |  | | --- | --- | --- | | **Sensing target** | **(dBsm)** | **(dB)** | | UAV with small size | -12.81 | 3.74 | | Human with RCS model 1 | -1.37 | 3.94 |   A second RCS model, called RCS model 2, splits a ST into single or multiple SPSTs, and adopts an angular dependent component of the monostatic RCS values for each SPST. For UAV with large size and human, single SPST is modelled. For vehicle and AGV, both models with single and multiple SPSTs are provided. For vehicle and AGV modelled with multiple scattering points, the recommended five scattering points are located at the front, left, back, right and roof side of the vehicle. The orientation of a ST in LCS is provided as follows.  - The face of a human, the front of a vehicle, a UAV with large size or an AGV is facing the direction with azimuth angle and zenith angle . The front of the AGV is the short edge of AGV in horizontal direction.  - The top of the ST is facing the direction with zenith angle .  For UAV of large size with single SPST, human with RCS model 2 with single SPST, vehicle with single/multiple SPSTs, and AGV with single/multiple SPSTs, the angle-dependent value of, denoted as , of the RCS for a SPST is deterministic based on the incident angle () and the scattered angle ().  (7.9.2-3)  with defined by      where,  - () are zenith angle and azimuth angle of the bisector of the angle between the incident and scattered rays, whose zenith and azimuth angle pairs are () and () respectively.  - . is the bistatic angle between the incident ray and scattering ray within the plane defined by incident angle () and scattering angle ().  - for UAV with large size.  - for human with RCS model 2.  - for vehicle with single/multiple SPSTs.  - for AGV with single/multiple SPSTs.  - is for the effect of forward scattering and is set to .  For a ST with single scattering point, sets of parameters , *Range of* and *Range of* are defined. The bisector angle () is used to index one set from the sets of parameters based on the *Range of* and *Range of* it lies in, and determine of the ST consequently. If the ST is split into scattering points, with each scattering point characterized by one of sets of parameters, are respectively determined for each scattering point.  The sets of parameters to define and the parameters of the RCS for the different STs are provided in Tables 7.9.2.1-2 through 7.9.2.1-7.  **Table 7.9.2.1-2: Parameters for RCS for UAV with large size**  **Table 7.9.2.1-3: Parameters for RCS for human with RCS model 2**  **Table 7.9.2.1-4: Parameters for RCS for vehicle with single scattering point**  **Table 7.9.2.1-5: Parameters for RCS for vehicle with multiple scattering points**  **Table 7.9.2.1-6: Parameters for RCS for AGV with single scattering point**  **Table 7.9.2.1-7: Parameters for RCS for AGV with multiple scattering points**  7.9.2.2 Cross-polarization matrix of a sensing target  The cross-polarization matrixof a SPST for a pair of incident/scattered angles is defined in LCS of the ST and is generally modelled by amplitude factors and initial random phases , i.e.,  (7.9.2-4)  For UAV, human, vehicle and AGV, , , i.e.,  (7.9.2-5)  where,  - is the XPR of the pair of incident/scattered angles. is randomly generated by log-normal distribution per target type defined in Table 7.9.2.2-1.  - is uniformly distributed within .  **Table 7.9.2.2-1: Parameters for XPR (dB) for the targets**  7.9.3 Reference channel models and required updates  A transmitter or receiver in the sensing operation can be a TRP, terrestrial UE, vehicle UE, aerial UE, AGV UE or RSU-type UE. The reference TR(s) to generate the channel for each combination of transmitter and receiver for each sensing scenario are provided in Table 7.9.3-1, where the terrestrial UE and AGV are both referred to as terrestrial UE.  …  The large scale and small scale parameters of the STX-SRX link, i.e., background channel for a sensing scenario are determined according to Table 7.9.3-1 assuming the same sensing scenario. The proper case for each combination of STX and SRX are provided in Table 7.9.3-3. For TRP monostatic sensing mode, a reference point (RP) is considered as a terrestrial UE. For UT monostatic sensing mode, a RP is considered as a TRP and an aerial UE is considered as a terrestrial UE.  …  7.9.4 Fast fading model  7.9.4.0 Introduction  The ISAC channel between a pair of STX and SRX is composed of the target channel(s) and the background channel. A multipath component in the target channel may include stochastic generated clusters in either of or both the STX-ST link and ST-SRX link. If blockage/forward scattering between sensing targets is not considered, a propagation path from STX to SRX interacting with more than one sensing target is not modelled.  A stepwise procedure illustrated in Figure 7.9.4-1 is used to generate the channel model for ISAC referring to the procedure in Clause 7.5 with parameters derived by Table 7.9.3-2 and 7.9.3-3. Step 1 is commonly executed, followed by the respective steps for target channel (Clause 7.9.4.1) and background channel (Clause 7.9.4.2). Finally, the target channel and background channel are combined to form the final channel model for ISAC (Clause 7.9.4.3).  …  7.9.4.1 Target channel  Following Step 1 in Clause 7.9.4.0, the target channels for the one or multiple STs between a pair of STX and SRX is generated using the following procedure with parameters derived by Table 7.9.3-2. It assumes a ST *k* consists of *P* scattering points indexed *p=1,2,…P*, . The propagation conditions for different STX-SPST links and SPST-SRX links can be modelled by spatial consistency procedure in Clause 7.9.5.1.\  …  **Small scale parameters:**  Step 5: Generate cluster delays  The cluster delays of cluster *n* in a STX-SPST link are generated using Step 5 of Clause 7.5, i.e.,.  The cluster delays of cluster in the corresponding SPST-SRX link of the same SPST are generated using Step 5 of Clause 7.5 by replacing subscript *n* with *n’*, i.e., .  …  Step 7: Generate arrival angles and departure angles for both azimuth and elevation.  The arrival angles and departure angles for both azimuth and elevation of a ray *m* of cluster *n* in a STX-SPST link are generated using Step 7 of Clause 7.5, i.e., , , , .  The arrival angles and departure angles for both azimuth and elevation of a ray *m’* of cluster *n’* in the corresponding SPST-SRX link of the same SPST are generated using Step 7 of Clause 7.5 by replacing subscript *n, m* with *n’, m’*, i.e.,, , , .  For monostatic sensing mode, are respectively equal to in Step 5-7, if and if applicable .  …  Step 9: Coupling of rays for a STX-SPST link and the corresponding SPST-SRX link of the same SPST.  In the STX-SPST link, a LOS ray is represented by , while a NLOS ray *m* of a stochastic cluster *n* is represented by . In the SPST-SRX link, a LOS ray is represented by while a NLOS ray *m’* of a stochastic cluster *n’* is represented by . A ray in the STX-SPST link and a ray in the corresponding SPST-SRX link that are coupled to each other construct a path.  The LOS ray (if present) in the STX-SPST link is coupled with the LOS ray (if present) in the SPST-SRX link. The resulting path is never dropped. Further, a set of paths are generated which include the coupled rays as follows.  - The LOS ray in the STX-SPST link (if present) is coupled with each NLOS ray in the SPST-SRX link.  - Each NLOS ray in the STX-SPST link is coupled with the LOS ray (if present) in the SPST-SRX link.  - The NLOS rays in the STX-SPST link are coupled with the NLOS rays in the SPST-SRX link. Two options for the coupling are recommended with other methods for complexity reduction up to company choice.  - Option 1: Each NLOS ray in the STX-SPST link is coupled with each NLOS ray in the SPST-SRX link.  - Option 2: The NLOS rays in the STX-SPST link are 1-by-1 randomly coupled with the NLOS rays in the ST-SRX link. If the number of rays M1, M2 in the two links are not equal, min(M1, M2) rays are randomly selected in the link with larger number of rays in the coupling operation, and the remaining rays are dropped.  Step 9: Coupling of rays for a STX-SPST link and the corresponding SPST-SRX link of the same SPST.  In the STX-SPST link, a LOS ray is represented by , while a NLOS ray *m* of a stochastic cluster *n* is represented by . In the SPST-SRX link, a LOS ray is represented by while a NLOS ray *m’* of a stochastic cluster *n’* is represented by . A ray in the STX-SPST link and a ray in the corresponding SPST-SRX link that are coupled to each other construct a path.  The LOS ray (if present) in the STX-SPST link is coupled with the LOS ray (if present) in the SPST-SRX link. The resulting path is never dropped. Further, a set of paths are generated which include the coupled rays as follows.  - The LOS ray in the STX-SPST link (if present) is coupled with each NLOS ray in the SPST-SRX link.  - Each NLOS ray in the STX-SPST link is coupled with the LOS ray (if present) in the SPST-SRX link.  - The NLOS rays in the STX-SPST link are coupled with the NLOS rays in the SPST-SRX link. Two options for the coupling are recommended with other methods for complexity reduction up to company choice.  - Option 1: Each NLOS ray in the STX-SPST link is coupled with each NLOS ray in the SPST-SRX link.  - Option 2: The NLOS rays in the STX-SPST link are 1-by-1 randomly coupled with the NLOS rays in the ST-SRX link. If the number of rays M1, M2 in the two links are not equal, min(M1, M2) rays are randomly selected in the link with larger number of rays in the coupling operation, and the remaining rays are dropped.  …  Step 13: Draw initial random phases for paths in set *R*.  The random initial phases for each ray *m* of a cluster *n* in a STX-ST link is generated using Step 9 of Clause 7.5, i.e.,  The random initial phases for each ray *m’* of a cluster *n’* in a ST-SRX link is generated using Step 9 of Clause 7.5 by replacing subscript *n, m* with *n’, m’*, i.e., .  For monostatic sensing mode, are respectively equal to , if and .  Draw random initial phases for each path in set *R* at SPST *p* and for four different polarisation combinations (*θθ*, *θϕ,* *ϕθ,* *ϕϕ*). The distribution for initial phases is uniform within (*-π, π*). are independently determined for each path of a SPST of the same ST and of the different STs. of a path of a SPST keeps unchanged until it is updated.  …  - is the velocity of SPST *p* of ST *k*, , where is the velocity of the ST *k*, is velocity due to micro motion of SPST *p* of ST *k*.  …  7.9.4.2 Background channel  For TRP-TRP, TRP-UE, UE-TRP and UE-UE bistatic sensing modes, following Step 1 in Clause 7.9.4.0, the background channel between a pair of STX and SRX is generated using Step 2 to Step 12 of Clause 7.5 with parameters derived by Table 7.9.3-3. The absolute time of arrival in clause 7.6.9 is applied. The resulting channel is denoted as .  For TRP monostatic and UE monostatic sensing modes, the background channel between a pair of STX and SRX is generated using the following steps after Step 1 in Clause 7.9.4.0, wherein the pair of STX and SRX is referred to as STX/SRX, and are assumed to have the same location.  Step 2: Generate 3 reference points (RPs) for the STX/SRX.  Draw the 2D distance between the STX/SRX and each RP, and the height of each RP, respectively from Gamma distribution and . These distributions are defined in Table 7.9.4.2-1,2. With uniform distribution within range , draw the LOS azimuth AOD (*ϕLOS,AOD*) between the STX/SRX and the first RP. The LOS azimuth AOD is further rotated by and to respectively derive the LOS azimuth AOD from the STX/SRX to the second and third RPs. Consequently, the 3D location of each RP can be calculated.  - Determine LOS ZOD (*θLOS,ZOD*) of the STX/SRX and each RP in the global coordinate system.  - Set for each RP the same antenna field patterns *Frx* in the global coordinate system and array geometries as the STX/SRX.  - Set for each RP the same array orientations with respect to the global coordinate system, i.e., Ω*RP,α* (RP bearing angle), Ω*RP,β* (RP downtilt angle) and Ω*RP,γ* (RP slant angle) as the STX/SRX.  - Set for each RP the same velocity as the STX/SRX.  NOTE: Distributions of height and distance of RPs are not subject to geographical constraints on TRP and UT for the corresponding deployment scenario.  Step 3: Assign NLOS propagation condition to the channel between the STX/SRX and each of the 3 RPs.  Step 4: Generate the channel between the STX/SRX and the RP with index *r* using Step 3 to Step 12 of Clause 7.5 and Clause 7.6.10 with parameters derived by Table 7.9.3-3, with updates as follows.  - In Step 7 of Clause 7.5, the arrival angles are respectively equal to the departure angles . The rays in a cluster with less than 50, 80, and 90 degrees respectively for scenario UMi, Uma, and RMa are dropped. The dropping is not applicable to other sensing scenarios.  - The absolute time of arrival in clause 7.6.9 is applied with d3D replaced by , where is the height of the STX/SRX. Three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.  NOTE: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0.  ------------------------------------------------------------- END OF TEXT PROPOSAL----------------------------------------------- |

[Moderator’s note] In maintenance stage, the suggestion is to focus on necessary fix of functions. Some editorial changes, if not critical is not preferred in the moderator’s view.

### [FL1][M] Question 4.9-3

Please provide your views on whether TP #4.9-5 is agreeable? Especially which part is necessary functional fix?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
|  |  |  |
|  |  |  |
|  |  |  |

## Hybrid channel model

TP #4.10-1 (ZTE)

|  |
| --- |
| <Start of Changes> 8.4 Channel generation The radio channels are created using the deterministic ray-tracing upon a digitized map and emulating certain stochastic components according to the statistic parameters listed in Tables 7.5-6 to 7.5-11 [Note: Not all parameters listed in these tables are used in hybrid model]. The channel realizations are obtained by a step-wise procedure illustrated in Figure 8.4-1 and described below. In the following steps, downlink is assumed. For uplink, arrival and departure parameters have to be swapped.    Figure 8.4-1: Channel coefficient generation procedure  <omitted text>  Step 14: Generated deterministic propagation paths in sensing targets channel for ISAC  BS and UT can be replaced by ISAC Tx and Rx in the above step 2.  The first arrival absolute delay are added for all deterministic paths in the above step 3.  The deterministic paths and random paths generated in above step 3 and 4 can include low power paths whose power similar as or larger than that of sensing objects.  a) Import sensing object(s) in the digitized map. The sensing object(s) should at least contain the following information:  - The 3D geometric information.  - The material and shape as well as the corresponding electromagnetic properties including permittivity and conductivity;  - The velocity  b) Generate power, absolute delay, angle, XPR, Doppler, etc. based on ray tracing for deterministic propagation paths which interact with sensing object channel.  - To support for true motion, i.e. the case when a trajectory is specified for a sensing object, a sensing path ID is associated for each deterministic path. The same ID is associated for a path across a number of sensing object locations as far as 1) it has same interaction types in the same order and 2) its interactions occur in same walls or other surfaces.  c) Combine the sensing channel in step 14(b) and channel step13.  <End of Changes> |

[Moderator’s note]: We handle this in Malta but not conclusion at that time. Companies are encouraged to check the issue again and provide views on how to handle hybrid map-based channel model for ISAC.

### [FL1][M] Proposal 4.10

* TP #4.10-1 is agreed for TR 38.901 v19.0.0

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
|  |  |  |
|  |  |  |
|  |  |  |

# Reference

1. RP-242348, “Revised SID: Study on channel modelling for Integrated Sensing And Communication (ISAC) for NR”, Xiaomi, AT&T
2. TR 38.901, “Study on channel model for frequencies from 0.5 to 100 GHz, V19.0.0 (2025-06)”
3. R1-2505215 Maintenance for ISAC channel modelling Huawei, HiSilicon
4. R1-2505293 Maintenance on channel modelling enhancements for ISAC CATT, CICTCI
5. R1-2505384 Maintenance on ISAC channel modeling vivo
6. R1-2505436 Text proposals to TR 38.901 on ISAC CM Xiaomi, AT&T
7. R1-2505548 Remaining issues on channel modelling for Integrated sensing and communication in NR Samsung
8. R1-2505651 Maintenance for ISAC channel model in TR 38.901 InterDigital, Inc.
9. R1-2505728 Maintenance on ISAC channel modelling OPPO
10. R1-2505883 Maintenance on channel modelling for ISAC for NR Apple
11. R1-2505974 Discussion on R19 ISAC Channel Model Maintenance SK Telecom
12. R1-2506107 Calibration results for ISAC channel modelling Sony
13. R1-2506125 TP for ISAC channel modeling ZTE Corporation, Sanechips
14. R1-2506186 Maintenance on channel modelling for ISAC Qualcomm Incorporated
15. R1-2506224 Draft 38.901 TP for updated Rel-19 ISAC Calibration Results AT&T, Xiaomi
16. R1-2506225 ISAC channel model calibration results Moderator (AT&T)
17. R1-2506252 Text proposal to TR 38.901 on ISAC CM NIST, Xiaomi, AT&T
18. R1-2506261 Maintenance on ISAC Channel Model Ericsson (China)

# ANNEX: All agreements

## ISAC deployment scenario

### RAN1 #116 (Feb. 2024)

[**R1-2400953**](file:///D:\3GPP\RAN1\116\tdocs\R1-2400953.zip) FL summary on ISAC deployment scenarios Moderator (AT&T)

[**R1-2401705**](file:///D:\3GPP\RAN1\116\tdocs\R1-2401705.zip) FL summary#2 on ISAC deployment scenarios Moderator (AT&T)

Agreement

For progressing ISAC study, the following sensing targets and existing communication scenarios will be considered as a starting point:

* Note1: the table below does not imply that the sensing target will be placed at positions defined for UEs and BSs in the scenarios in the right column.
* Note2: the table below does not imply that UEs are necessarily placed at positions defined for UEs in the scenarios in the right column.
* Note3: the existing communication scenarios are listed with the intent to use the evaluation parameters defined for those scenarios, as a starting point.

|  |  |
| --- | --- |
| **Sensing Targets** | **scenarios** |
| UAVs | RMa-AV, UMa-AV, UMi-AV (TR 36.777) |
| Humans indoors | InF, Indoor Office, [Indoor Room (TR 38.808)], [UMi, UMa] |
| Humans outdoors | UMi, UMa, [RMa] |
| Automotive vehicles (at least outdoors) | Highway, Urban grid, UMa, UMi, RMa |
| Automated guided vehicles (e.g. in indoor factories) | InF |
| Objects creating hazards on roads/railways (examples defined in TR 22.837) | Highway, Urban grid, HST |

Agreement

For ISAC channel modelling, RAN1 uses the sensing related terminology as defined in TS22.137 or TR22.837 as a starting point for discussion purposes with the following definitions:

1. Sensing transmitter: the TRP or a UE that sends out the sensing signal which the sensing service will use in its operation. A sensing transmitter can be located in the same or different TRP or a UE as the sensing receiver.
2. Sensing receiver: the TRP or a UE that receives the sensing signal which the sensing service will use in its operation. A sensing receiver can be located in the same or different TRP or a UE as the sensing transmitter.
3. Sensing target: target that need to be sensed by deriving characteristics of the objects within the environment from the sensing signal.
4. Background environment: background (clutter and/or environmental objects) that are not the sensing target(s).
5. Mono-static sensing: sensing where the sensing transmitter and sensing receiver are co-located in the same TRP or UE.
6. Bi-static sensing: sensing where the sensing transmitter and sensing receiver are in different TRPs or UEs.
7. Multi-static sensing: sensing where there are multiple sensing transmitters and/or multiple sensing receivers, for a sensing target.
8. Sensing signal: Transmissions on the 3GPP radio interface that can be used for sensing purposes.

### RAN1 #116bis (Apr. 2024)

[**R1-2403048**](file:///D:\3GPP\RAN1\116bis\tdocs\R1-2403048.zip) FL Summary #1 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2403049**](file:///D:\3GPP\RAN1\116bis\tdocs\R1-2403049.zip) FL Summary #2 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2403050**](file:///D:\3GPP\RAN1\116bis\tdocs\R1-2403050.zip) FL Summary #3 on ISAC Deployment Scenarios Moderator (AT&T)

Agreement

RAN1 agrees the following ISAC terminology with minor modifications as follows:

For ISAC channel modelling, RAN1 uses the sensing related terminology as defined in TS22.137 or TR22.837 as a starting point for discussion purposes with the following definitions:

1. Sensing transmitter: the TRP or a UE that sends out the sensing signal which the sensing service will use in its operation. A sensing transmitter can be located in the same or different TRP or a UE as the sensing receiver.
2. Sensing receiver: the TRP or a UE that receives the sensing signal which the sensing service will use in its operation. A sensing receiver can be located in the same or different TRP or a UE as the sensing transmitter.
3. Sensing target: target that need to be sensed by deriving characteristics of the objects within the environment from the sensing signal.
4. Background environment: background (clutter and/or environmental objects) that are not the sensing target(s).
5. Mono-static sensing: sensing where a sensing transmitter that transmits a sensing signal and a sensing receiver that receives the sensing signal are co-located in the same TRP or UE.
6. Bi-static sensing: sensing where a sensing transmitter that transmits a sensing signal and a sensing receiver that receives the sensing signal are not co-located in the same TRP or UE.
7. Multi-static sensing: sensing where there are multiple sensing transmitters and/or multiple sensing receivers, for a sensing target.
8. Sensing signal: Transmissions on the 3GPP radio interface that can be used for sensing purposes.

Agreement

Any TRP and/or UE location in the corresponding communication scenario can be selected as sensing transmitters and receivers locations. FFS: other possible sensing transmitters and receivers locations.

Agreement

The following table can be used by companies to propose values for each sensing target

* Additional parameters/rows can be added if needed

Table x. Evaluation parameter template for sensing scenarios

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios | |  |
| Sensing transmitters and receivers properties | |  |
| Supported sensing modes | |  |
| Sensing target | Outdoor/indoor |  |
| 3D mobility |  |
| 3D distribution |  |
| Orientation |  |
| Physical characteristics (e.g., size) |  |
| [Unintended/Environment objects] | Types |  |
| 3D mobility |  |
| 3D distribution |  |
| Orientation |  |
| Physical characteristics (e.g., size) |  |
| [Sensing area] | |  |
| Minimum 3D distances between pairs of Tx/Rx/sensing target/[unintended objects] | |  |

### RAN1 #117 (May 2024)

[**R1-2404486**](file:///D:\3GPP\RAN1\117\tdocs\R1-2404486.zip) FL Summary #1 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2404487**](file:///D:\3GPP\RAN1\117\tdocs\R1-2404487.zip) FL Summary #2 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2404488**](file:///D:\3GPP\RAN1\117\tdocs\R1-2404488.zip) FL Summary #3 on ISAC Deployment Scenarios Moderator (AT&T)

Agreement

For each of the sensing target deployment scenarios using the template agreed in RAN#116-bis, the following principles apply:

1. For defining sensing Tx and sensing Rx properties (e.g., cell layout, BS antenna height, and minimum distance), scenario parameter values for the applicable communication scenarios in 38.901 are considered as a starting point. Updates to these evaluation parameter values for ISAC scenarios will consider the following:
   * aerial UEs parameter values as defined in TR 36.777
   * indoor room scenario parameter values defined in TR 38.808
   * automotive scenario parameter values as defined in TR 37.885, 38.859 for Urban grid/Highway
   * Minimum distances between Tx/Rx and target are not defined in the existing communications scenarios and shall be included in the sensing target deployment scenarios.
   * Note: Only deviation from the existing evaluation parameters in the applicable communication scenarios need to be explicitly defined in the ISAC scenario tables.
2. For defining sensing target properties, as a baseline

* Evaluation parameter values can be taken from additional TRs, e.g., TR 36.777, 37.885, 38.859, etc.
* Size of sensing targets based on TR 22.837, 37.885 (e.g. for automotive), 38.901 (e.g. for AGV size), etc

Agreement

For ISAC deployment scenarios, carrier frequency, bandwidth, and SCS are not included in the evaluation parameters templates for sensing scenarios, but may be included in the evaluation/calibration phase.

Agreement

For UAV sensing target scenarios, the following table is used as a starting point for deployment scenario parameters/values.

Note: Additional parameters, value/value ranges are not precluded.

Table x. Evaluation parameters for UAV sensing scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | | **Value** |
| Applicable communication scenarios | | | UMi, UMa, RMa [38.901]  UMi-AV, UMa-AV, RMa-AV |
| Sensing transmitters and receivers properties | Rx/Tx Locations | | Rx/Tx locations are selected among the TRPs and UEs locations in the corresponding communication scenario  Note1: this may include aerial UEs for UMi-AV, UMa-AV, RMa-AV communication scenarios. [In this case, other Rx/Tx properties (e.g. mobility) are also taken from the corresponding communication scenario.] |
| Supported sensing modes | | | [All 6 sensing modes] |
| Sensing target | | Outdoor/indoor | Outdoor |
| 3D mobility | Horizontal velocity: Up to 160 km/h  [FFS specific velocity(ies) or random distribution]  [FFS vertical plane velocity] |
| 3D distribution | [Uniform between a minimum and maximum height]  [Uniform in horizontal domain at a given height] |
| Orientation | Random in horizontal domain |
| Physical characteristics (e.g., size) | UAV object type(s) [FFS] |
| [Sensing area] | | |  |
| Minimum 3D distances between pairs of Tx/Rx and sensing target/[unintended objects] | | | FFS |
| Minimum 3D distance between sensing targets | | | FFS |
| [Unintended/Environment objects, e.g., types, characteristics, mobility, distribution, etc.] | | | FFS |

Agreement

RAN1 agrees to the following revised evaluation parameters values for the UAV sensing target scenarios:

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| Sensing transmitters and receivers properties | Rx/Tx locations are selected among the TRPs and UEs locations in the corresponding communication scenario  Note 1: Other Rx/Tx properties (e.g. mobility) can also be taken from the corresponding communication scenario.  Note 2: This may include aerial UEs as Rx/Tx that can be selected among locations in the UMi-AV, UMa-AV, RMa-AV communication scenarios. |
|

### RAN1 #118 (Aug. 2024)

[R1-2406873](file:///D:\3GPP\RAN1\118\tdocs\R1-2406873.zip) FL Summary #1 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2406874**](file:///D:\3GPP\RAN1\118\tdocs\R1-2406874.zip) FL Summary #2 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2406875**](file:///D:\3GPP\RAN1\118\tdocs\R1-2406875.zip) FL Summary #3 on ISAC Deployment Scenarios Moderator (AT&T)

**Conclusion**

RAN1 will consider the recommendations for the physical characteristics (e.g., sizes, shapes, materials, velocities, etc.) of sensing targets and objects provided in 5GAA LS ([R1-2405964](file:///D:\3GPP\RAN1\118\tdocs\R1-2405964.zip)), along with the relevant characteristics defined in 3GPP TRs, within the scope of the Rel-19 study item.

* No LS response from RAN1 to 5GAA is necessary.
* [R1-2405964](file:///D:\3GPP\RAN1\118\tdocs\R1-2405964.zip) is proposed to be NOTED.

Agreement

General principles for all sensing target deployment scenarios should consider the following:

* “Sensing mode” is removed in the scenario tables, but may be included in the evaluation/calibration phase. Per the SI, all sensing modes are possible for the deployment scenarios.
* “Sensing area” may be addressed as part of the sensing target distribution and/or Tx/Rx characteristics and/or cell layout.

Agreement

For UAV sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#117 as a baseline.

Note: Additional parameters, value/value ranges are not precluded.

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-UAV**

Details on ISAC-UAV scenarios are listed in Table x.

Table x. Evaluation parameters for UAV sensing scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | | **Value** |
| Applicable communication scenarios | | | UMi, UMa, RMa [38.901]  UMi-AV, UMa-AV, RMa-AV |
| Sensing transmitters and receivers properties | Rx/Tx Locations | | Rx/Tx locations are selected among the TRPs and UEs locations in the corresponding communication scenarios.  Note1: This may include aerial UEs for UMi-AV, UMa-AV, RMa-AV communication scenarios. In this case, other Rx/Tx properties (e.g. mobility) are also taken from the corresponding communication scenario. |
| Sensing target | | Outdoor/indoor | Outdoor |
| 3D mobility | Horizontal velocity: uniform distribution between 0 and 180km/h, if horizontal velocity is not fixed to 0.  Vertical velocity: 0km/h, optional {20, 40} km/h  NOTE2: 3D mobility can be horizontal only or vertical only or a combination for each sensing target  FFS: time-varying velocity. |
| 3D distribution | Horizontal plane:  Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.  FFS: Value of *N*, defined area, and other distributions  Vertical plane:  Option A: Uniform between 1.5m and 300m.  Option B: Fixed height value chosen from {25, 50, 100, 200, 300} m assuming vertical velocity is equal to 0.  FFS Other options are not precluded.  Note2: target(s) are outside the minimum distance to the Tx/Rx |
| Orientation | Random in horizontal domain |
| Physical characteristics (e.g., size) | Size:   * Option 1: 1.6m x 1.5m x 0.7m * Option 2: 0.3m x 0.4m x 0.2m   FFS: Material(s), Structure, Other size(s) |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | | Option B: Min distances based on min. TRP/UE distances defined in TR36.777 as a starting point.  Option C: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | | Option 1: At least larger than the physical size of a target  Option 2: 10 meters |
| [Unintended/Environment objects, e.g., types, characteristics, mobility, distribution, etc.] | | | FFS |

Note: further down-selection between the options in the table is not precluded.

### RAN1 #118bis (Oct. 2024)

[**R1-2408760**](file:///D:\3GPP\RAN1\118bis\tdocs\R1-2408760.zip) FL Summary #1 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2408761**](file:///D:\3GPP\RAN1\118bis\tdocs\R1-2408761.zip) FL Summary #2 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2408762**](file:///D:\3GPP\RAN1\118bis\tdocs\R1-2408762.zip) FL Summary #3 on ISAC Deployment Scenarios Moderator (AT&T)

Agreement

For Automotive sensing target scenarios, the following table is used as a starting point for deployment scenario parameters/values.

The detailed scenario description in this clause can be used for channel model calibration.

Note: Additional parameters, value/value ranges are not precluded.

Table x. Evaluation parameters for Automotive sensing scenarios

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Values** |
| Applicable communication scenarios | | Highway, Urban Grid. NOTE1 |
| Sensing transmitters and receivers properties | | Rx/Tx locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenario. NOTE2  FFS: Option 2: ISD between TRPs of Urban Grid is 250 meters |
| Sensing target | LOS/NLOS | LOS and NLOS (including NLOSv) |
| Outdoor/indoor | Outdoor |
| Mobility (horizontal plane only) | Based on TR37.885 mobility for urban grid or highway scenario |
| Distribution (horizontal) | Based on dropping in TR37.885 per urban grid or highway communication scenario |
| Orientation | Lane direction in horizontal plane |
| Physical characteristics (e.g., size) | Type 1/2 (passenger vehicle)  Type 3 (truck/bus)  Vehicle type distribution per TR 37.885 as a starting point  FFS: Other sizes, additional distributions, and vehicle types, e.g. one new type of e-scooter/motorcycle/bike |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | Option 1: Min distances based on min. TRP/UE distances defined in TR37.885 as a starting point.  Option 2: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, [x] m. value of x is FFS |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | | EO Type 2 for Urban Grid   * FFS: details, e.g. 4 walls (as EO type 2) per building of size [413mx230mx20m] |

NOTE1: calibration for UMi, Uma, RMa is not performed for the automotive scenario, but UMi, Uma, RMa can be considered for future evaluations of the automotive sensing target scenarios. Calibration for UMi, Uma, RMa is expected to be performed for another sensing scenario.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

Agreement

For Human sensing target scenarios, (indoor and outdoor), the following table is used as a starting point for deployment scenario parameters/values.

The detailed scenario description in this clause can be used for channel model calibration.

Note: Additional parameters, value/value ranges are not precluded.

Table x. Evaluation parameters for Human (indoor and outdoor) sensing scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | **Indoor Values** | **Outdoor Values** |
| Applicable communication scenarios NOTE1 | | Indoor office, indoor factory [TR38.901]  Indoor room [TR38.808] | UMi, Uma, RMa [TR38.901] |
| Sensing transmitters and receivers properties | Rx/Tx Locations  NOTE 2 | Rx/Tx locations are selected among the TRPs and UE locations in the corresponding communication scenario | Rx/Tx locations are selected among the TRPs and UE locations in the corresponding communication scenario |
| Rx/Tx Mobility for UEs | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/hr | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/hr |
| Sensing target | Outdoor/indoor | Indoor | Outdoor |
| 3D mobility | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/hr  (horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/hr  (horizontal plane with random direction straight-line trajectory) |
| 3D distribution | N targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment  FFS: Value of N | Uniform in horizontal plane |
| Orientation | Random over the horizontal area | Random over the horizontal area |
| Physical characteristics (e.g., size) | Size (Length x Width x Height):   * Child: 0.2m x 0.3m x 1m * Adult Pedestrian: 0.5m x 0.5m x 1.75m | Size (Length x Width x Height):   * Child: 0.2m x 0.3m x 1m * Adult Pedestrian: 0.5m x 0.5m x 1.75m |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx  Option 2: Min distances defined in TR 38.901 as a starting point | Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx  Option 2: Min distances defined in TR 38.901 as a starting point |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, [x] m. value of x is FFS | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, [x] m. value of x is FFS |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | | FFS, based on outcome for AI 9.7.2 | FFS, based on outcome for AI 9.7.2 |

NOTE1: For the human (indoor and outdoor) sensing targets, additional communication scenarios can be considered for future evaluations. Channel model calibration for Urban Grid with outdoor humans is expected to be performed from Objects creating hazards on the road/railway sensing scenarios.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

Agreement

For Automated Guided Vehicles (AGV) target scenarios, the following table is used as a starting point for deployment scenario parameters/values.

The detailed scenario description in this clause can be used for channel model calibration.

Note: Additional parameters, value/value ranges are not precluded.

**Table x. Evaluation parameters for Automated Guided Vehicles**

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios  NOTE1 | | InF (TR38.901 including Table 7.8-7) |
| Sensing transmitters and receivers properties NOTE2 | | Rx/Tx location are selected among the TRPs and UEs location in the corresponding communication scenario  Rx/Tx Mobility for UEs   * Option 1: 0 km/h * Option 2: 3km/h * Option 3: Uniform distribution between 0km/h and 3km/h |
| Sensing target | LOS/NLOS | LOS and NLOS |
| Outdoor/indoor | Indoor |
| 3D mobility | Horizontal velocity with random straight-line trajectory   * Option 1: Uniform distribution in the range of up to 30 km/h * Option 2: Fixed velocities [3, 10] km/h |
| 3D distribution | Option A: Uniformly distributed in the convex hull of the horizontal BS deployment  Option B: Uniformly distributed in horizontal plane |
| Orientation | Horizontal plane only |
| Physical characteristics (e.g., size) | Size (L x W x H)   * Option 1: 0.5m x 1.0m x 0.5m * Option 2: 1.5 m x 3.0m x 1.5 m * FFS: Material, Additional sizes, and AGV size distribution |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx from the sensing target  Option 2: Min distances based on min. TRP/UE distances defined in TR38.901 |
| Minimum 3D distance between sensing targets | | Option A: At least larger than the physical size of a target  Option B: Fixed value, [x] m. value of x is FFS |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | FFS |

NOTE1: For the AGV sensing targets, additional communication scenarios can be considered for future evaluations.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

NOTE3: RAN1 can further discuss narrowing down the number of sub-scenarios of InF

Agreement

For objects creating hazards, the following proposals are suggested to be discussed by RAN1:

For objects creating hazards use cases, RAN1 to consider the following table as a starting point for deployment scenario parameters/values.

The detailed scenario description in this clause can be used for channel model calibration.

Note: Additional parameters, value/value ranges are not precluded.

**Table x. Evaluation parameters for objects creating hazards**

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios NOTE1 | | Highway, Urban grid, HST (High Speed Train) |
| Sensing transmitters and receivers properties  NOTE2 | Rx/Tx Locations | Rx/Tx locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenarios.  FFS: Option 2: ISD between TRPs of Urban Grid is 250 meters |
| Sensing target | LOS/NLOS | LOS and NLOS |
| Outdoor/indoor | Outdoor |
| 3D mobility | Horizontal velocity: up to [10] km/h for humans and animals  FFS: Additional velocities, trajectory |
| 3D distribution | Uniformly distributed in horizontal plane |
| Orientation | Random distribution in horizontal plane |
| Physical characteristics (e.g., size) | For human/pedestrians: Child: 0.2m x 0.3m x 1m  Adult: 0.5m x 0.5m x 1.75m  For animals:  Size: 1.5m x 0.5m x 1 m  FFS: other types of targets |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx from the sensing target  Option 2: based on TR37.885 and TR38.802 |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a target  Option 2: Fixed value, [x] m. value of x is FFS |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | EO Type 2 for Urban Grid   * FFS: details, e.g. 4 walls (as EO type 2) per building of size [413mx230mx20m] |

NOTE1: For the objects creating hazards sensing targets, additional communication scenarios can be considered for future evaluations.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

### RAN1 #119 (Nov. 2024)

[**R1-2410337**](file:///D:\3GPP\RAN1\119\tdocs\R1-2410337.zip) FL Summary #1 on ISAC Deployment Scenarios Moderator (AT&T)

[**R1-2410338**](file:///D:\3GPP\RAN1\119\tdocs\R1-2410338.zip) FL Summary #2 on ISAC Deployment Scenarios Moderator (AT&T)

R1-2410339 FL Summary #3 on ISAC Deployment Scenarios Moderator (AT&T)

Guidance for further work

1. Rapporteurs are encouraged to start providing a draft CR for both agendas to RAN1#120

2. Jerome to provide an initial proposal for calibrations discussions by the end of RAN1#119

3. RAN1 agenda will clarify that input on calibrations discussions is to be provided to agenda 9.7.1 starting at RAN1#120

Agreement

For UAV sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#118 as a baseline:

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-UAV**

Details on ISAC-UAV scenarios are listed in Table x.

Table x. Evaluation parameters for UAV sensing scenarios

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios | | UMi, UMa, RMa [38.901]  UMi-AV, UMa-AV, RMa-AV |
| Sensing transmitters and receivers properties | Rx/Tx Locations | Rx/Tx locations are selected among the TRPs and UEs locations in the corresponding communication scenarios.  NOTE1: This may include aerial UEs for UMi-AV, UMa-AV, RMa-AV communication scenarios. In this case, other Rx/Tx properties (e.g. mobility) are also taken from the corresponding communication scenario. |
| Sensing target | LOS/NLOS | LOS and NLOS |
| Outdoor/indoor | Outdoor |
| 3D mobility | Horizontal velocity: uniform distribution between 0 and 180km/h, if horizontal velocity is not fixed to 0.  Vertical velocity: 0km/h, optional {20, 40} km/h  NOTE2: 3D mobility can be horizontal only or vertical only or a combination for each sensing target  ~~FFS: time-varying velocity.~~  NOTE 3: time-varying velocity may be considered for future evaluations. |
| 3D distribution | Horizontal plane:  Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.  ~~FFS: Value of~~ *~~N~~*~~, defined area, and other distributions~~  *N* = {1, 2, 3, 4, 5}  NOTE4: *N*=0 may be considered for the evaluation of false alarm  Vertical plane:  Option A: Uniform between 1.5m and 300m.  Option B: Fixed height value chosen from {25, 50, 100, 200, 300} m assuming vertical velocity is equal to 0.  ~~FFS Other options are not precluded.~~  ~~NOTE5: target(s) are outside the minimum distance to the Tx/Rx~~ |
| Orientation | Random in horizontal domain |
| Physical characteristics (e.g., size) | Size:   * Option 1: 1.6m x 1.5m x 0.7m * Option 2: 0.3m x 0.4m x 0.2m   ~~FFS: Material(s), Structure, Other size(s)~~ |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | ~~Option B:~~ Min distances based on min. TRP/UE distances defined in TR36.777 as a starting point.  NOTE5: the sensing target is assumed in the far field of sensing Tx/Rx  ~~Option C: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~ |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a target  Option 2: 10 meters |
| [Unintended/Environment objects, e.g., types, characteristics, mobility, distribution, etc.] | | FFS |

NOTE: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

Agreement

For Automotive sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#118-bis as a baseline:

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-Automotive**

Details on ISAC-Automotive scenarios are listed in Table x.

Table x. Evaluation parameters for Automotive sensing scenarios

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Values** |
| Applicable communication scenarios | | Highway, Urban Grid. NOTE1 |
| Sensing transmitters and receivers properties | | Rx/Tx locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenario. NOTE2  ~~FFS:~~ Additional option: ISD between TRPs of Urban Grid is 250m |
| Sensing target | LOS/NLOS | LOS and NLOS (including NLOSv) |
| Outdoor/indoor | Outdoor |
| Mobility (horizontal plane only) | Based on TR37.885 mobility for urban grid or highway scenario |
| Distribution (horizontal) | Based on dropping in TR37.885 per urban grid or highway communication scenario |
| Orientation | Lane direction in horizontal plane |
| Physical characteristics (e.g., size) | Type 1/2 (passenger vehicle)  Type 3 (truck/bus)  Vehicle type distribution per TR 37.885 as a starting point  ~~FFS:~~ ~~Other sizes, additional distributions, and vehicle types, e.g. one new type of e-scooter/motorcycle/bike~~ |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | ~~Option 1:~~ Min distances based on min. TRP/UE distances defined in TR37.885 as a starting point.  ~~Option 2: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~  NOTE3: the sensing target is assumed in the far field of sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, ~~[~~10~~]~~ m. ~~value of x is FFS~~ |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | | EO Type 2 for Urban Grid   * ~~FFS: details, e.g.~~ up to 4 walls modelled as EO type 2, per building of size ~~[~~413m x 230m x 20m~~]~~. FFS: number of buildings, how many walls are modelled, additional building sizes, etc. |

NOTE1: calibration for UMi, Uma, RMa is not performed for the automotive scenario, but UMi, Uma, RMa can be considered for future evaluations of the automotive sensing target scenarios. Calibration for UMi, Uma, RMa is expected to be performed for another sensing scenario.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

Agreement

For Human (indoor and outdoor) sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#118-bis as a baseline:

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-Human**

Details on ISAC-Human scenarios are listed in Table x.

Table x. Evaluation parameters for Human (indoor and outdoor) sensing scenarios

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | | **Indoor Values** | **Outdoor Values** |
| Applicable communication scenarios NOTE1 | | Indoor office, indoor factory [TR38.901]  Indoor room [TR38.808] | UMi, Uma, RMa [TR38.901] |
| Sensing transmitters and receivers properties | Rx/Tx Locations  NOTE 2 | Rx/Tx locations are selected among the TRPs and UE locations in the corresponding communication scenario | Rx/Tx locations are selected among the TRPs and UE locations in the corresponding communication scenario |
| Rx/Tx Mobility for UEs | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/hr | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/hr |
| Sensing target | LOS/NLOS | LOS and NLOS | LOS and NLOS |
| Outdoor/indoor | Indoor | Outdoor |
| 3D mobility | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 3km/hr  (horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h  Option 2: 3km/h  Option 3: Uniform distribution between 0km/h and 10km/hr  (horizontal plane with random direction straight-line trajectory) |
| 3D distribution | *N* targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment  ~~FFS: Value of N~~  NOTE1: *N*=0 may be considered for the evaluation of false alarm | Option A: *N* targets uniformly distributed within one cell.  Option B: *N* targets uniformly distributed per cell.  Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries. ~~Uniform in horizontal plane~~  NOTE1: *N*=0 may be considered for the evaluation of false alarm |
| Orientation | Random over the horizontal area | Random over the horizontal area |
| Physical characteristics (e.g., size) | Size (Length x Width x Height):   * Child: 0.2m x 0.3m x 1m * Adult Pedestrian: 0.5m x 0.5m x 1.75m | Size (Length x Width x Height):   * Child: 0.2m x 0.3m x 1m * Adult Pedestrian: 0.5m x 0.5m x 1.75m |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | ~~Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~  ~~Option 2:~~ Min distances defined in TR 38.901 and TR36.843 and TR38.859as a starting point  NOTE2: the sensing target is assumed in the far field of sensing Tx/Rx | ~~Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~  ~~Option 2:~~ Min distances defined in TR 38.901 and TR36.843 and TR38.859 as a starting point  NOTE3: the sensing target is assumed in the far field of sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, [x] m. value of x is FFS | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, [x] m. value of x is FFS |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | | FFS, based on outcome for AI 9.7.2 | FFS, based on outcome for AI 9.7.2 |

NOTE1: For the human (indoor and outdoor) sensing targets, additional communication scenarios can be considered for future evaluations. Channel model calibration for Urban Grid with outdoor humans is expected to be performed from Objects creating hazards on the road/railway sensing scenarios.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

Agreement

For AGV sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#118-bis as a baseline:

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-AGV**

Details on ISAC-AGV are listed in Table x.

**Table x. Evaluation parameters for Automated Guided Vehicles**

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios  NOTE1 | | InF (TR38.901 including Table 7.8-7) |
| Sensing transmitters and receivers properties NOTE2 | | Rx/Tx location are selected among the TRPs and UEs location in the corresponding communication scenario  Rx/Tx Mobility for UEs   * Option 1: 0 km/h * Option 2: 3km/h * Option 3: Uniform distribution between 0km/h and 3km/h |
| Sensing target | LOS/NLOS | LOS and NLOS |
| Outdoor/indoor | Indoor |
| 3D mobility | Horizontal velocity with random straight-line trajectory   * Option 1: Uniform distribution in the range of up to 30 km/h * Option 2: Fixed velocities [3, 10] km/h |
| 3D distribution | Option A: Uniformly distributed in the convex hull of the horizontal BS deployment  Option B: Uniformly distributed in horizontal plane |
| Orientation | Horizontal plane only |
| Physical characteristics (e.g., size) | Size (L x W x H)   * Option 1: 0.5m x 1.0m x 0.5m * Option 2: 1.5 m x 3.0m x 1.5 m * FFS: Material, Additional sizes, and AGV size distribution |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | ~~Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx from the sensing target~~  ~~Option 2:~~ Min distances based on min. TRP/UE distances defined in TR38.901  NOTE: the sensing target is assumed in the far field of sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | Option A: At least larger than the physical size of a target  Option B: Fixed value, [x] m. value of x is FFS |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | FFS |

NOTE1: For the AGV sensing targets, additional communication scenarios can be considered for future evaluations.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

NOTE3: RAN1 can further discuss narrowing down the number of sub-scenarios of InF

Agreement

For Objects creating hazards sensing target scenarios, the following table is agreed for deployment scenario parameters/values using the agreements from RAN1#118-bis as a baseline:

The detailed scenario description in this clause can be used for channel model calibration.

**ISAC-Hazards**

Details on ISAC-Hazards are listed in Table x.

**Table x. Evaluation parameters for objects creating hazards**

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios NOTE1 | | Highway, Urban grid, HST (High Speed Train) |
| Sensing transmitters and receivers properties  NOTE2 | Rx/Tx Locations | Rx/Tx locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenarios.  ~~FFS:~~ ~~Option 2~~ Additional option ISD between TRPs of Urban Grid is 250 m |
| Sensing target | LOS/NLOS | LOS and NLOS |
| Outdoor/indoor | Outdoor |
| 3D mobility | Horizontal velocity: up to [10] km/h for humans and animals  FFS: Additional velocities, trajectory |
| 3D distribution | Uniformly distributed in horizontal plane |
| Orientation | Random distribution in horizontal plane |
| Physical characteristics (e.g., size) | For human/pedestrians: Child: 0.2m x 0.3m x 1m  Adult: 0.5m x 0.5m x 1.75m  For animals:  Size: 1.5m x 0.5m x 1 m  ~~FFS: other types/sizes of targets may be considered for future evaluations~~ |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | | ~~Option 1:~~ Min. distance is ~~larger than the min. far-field distance of the sensing Tx/Rx from the sensing target~~  ~~Option 2:~~ based onmin TRP/UE distances defined in TR37.885 and TR38.802 and TR36.843 and TR38.859  NOTE: the sensing target is assumed in the far field of sensing Tx/Rx |
| Minimum 3D distance between sensing targets | | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, ~~[~~10~~]~~ m. ~~value of x is FFS~~ |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | EO Type 2 for Urban Grid   * ~~FFS: details, e.g.~~ up to 4 walls modelled as EO type 2, per building of size ~~[~~413m x 230m x 20m~~]~~. FFS: number of buildings, how many walls are modelled, additional building sizes, etc. |

NOTE1: For the objects creating hazards sensing targets, additional communication scenarios can be considered for future evaluations.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

[Post-119-ISAC-01] – Jerome (AT&T)

Email discussion on simulation assumptions for channel model calibration, from January 8th-17th:

* Companies are encouraged to provide initial channel model calibration assumptions, parameters, and values
* Jerome to collect inputs, provide potential consolidated tables, proposals for consideration by January 17th

**Decision:** The discussions are to be carried over to RAN1#120.

### RAN1 #120 (Feb. 2024)

[R1-2501076](file:///D:\3GPP\RAN1\120\tdocs\R1-2501076.zip) FL Summary #1 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2501077**](file:///D:\3GPP\RAN1\120\tdocs\R1-2501077.zip) FL Summary #2 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2501078**](file:///D:\3GPP\RAN1\120\tdocs\R1-2501078.zip) FL Summary #3 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2501574**](file:///D:\3GPP\RAN1\120\tdocs\R1-2501574.zip) FL Summary #4 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2501607**](file:///D:\3GPP\RAN1\120\tdocs\R1-2501607.zip) FL Summary #4 on ISAC Scenarios and Calibrations Moderator (AT&T)

Agreement

For ISAC channel modelling calibration, RAN1 considers both large-scale and full-scale calibration to include parameters and values for at least the following:

* + - large scale parameters, where fast fading is not included
    - full-scale calibration parameters, which includes fast fading.
* NOTE0: one part of calibration work does not include additional components and does not include spatial consistency
  + - FFS: whether spatial consistency is specified as an additional component for ISAC CM
* NOTE1: additional calibrations including spatial consistency can also be considered case by case for different scenarios.
* NOTE2: Inclusion of EO in ISAC CM calibrations can also be considered case by case for different scenarios.

Agreement

Calibration of ISAC CM includes separate calibration of the target channel and of the background channel

* FFS: additional calibration for the combined channel (combination of target and background channel).

Agreement

For the purposes of large scale calibration for UAV sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for large scale calibration for UAV sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | UMa-AV |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic  Note: further down-selection of the sensing modes for UAV sensing is not precluded |
| Sectorization | 3 sectors per cell site: 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| Sensing target distribution | 1target uniformly distributed (across multiple drops) within the center cell. Vertical distribution: Fixed height value of 200 m. |
| Component A of the RCS for each scattering point | a fixed value of A |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Wrapping Method | No wrapping method is used if interference is not modelled, otherwise geographical distance based wrapping |
| Metrics | Coupling loss (based on LOS pathloss)   * FFS: how to select sensing Tx and Rx   FFS: additional metrics, wideband SIR and SINR based on RSRP if interference is modelled. |

### RAN1 #120bis (Apr. 2024)

[R1-2502731](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2502731.zip) FL Summary #1 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2502732**](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2502732.zip) FL Summary #2 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2502733**](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2502733.zip) FL Summary #3 on ISAC Scenarios and Calibrations Moderator (AT&T)

[R1-2502734](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2502734.zip) FL Summary #4 on ISAC Scenarios and Calibrations Moderator (AT&T)

[R1-2503150](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2503150.zip) Email summary on Post-120bis-ISAC-01 Moderator (AT&T)

[R1-2503151](file:///D:\3GPP\RAN1\120bis\tdocs\R1-2503151.zip) ISAC calibration templates Moderator (AT&T)

Agreement

For the purposes of large scale calibration for UAV sensing targets, the following revised calibration parameters are proposed below in Table x. Note that the change bars are against the agreements from RAN1#120.

**Table x. Simulation assumptions for large scale calibration for UAV sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | UMa-AV |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic |
| Target type | UAV of small size (0.3m x 0.4m x 0.2m) |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m for terrestrial UTs, |
| UT Tx power | 23dBm |
| UT Distribution | • The overall number of UTs is 30 uniformly distributed in the center cell.  • All of the UTs are either terrestrial UTs or aerial UTs, all outdoors.  • Vertical distribution of aerial UE: Fixed height value of 200 m.  • FR1 is assumed for aerial UE. |
| Sensing target distribution | 1target uniformly distributed (across multiple drops) within the center cell. Vertical distribution: Fixed height value of 200 m. |
| Component A of the RCS for each scattering point | -12.81 dBsm |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Wrapping Method | No wrapping method is used if interference is not modelled, otherwise geographical distance based wrapping |
| Coupling loss for target channel | power scaling factor (pathloss, shadow fading, and RCS component A included): |
| Sensing Tx/Rx selection | Best N = 4 Tx-Rx pairs to be selected for the target.  NOTE1: Based on the Tx-Rx pairs with the smallest power scaling factor of the target channel. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the coupling loss between Tx and one reference point)  Note: CDFs can be separately generated for target channel, background channel |

Agreement

For the purposes of full calibration for UAV sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for full calibration for UAV sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | UMa-AV |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic |
| Target type | UAV of small size (0.3m x 0.4m x 0.2m) |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m for terrestrial UTs |
| UT Tx power | 23dBm |
| UT Distribution | * The overall number of UTs is 30 uniformly distributed in the center cell. * All of the UTs are either terrestrial UTs or aerial UTs, all outdoors. * Vertical distribution of aerial UE: Fixed height value of 200 m. * FR1 is assumed for aerial UE. |
| Sensing target distribution | 1target uniformly distributed (across multiple drops) within the center cell. Vertical distribution: Fixed height value of 200 m. |
| RCS for each scattering point | Component A: -12.81 dBsm  Component B1: 0 dB  Component B2: 3.74 dB for standard deviation  The same values are used for monostatic RCS and bistatic RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Wrapping Method | No wrapping method is used if interference is not modelled, otherwise geographical distance based wrapping |
| Fast fading model | TR 36.777 Annex B.1.3 |
| (u, std) for XPR of target | Mean 13.75 dB, deviation 7.07 dB |
| The power threshold for path dropping after concatenation for target channel | FFS |
| The power threshold for removing clusters in step 6 in section 7.5, TR 38.901 for background channel | FFS |
| Coupling loss for target channel | By definition, need to consider all direct and indirect paths. The following parameters are included in the calculation:   * power scaling factor (pathloss, shadow fading, and RCS component A included) * for small scale   RCS B1/B2 and power of rays in Tx-target/target-Rx links (), Tx/Rx antenna pattern, 3 polarization matrixes, i.e., |
|  |
| Sensing Tx/Rx selection | Best N = 4 Tx-Rx pairs to be selected for the target.  NOTE1: Based on the Tx-Rx pairs with the smallest power scaling factor of the target channel. |
| Absolute delay | The model of UMa scenario defined in TR 38.901 7-24GHz channel modeling [ref] is reused for UMa-AV for all sensing modes. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the linear sum of coupling losses between Tx/Rx and all reference points)  Note: CDFs can be separately generated for target channel, background channel  CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA). Definition of Delay Spread is similar to the definition of angle spread in Annex A of TR 25.996,  Definition of Angle Spread can ref to Annex A of TR 25.996. |

Agreement ([Post-120bis-ISAC-01])

For the purposes of full calibration for UAV sensing targets, the following update is proposed below based on the agreement from RAN1#120-bis for Coupling loss for target channel:

|  |  |
| --- | --- |
| Coupling loss for target channel | By definition, need to consider all direct and indirect paths. The following parameters are included in the calculation:   * power scaling factor (pathloss, shadow fading, and RCS component A included) * for small scale   RCS B1/B2 and power of rays in Tx-target/target-Rx links (), Tx/Rx antenna pattern, 3 polarization matrixes, i.e., |

Agreement

For the purposes of large scale calibrations for Automotive sensing targets, the following parameters are proposed below in Table x.

* + FFS: which type of UE is used for UT in different sensing mode
  + FFS: impact of spatial consistency, if any, in case of vehicle with 5 scattering points
  + FFS: cell layout for ISD = 250 m

**Table x. Simulation assumptions for large scale calibration for Automotive sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | For FR1:  Urban Grid (ISD=500m, BS height=25m)  Highway (ISD=1732m, BS height=35m)  For FR2:  Urban Grid (ISD=250m, BS height=25m)  Highway (ISD=500m, BS height=35m) |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic |
| Target type | Vehicle type 2 [TR37.885] |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna, (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m for pedestrian type UE  5m for RSU type UE  1.6m for vehicle type UE |
| UT Tx power | 23dBm |
| UT Distribution | Per TR37.885 |
| Sensing target distribution | Per TR37.885: - Option A - Vehicle type distribution: 100% vehicle type 2. - Clustered dropping is not used. - Highway: one target uniformly distributed (across multiple drops) within the simulation region. Vehicle speed is 140 km/h in all the lanes as baseline.  - Urban Grid: one target is uniformly distributed (across multiple drops) within the center road grid. Vehicle speed is 60 km/h in all the lanes as baseline.  NOTE: vehicle is dropped with 5 scattering points (front/left/right/back/roof) and each point has one location, or vehicle is dropped with 1 scattering points |
| Component A of the RCS for each scattering point | -20dBsm |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
|  |  |
| Wrapping Method | As defined in urban grid/highway scenario |
| Coupling loss for target channel | Power scaling factor (pathloss, shadow fading, and RCS component A included) |
| Sensing Tx/Rx selection | Best *N*= Tx-Rx pairs to be selected for the target.  For urban grid *N* = 4  For Highway *N* = 4  NOTE: Based on the Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the coupling loss between Tx and one reference point)  Note: CDFs can be separately generated for target channel, background channel |

Agreement ([Post-120bis-ISAC-01])

For the purposes of large scale calibrations for Automotive sensing targets, the following parameters are updated below in Table x based on the agreements in RAN1#120-bis.

**Table x. Simulation assumptions for large scale calibration for Automotive sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | For FR1:  Urban Grid (ISD=500m, BS height=25m)  Highway (ISD=1732m, BS height=35m)  For FR2:  Urban Grid (ISD=250m, BS height=25m)  Highway (ISD=500m, BS height=35m)  For Urban Grid ISD =250m   * The layout is configured as follows:   + Red triangles: BS with 250m ISD, 18 BSs are located.   A diagram of a road with red arrows  AI-generated content may be incorrect. |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic |
| Target type | Vehicle type 2 [TR37.885] |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna, (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m for pedestrian type UE  5m for RSU type UE  1.6m for vehicle type UE |
| UT Tx power | 23dBm |
| UT Distribution | For Highway:   * Vehicle Type **UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885.** * **RSU-type UTs are uniformly allocated with 100m spacing in the middle of the freeway as per TR36.885.**   For Urban grid:   * Vehicle Type **UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885.** * Pedestrian type UT, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR36.885   + Total number of pedestrian UEs is 16 in the centre grid.   + Pedestrian UE is in the middle of the sidewalk   + The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘36.344’.   + N=1; * RSU-type UT: the dropping is at the center of intersection per TR36.885.   NOTE: A single UT type is used per calibration, e.g., pedestrian type UT, RSU type UT, or vehicle type UT |
| Sensing target distribution | Per TR37.885: - Option A - Vehicle type distribution: 100% vehicle type 2. - Clustered dropping is not used. - Highway: one target uniformly distributed (across multiple drops) within the simulation region. Vehicle speed is 140 km/h in all the lanes as baseline.  - Urban Grid: one target is uniformly distributed (across multiple drops) within the center road grid. Vehicle speed is 60 km/h in all the lanes as baseline.  NOTE: vehicle is dropped with 5 scattering points (front/left/right/back/roof) and each point has one location, or vehicle is dropped with 1 scattering points. In the case of vehicle with 5 scattering points, spatial consistency is enabled with the following assumptions:   * The correlation for LOS/NLOS condition of the 5 points is assumed equal to 1. LOS/NLOS condition can be calculated based on the distance of the Tx/Rx to the centroid of the ST, then apply the LOS/NLOS condition to each of the 5 points. * The correlation for stochastic cluster paths of the 5 points is assumed equal to 1. The stochastic cluster paths can be calculated between the Tx/Rx and the centroid of the ST, then the stochastic cluster paths are added to each of the 5 points. |
| Component A of the RCS for each scattering point | -20dBsm |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Wrapping Method | As defined in urban grid/highway scenario |
| Coupling loss for target channel | Power scaling factor (pathloss, shadow fading, and RCS component A included) |
| Sensing Tx/Rx selection | Best *N*= Tx-Rx pairs to be selected for the target.  For urban grid *N* = 4  For Highway *N* = 4  NOTE: Based on the Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the coupling loss between Tx and one reference point)  Note: CDFs can be separately generated for target channel, background channel |

Agreement ([Post-120bis-ISAC-01])

For the purposes of full calibrations for Automotive sensing targets, the following parameters are proposed below in Table x.

**Table x. Simulation assumptions for full calibration for Automotive sensing targets**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | For FR1:  Urban Grid (ISD=500m, BS height=25m)  Highway (ISD=1732m, BS height=35m)  For FR2:  Urban Grid (ISD=250m, BS height=25m)  Highway (ISD=500m, BS height=35m)  For Urban Grid ISD =250m   * The layout is configured as follows:   + Red triangle: BS with 250m ISD, 18 BSs are located.   A diagram of a road with red arrows  AI-generated content may be incorrect. |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic |
| Target type | Vehicle type 2 [TR37.885] |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna, (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m for pedestrian type UE  5m for RSU type UE  1.6m for vehicle type UE |
| UT Tx power | 23dBm |
| UT Distribution | For Highway:   * Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885. * RSU-type UTs are uniformly allocated with 100m spacing in the middle of the freeway as per TR36.885.   For Urban grid:   * Vehicle Type UT distribution follows vehicle UE dropping as in Table A.1.2-1 from TR36.885. * Pedestrian type UT, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR36.885   + Total number of pedestrian UEs is 16 in the centre grid.   + Pedestrian UE is in the middle of the sidewalk   + The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘36.344’.   + N=1; * RSU-type UT: the dropping is at the center of intersection per TR36.885.   NOTE: A single UT type is used per calibration, e.g., pedestrian type UT, RSU type UT, or vehicle type UT  . |
| Sensing target distribution | Per TR37.885: - Option A - Vehicle type distribution: 100% vehicle type 2. - Clustered dropping is not used. - Highway: one target uniformly distributed (across multiple drops) within the simulation region. Vehicle speed is 140 km/h in all the lanes as baseline.  - Urban Grid: one target is uniformly distributed (across multiple drops) within the center road grid. Vehicle speed is 60 km/h in all the lanes as baseline.  NOTE: vehicle is dropped with 5 scattering points (front/left/right/back/roof) and each point has one location, or vehicle is dropped with 1 scattering points. In the case of vehicle with 5 scattering points, spatial consistency is enabled with the following assumptions:   * The correlation for LOS/NLOS condition of the 5 points is assumed equal to 1. LOS/NLOS condition can be calculated based on the distance of the Tx/Rx to the centroid of the ST, then apply the LOS/NLOS condition to each of the 5 points. * The correlation for stochastic cluster paths of the 5 points is assumed equal to 1. The stochastic cluster paths can be calculated between the Tx/Rx and the centroid of the ST, then the stochastic cluster paths are added to each of the 5 points. |
| RCS for each scattering point | Based on the agreed RCS. |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| ~~Minimum 3D distance between sensing targets~~ | ~~10 m~~ |
| Wrapping Method | As defined in urban grid/highway scenario |
| Fast fading model (full calibration) | Procedures based on 37.885 |
| (u, std) for XPR of target | (21.12, 6.88) dB. |
| The power threshold for path dropping after concatenation for target channel | [-40dB]  FFS: Other power thresholds. |
| The power threshold for removing clusters in step 6 in section 7.5, TR 38.901 for background channel | -25dB |
| Coupling loss for target channel | By definition, need to consider all direct and indirect paths. The following parameters are included in the calculation:   * power scaling factor (pathloss, shadow fading, and RCS component A included) * for small scale   RCS B1/B2 and power of rays in Tx-target/target-Rx links (), Tx/Rx antenna pattern, 3 polarization matrixes, i.e., |
| Sensing Tx/Rx selection | Best *N*= Tx-Rx pairs to be selected for the target.  For urban grid *N* = 4  For Highway *N* = 4  NOTE: Based on the Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Absolute delay | The model of UMa scenario defined in TR 38.901 7-24GHz channel modelling [Table 7.6.9-1] is reused for Highway (FR2)/Urban Grid for all sensing modes.  The model of RMa scenario defined in TR 38.901 7-24GHz channel modelling [Table 7.6.9-1] is reused for Highway (1732m ISD) for all sensing modes. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the linear sum of the coupling loss between Tx/Rx and all reference points)  Note: CDFs can be separately generated for target channel, background channel  CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA). Definition of Delay Spread is similar to the definition of angle spread in Annex A of TR 25.996,  Definition of Angle Spread can ref to Annex A of TR 25.996. |

Agreement ([Post-120bis-ISAC-01])

For the purposes of large scale calibration for Human (indoor and outdoor) sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for large scale calibration for Human sensing targets**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Indoor Values** | **Outdoor Values** |
| Scenario | Indoor office  12 sectors per 120m \* 50m \* 3m  ISD = 20m  InF-SH  Hall size: 300x150 m  Room height: 10m  18 BSs on a square lattice with spacing D, located D/2 from the walls.  -big hall (L=300m x W=150m): D=50m | UMa (ISD = 500m), UMi (ISD= 200m) |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic | |
| Target type | Adult Pedestrian: 0.5m x 0.5m x 1.75m.  Note: Height of scattering point 1.5m | |
| Sectorization | Single 360-degree sector can be assumed | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 24dBm  FR2: 23dBm | FR1: 56dBm  FR2: 41dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB | FR1: 9dB  FR2: 10dB |
| UT height | 1m | 1.5m |
| UT Tx power | 23dBm | 23dBm |
| UT Distribution | Per Table 7.8-1 Indoor-Office  Number of UTs: 20 | Per Table 7.8-1.  Number of UTs/cell: 10 |
| Sensing target distribution | 100% indoor, 1target uniformly distributed (across multiple drops) over the convex hull of the TRP deployment | 100% outdoor. 1target uniformly distributed (across multiple drops) within the center cell. |
| Component A of the RCS for each scattering point | -1.37 dBsm | -1.37 dBsm |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | Min distances defined in TR 38.901 and TR36.843 and TR38.859 | Min distances defined in TR 38.901 and TR36.843 and TR38.859 |
| Wrapping Method | N/A | No wrapping method is used if interference is not modelled, otherwise geographical distance based wrapping |
| Coupling loss for target channel | Power scaling factor (pathloss, shadow fading, and RCS component A included) | |
| Sensing Tx/Rx selection | Best N = 4 Tx-Rx pairs to be selected for the target.  Based on Tx-Rx pair with the smallest power scaling factor of the target channel. | Best N = 4 Tx-Rx pairs to be selected for the target.  Based on Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the coupling loss between Tx and one reference point)  Note: CDFs can be separately generated for target channel, background channel | |

Agreement ([Post-120bis-ISAC-01])

For the purposes of full calibration for Human sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for full calibration for Human sensing targets**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameters** | **Indoor Values** | **Outdoor Values** | |
| Scenario | Indoor office  12 sectors per 120m \* 50m \* 3m  ISD = 20m  InF-SH  Hall size: 300x150 m  Room height: 10m  18 BSs on a square lattice with spacing D, located D/2 from the walls.  -big hall (L=300m x W=150m): D=50m | UMa (ISD = 500m), UMi (ISD= 200m) | |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic | | |
| Target type | Adult Pedestrian: 0.5m x 0.5m x 1.75m  Note: Height of scattering point 1.5m | | |
| Sectorization | Single 360-degree sector can be assumed | Single 360-degree sector can be assumed | |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz | FR1: 6 GHz  FR2: 30 GHz | |
| BS antenna configurations | Single dual-pol isotropic antenna | Single dual-pol isotropic antenna | |
| BS Tx power | FR1: 24dBm  FR2: 23dBm | FR1: 56dBm  FR2: 41dBm | |
| Bandwidth | FR1: 100MHz  FR2: 400MHz | FR1: 100MHz  FR2: 400MHz | |
| BS noise figure | FR1: 5dB  FR2: 7dB | FR1: 5dB  FR2: 7dB | |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) | |
| UT noise figure | FR1: 9dB  FR2: 10dB | FR1: 9dB  FR2: 10dB | |
| UT height | 1 m | 1.5 m | |
| UT Tx power | 23dBm | 23dBm | |
| UT Distribution | Per Table 7.8-2 Indoor-Office  Number of UTs: 20 | Per Table 7.8-2  Number of UTs/cell: 10 | |
| Sensing target distribution | 100% indoor, 1 target uniformly distributed (across multiple drops) over the convex hull of the TRP deployment | 100% outdoor. 1target uniformly distributed (across multiple drops) within the center cell. | |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | Min distances defined in TR 38.901 and TR36.843 and TR38.859 | Min distances defined in TR 38.901 and TR36.843 and TR38.859 | |
| RCS for each scattering point | Component A: -1.37 dBsm  Component B1: 0 dB  Component B2: 3.94 dB  The same values are used for monostatic RCS and bistatic RCS | Component A: -1.37 dBsm  Component B1: 0 dB  Component B2: 3.94 dB  The same values are used for monostatic RCS and bistatic RCS | |
| Fast fading model | For BS to UE link: Follow the procedure defined in TR38.901 For BS to target link: Follow the procedure defined in TR38.901 for target to UE link: Follow the procedure defined in 38.858 | For BS to UE link: Follow the procedure defined in TR38.901 For BS to target link: Follow the procedure defined in TR38.901 for target to UE link: Follow the procedure defined in 38.858 | |
| (u, std) for XPR of target | FFS | FFS | |
| The power threshold for path dropping after concatenation for target channel | [-40dB]  FFS: Other power thresholds. | [-40dB]  FFS: Other power thresholds. | |
| The power threshold for removing clusters in step 6 in section 7.5, TR 38.901 for background channel | [-25dB]  FFS: Other power thresholds. | [-25dB]  FFS: Other power thresholds. | |
| Coupling loss for target channel | By definition, need to consider all direct and indirect paths. The following parameters are included in the calculation:   * power scaling factor (pathloss, shadow fading, and RCS component A included) * for small scale   RCS B1/B2 and power of rays in Tx-target/target-Rx links (), Tx/Rx antenna pattern, 3 polarization matrixes, i.e., | | |
| Tx-Rx pairing | Best N = 4 Tx-Rx pairs to be selected for the target.  NOTE1: Based on the Tx-Rx pairs with the smallest power scaling factor of the target channel. | | |
| Absolute delay | The model of InH, InF-SH scenarios defined in TR 38.901 7-24GHz channel modeling [Table 7.6.9-1]. | | The model of UMa/UMi scenario defined in TR 38.901 7-24GHz channel modeling [Table 7.6.9-1]. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the linear sum of coupling losses between Tx/Rx and all reference points)  Note: CDFs can be separately generated for target channel, background channel  CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA). Definition of Delay Spread is similar to the definition of angle spread in Annex A of TR 25.996,  Definition of Angle Spread can ref to Annex A of TR 25.996. | | |

Agreement ([Post-120bis-ISAC-01])

For the purposes of large scale calibration for AGV sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for large scale calibration for AGV indoor sensing targets (full calibration)**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | InF: 18 TRPs per the big hall: L = 300 m x W = 150 m  A diagram of a diagram  AI-generated content may be incorrect.   * X-axis is pointing down to the floor * The antenna array is mounted in the Y-Z plane with boresight along the X-axis * The X-axis/Y-axis/Z-axis refer to LCS * 8 m for high BS scenario |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic |
| Target type | Option 2: 1.5m x 3.0m x 1.5m |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 24dBm  FR2: 23dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m |
| UT Tx power | 23dBm |
| UT Distribution | Per Table 7.8-7 Indoor Factory.  Number of UTs: 30 |
| Sensing target distribution | 100% indoor, 1 target uniformly distributed (across multiple drops) over the convex hull of the TRP deployment |
| Component A of the RCS for each scattering point | -1.37 dBsm  Note: For calibration purposes, other value(s) are not precluded. |
| Coupling loss for target channel | Power scaling factor (pathloss, shadow fading, and RCS component A included) |
| Tx-Rx pairing | Best N = 4 Tx-Rx pairs to be selected for the target.  Based on Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the coupling loss between Tx and one reference point)  Note: CDFs can be separately generated for target channel, background channel |

Agreement ([Post-120bis-ISAC-01])

For the purposes of full calibration for AGV sensing targets, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for full calibration for AGV indoor sensing targets (full calibration)**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | InF: 18 TRPs per the big hall: L = 300 m x W = 150 m  A diagram of a diagram  AI-generated content may be incorrect.   * X-axis is pointing down to the floor * The antenna array is mounted in the Y-Z plane with boresight along the X-axis * The X-axis/Y-axis/Z-axis refer to LCS * 8 m for high BS scenario |
| Sensing mode | TRP monostatic, TRP-TRP bistatic, TRP-UE bistatic, UE-UE bistatic, UE monostatic |
| Target type | Option 2: 1.5m x 3.0m x 1.5m |
| Sectorization | Single 360-degree sector can be assumed |
| Carrier Frequency | FR1: 6 GHz  FR2: 30 GHz |
| BS antenna configurations | Single dual-pol isotropic antenna |
| BS Tx power | FR1: 24dBm  FR2: 23dBm |
| Bandwidth | FR1: 100MHz  FR2: 400MHz |
| BS noise figure | FR1: 5dB  FR2: 7dB |
| UT antenna configurations | Single dual-pol isotropic antenna; (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT noise figure | FR1: 9dB  FR2: 10dB |
| UT height | 1.5m |
| UT Tx power | 23dBm |
| UT Distribution | Per Table 7.8-7 Indoor-Factory.  Number of UTs: 30 |
| Sensing target distribution | 100% indoor, 1 target uniformly distributed (across multiple drops) over the convex hull of the TRP deployment |
| RCS for each scattering point | The values/pattern of component A\*B1 are generated by the following parameters   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* | | *Front* | *0°* | *13.68°* | *90°* | *13.68°* | *13.02* | *23.29* | *[30°,180°]* | *[45°,135°]* | | *Left* | *90°* | *15.53°* | *75°* | *20.03°* | *7.33* | *17.60* | *[30°,180°]* | *[135°,225°]* | | *Back* | *180°* | *12.49°* | *90°* | *11.89°* | *11.01* | *21.28* | *[30°,180°]* | *[225°,315°]* | | *Right* | *270°* | *15.53°* | *75°* | *20.03°* | *7.33* | *17.60* | *[30°,180°]* | *[-45°,45°]* | | *Roof* | */* | */* | *0°* | *11.44°* | *11.79* | *22.06* | *[0°,30°]* | *[0°,360°]* |  * + When is in the range [0°,30° ),   The standard deviation of component B2 is 2.51 dB  The same values are used for monostatic RCS and bistatic RCS |
| Fast fading model (Full calibration) | For BS to UE link: Follow the procedure defined in TR38.901  For BS to target link: Follow the procedure defined in TR38.901  for target to UE link: Follow the procedure defined in TR 38.858 |
| (u, std) for XPR of target | FFS |
| The power threshold for path dropping after concatenation for target channel | [-40dB]  FFS: Other power thresholds. |
| The power threshold for removing clusters in step 6 in section 7.5, TR 38.901 for background channel | [-25dB]  FFS: Other power thresholds. |
| Coupling loss for target channel | By definition, need to consider all direct and indirect paths. The following parameters are included in the calculation:   * power scaling factor (pathloss, shadow fading, and RCS component A included) * for small scale   RCS B1/B2 and power of rays in Tx-target/target-Rx links (), Tx/Rx antenna pattern, 3 polarization matrixes, i.e., |
| Tx-Rx pairing | Best N = 4 Tx-Rx pairs to be selected for the target.  Based on Tx-Rx pair with the smallest power scaling factor of the target channel. |
| Absolute delay | The model of InF scenario defined in TR 38.901 7-24GHz channel modeling [Table 7.6.9-1] is reused for all sensing modes. |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the linear sum of coupling losses between Tx/Rx and all reference points)  Note: CDFs can be separately generated for target channel, background channel  CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA). Definition of Delay Spread is similar to the definition of angle spread in Annex A of TR 25.996,  Definition of Angle Spread can ref to Annex A of TR 25.996. |

Agreement ([Post-120bis-ISAC-01])

RAN1 may calibrate EO Type-2 for ISAC in Rel-19. Interested companies can provide results. For the purposes of EO Type-2 calibration, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for calibration of EO type-2**

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Scenario | Urban grid |
| Cell layout | For FR1: ISD = 500m, the layout is defined as below:  The BSs are placed at the top of buildings at one corner. Specifically, the road grids shall be shifted by () m in horizontal plane, or the BSs are shifted by ()m in horizontal plane equivalently.  A screenshot of a map  AI-generated content may be incorrect.  For FR2 ISD=250m, the cell layout is as follows:  A diagram of a road with red arrows  AI-generated content may be incorrect. |
| Sensing mode | TRP- pedestrian UE bistatic  TRP- RSU type UE bistatic  TRP monostatic  TRP-TRP bistatic  RSU type UE - RSU type UE bistatic (optional) |
| EO deployment | 9 buildings with size 413m x 230m x 20m illustrated by the green blocks as in the figure shown in the row of cell layout. |
| ST distribution | one target is uniformly distributed (across multiple drops) within the center of the outside lane of the grid. |
| UT distribution | * For pedestrian UT * Pedestrian type UE, the dropping using equally spaced along the sidewalk with a fixed inter-pedestrian X m dropped per TR36.885.   + Total number of pedestrian UEs is 16 in the centre grid.   + Pedestrian UE is in the middle of the sidewalk   + The inter-pedestrian UE distance (m) (i.e., X) is calculated by ‘A/16’, where ‘A’ is the total length of sidewalk where the pedestrian UEs are dropped under the assumption of ‘N’ road grids (i.e., ‘{(250m – 17m) + (433m – 17m)} \* 2 \* N’). For example, if the pedestrian UEs are dropped in ‘14’ road grids, the inter-pedestrian UE distance (m) is ‘36.344’.     - N=1; * For RSU type UT * The dropping is at the center of intersection per TR36.885. |
| EM-parameters | Table 7.6.8-1 Material properties [TR38.901]   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Material**  **class** | **Relative permittivity** | | **Conductivity** | | **Frequency range in [GHz]** | |  |  |  |  | | Concrete | 5.31 | 0 | 0.0326 | 0.8095 | 1-100 | |
| Metrics | CDF curves:   * Full coupling loss: calculate the coupling loss for each Tx-EO-ST-LOS-Rx and Tx-LOS-ST-EO-Rx rays. * CDF of the Delay. * CDF of the AoA, AoD, ZoA, ZoD.   Additional CDF curves:   * Coupling loss for target channel * CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA). Definition of Delay Spread is similar to the definition of angle spread [TR 25.996, Annex A]. |
| Note: Other necessary but unspecified parameters in this table are the same as those in the table for urban grid scenario calibration. | |

Agreement ([Post-120bis-ISAC-01])

RAN1 may calibrate spatial consistency for ISAC in Rel-19. Interested companies can provide results. For the purposes of spatial consistency calibration, the following calibration parameters are proposed below in Table x.

**Table x. Simulation assumptions for calibration of spatial consistency**

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| Scenario | Urban grid, Indoor office |
| Cell layout | Urban grid: ISD = 500m, the same layout with 37.885  Indoor office: Office size (WxLxH): 120mx50mx3m, ISD=20m (refer to TR 38.901) |
| Sensing mode | TRP- pedestrian UE bistatic in urban grid and TRP-UE bistatic in indoor office |
| BS antenna configuration | Single dual-pol isotropic antenna |
| UT antenna configuration | (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| Polarized antenna model | Model-2 in clause 7.3.2 in TR 38.901 |
| Scattering point | Single point |
| Calibration link and calibration method | * Calibration link: same target associated to different UT as following figure   A diagram of a cell phone  AI-generated content may be incorrect.   * Calibration method   Step1: In single drop simulation, drop one Target and multiple UTs.  Step2: Generate the channel of each link based on Target level spatial consistency method.  Step3: Determine Target-UT groups based on the distance between UTs.  Step4: Bin all the link pairs into certain distance groups, e.g.,   * 0m <= the location distance of link pair < 1m -> 0m group * 1m <= the location distance of link pair < 2m -> 1m group * 2m <= the location distance of link pair < 3m -> 2m group * 3m <= the location distance of link pair < 4m -> 3m group   ……   * (N)m <= the location distance of pair < (N+1)m -> (N)m group   Note: N is at least twice the maximum correlation distance associated with the channel parameters in the scenario  Step5: Calculate the correlation coefficient metric of each distance groups.  Step6: Draw the x-y cure, where x=0, …, N, y= correlation coefficient metric related to (x)m group |
| ST and UT distribution | * Urban grid   one target is uniformly dropped within the center grid in the outside lane with length of 433m,  the UT is distributed by a uniform distribution distance of [0,1]m in the walk road where is in the same street with the target.  As following figure.    Note: The ST-UT link only consider LOS condition discarding NLOSv condition.     * Indoor office   1 Target is uniform dropped in office region  10 UTs are dropped uniformly per cell, i.e., totally 120 UTs are uniformly dropped in office region. |
| Metrics | * Cross-correlation coefficient of delay for the third cluster of channel between link pairs. * Cross-correlation coefficient of AOA (for UT) for the third cluster of channel between link pairs. * Cross-correlation coefficient of LOS/NLOS status of channel between link pairs(only for indoor office scenario). |
| Note: Other necessary but unspecified parameters in this table are the same as those in the table for urban grid scenario calibration and indoor office scenario calibration. | |

### RAN1 #121 (May 2024)

[**R1-2504363**](file:///D:\3GPP\RAN1\121\tdocs\R1-2504363.zip) FL Summary #1 on ISAC Scenarios and Calibrations Moderator (AT&T)

[**R1-2504364**](file:///D:\3GPP\RAN1\121\tdocs\R1-2504364.zip) FL Summary #2 on ISAC Scenarios and Calibrations Moderator (AT&T)

**Agreement**

Updates to Table 7.9.1-1: Evaluation parameters for UAV sensing scenarios are as follows:

|  |  |
| --- | --- |
| **Parameters** | **Value** |
| Applicable communication scenarios | UMi, UMa, RMa, SMa  UMi-AV, UMa-AV, RMa-AV [36.777] |
| Unintended/Environment objects, e.g., types, characteristics, mobility, distribution, etc. | Can be considered in future evaluations |

NOTE1: calibration for the UAV scenario is performed for UMa-AV scenario, but UMi-AV, RMa-AV, UMi, UMa, RMa, SMa can be considered for future evaluations of the UAV sensing target scenarios.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

**Conclusion**

Channel model for ISAC for SMa scenario will not be fully studied in Rel-19.

**Agreement**

Updates to Table 7.9.1-2: Evaluation parameters for Automotive sensing scenarios are as follows:

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Applicable communication scenarios | Highway, Urban Grid.  UMi, UMa, RMa, SMa. NOTE1 |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | EO Type 2 for Urban Grid   * up to 4 walls modelled as EO type 2, per building of size 413m x 230m x 20m. Additional building sizes, building heights, materials, etc., can be considered in future evaluations |

NOTE1: calibration for the automotive scenario will be performed for Highway and Urban Grid scenarios. UMi, UMa, RMa, SMa and related calibration parameters can be considered for future evaluations of the automotive sensing target scenarios.

NOTE2: A percentage of TRPs/UEs that have sensing capabilities may be considered for future evaluations.

**Agreement**

Updates to Table 7.9.1-3: Evaluation parameters for Human (indoor and outdoor) sensing scenarios as follows:

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Indoor Values** | **Outdoor Values** |
| Applicable communication scenarios NOTE1 | Indoor office, indoor factory  Indoor room [TR38.808] | UMi, UMa, RMa, SMa |
| Minimum 3D distance between sensing targets | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1 m. | Option 1: At least larger than the physical size of a sensing target  Option 2: Fixed value, 1 m. |
| Environment Objects, e.g., types, characteristics, mobility, distribution, etc. | Can be considered in future evaluations | Can be considered in future evaluations |

**Agreement**

Updates to Table 7.9.1-4: Evaluation parameters for Automated Guided Vehicles sensing scenarios as follows:

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Sensing Target | Physical characteristics (e.g., size) | Size (L x W x H)   * Option 1: 0.5m x 1.0m x 0.5m * Option 2: 1.5 m x 3.0m x 1.5 m * Material, Additional sizes, and AGV size distribution can be considered in future evaluations |
| Minimum 3D distance between sensing targets | | Option A: At least larger than the physical size of a target  Option B: Fixed value, 5 m. |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | Can be considered in future evaluations |

**Agreement**

Updates to Table 7.9.1-5: Evaluation parameters for objects creating hazards sensing scenarios as follows:

|  |  |  |
| --- | --- | --- |
| **Parameters** | | **Value** |
| Applicable communication scenarios NOTE1 | | Highway, Urban grid, HST (High Speed Train)  UMi, UMa, RMa, SMa |
| Sensing Target | 3D mobility | Horizontal velocity: up to 10 km/h for humans and animals  Additional velocities, trajectory can be considered in future evaluations |
| Environment objects, e.g., types, characteristics, mobility, distribution, etc. | | EO Type 2 for Urban Grid   * up to 4 walls modelled as EO type 2, per building of size 413m x 230m x 20m. Additional building sizes, building heights, materials, etc., can be considered in future evaluations |

NOTE1: calibration for objects creating hazards scenario can be performed for Highway and Urban Grid scenarios. UMi, UMa, RMa, SMa and HST and related calibration parameters can be considered for future evaluations of the objects creating hazards scenarios.

**Agreement**

Updates to Table 7.9.7.1-3. Simulation assumptions for large scale calibration for Automotive sensing targets as follows:

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Scenario | For FR1:  Urban Grid (ISD=500m, BS height=25m)  Highway (ISD=1732m, BS height=35m)  For FR2:  Urban Grid (ISD=250m, BS height=25m)  Highway (ISD=500m, BS height=25m) |
| Component A of the RCS for each scattering point | 11.25 dBsm |
| Wrapping Method | No wrapping method is used if interference is not modelled, otherwise geographical distance based wrapping. |

**Agreement**

Clarification for metrics for Simulation assumptions for full calibration sensing targets as follows*:*

|  |  |
| --- | --- |
| The power threshold for path dropping after concatenation for target channel | -40dB |
| The power threshold for removing clusters in step 6 in section 7.5, TR 38.901 for background channel | -25dB |
| Metrics | Coupling loss for target channel  Coupling loss for background channel (in case of monostatic sensing, this is the linear sum of coupling losses between Tx/Rx and all reference points)  Note: CDFs can be separately generated for target channel, background channel  CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA)  For monostatic sensing mode: delay spread and angle spread of the background channel is calculated separately for each reference point ~~based on paths from all reference points~~.  Definition of Delay Spread is similar to the definition of angle spread in Annex A of TR 25.996,  Definition of Angle Spread can ref to Annex A of TR 25.996. |

**Agreement**

Updates to Table 7.9.7.2-2: Simulation assumptions for full calibration for Human sensing targets as follows*:*

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Indoor Values** | **Outdoor Values** |
| (u, std) for XPR of target | (19.81, 4.25) dB | (19.81, 4.25) dB |

**Agreement**

The following introductory text is added before each of the ISAC deployment scenarios;

1. ISAC-UAV

In the ISAC-UAV scenario, the sensing targets are outdoor UAVs below or above the buildings in urban or rural areas. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other UAVs.

1. ISAC-Automotive

In the ISAC-Automotive scenario, the sensing targets are passenger vehicles or trucks and buses traveling on roads and streets in urban and rural areas. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other vehicles and roadside UEs (RSU-type UEs).

1. ISAC-Human

In the ISAC-Human scenario, the sensing targets are children and adult persons in indoor (room, office, factory) and outdoor (urban, rural) locations. Monostatic or bistatic sensing can be performed using TRPs and/or UEs in the corresponding communication scenarios.

1. ISAC-AGV

In the ISAC-AGV scenario, the sensing targets are automated guided vehicles (AGVs) inside a factory. Monostatic or bistatic sensing can be performed using TRPs and/or UEs in the corresponding communication scenario.

1. ISAC-Objects creating hazards

In the ISAC-Objects creating hazards scenario, the sensing targets are adult humans and children and animals in communication scenarios involving vehicles or high-speed trains. Monostatic or bistatic sensing can be performed using TRPs and/or UEs, including UEs on other vehicles and roadside UEs (RSU-type UEs).

**Agreement**

Updates to 7.9.7.1-4: Simulation assumptions for large scale calibration for AGV sensing targets as follows*:*

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Component A of the RCS for each scattering point | -4.25 dBsmNote: based on AGV option 1 |

**Agreement**

Updates to 7.9.7.2-4: Simulation assumptions for full calibration for AGV sensing targets as follows*:*

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| (u, std) for XPR of target | (9.60, 6.85) dB |

**Agreement**

Resolve square brackets for Table 7.9.1-4: Evaluation parameters for Automated Guided Vehicles sensing scenarios:

|  |  |  |
| --- | --- | --- |
| Sensing Target | 3D mobility | Horizontal velocity with random straight-line trajectory   * Option 1: Uniform distribution in the range of up to 30 km/h * Option 2: Fixed velocities {3, 10} km/h |

## ISAC channel model

### RAN1 #116 (Feb. 2024)

Agreement

The common framework for ISAC channel model is composed of a component of target channel and a component of background channel,

* Target channel includes all [multipath] components impacted by the sensing target(s).
  + FFS details of the target channel
* Background channel includes other [multipath] components not belonging to target channel
  + FFS details of the background channel
* FFS whether/how to model environment object(s), i.e., object(s) with known location, other than sensing target(s)
  + FFS whether/how to model propagation path(s) between the target(s) and the environment object(s)
* FFS whether/how to model propagation path(s) between the target(s) and the stochastic clutter(s)
* Note: the notation *HISAC* can be revised later if needed

### RAN1 #116bis (Apr. 2024)

Agreement

The following cases of radio propagation in the target channel are considered for the study

|  |  |  |
| --- | --- | --- |
| Case | Tx-target | Target-Rx |
| 1 | LOS condition | LOS condition |
| 2 | LOS condition | NLOS condition |
| 3 | NLOS condition | LOS condition |
| 4 | NLOS condition | NLOS condition |

* Case 1/2/3/4 can be considered for bistatic sensing mode
* At least Case 1/4 can be considered for monostatic sensing mode
* Note: It doesn’t imply the channel response for each link is separately generated then concatenated
* FFS how to determine LOS condition and NLOS condition, e.g., based on LOS probability, or determined based on geometrical locations of environment object (EO).
* In LOS condition, line of sight ray(s) are present between Tx/Rx and target, and there may or may not exist non-line of sight ray(s) between Tx/Rx and target too
* In NLOS condition, there only exist non-line of sight ray(s) between Tx/Rx and target

Agreement

* In the target channel between Tx and Rx, scattering of a sensing target can be modelled as single scattering point or multiple scattering points
* FFS one or multiple incoming/output rays corresponding to a scattering point
* FFS how to select single or multiple scattering points for the target, e.g. depending on the distance between target and Tx/Rx, size/shape of target, etc.
* Note: the sensing target can be assumed in far field of sensing Tx/Rx.
* FFS details to model the single or multiple scattering points

Agreement

RCS of a physical object shows dependency to at least the following factors:

* Type of the object
  + The size of the object
  + The material of the object
  + The shape of the object
* Orientation of the object
* FFS: Distance between Tx/Rx and the object
* The incident angle and scatter angle
* The carrier frequency
* polarization of the transmitter and receiver
* FFS Temporal or spatial consistency
* FFS antenna pattern
* FFS whether/how to model the above factors in the CR, e.g. with an RCS model with a scattering point

Agreement

EO is a non-target object with known location.

* FFS other known parameters of the EO
* FFS details on EO modelling

The following options for EO modelling are considered for further study

* + Option 1: EO is modelled different from a sensing target
    - Applicable at least for an EO having extremely large size (referred as EO type-2 for discussion purpose)
    - FFS modeled similar to section 7.6.8 ground reflection in TR 38.901
    - FFS EO modelling impacts the target channel and/or the background channel
  + Option 2: EO is modeled same/similar as a sensing target
    - Applicable for an EO having comparable physical characteristics as a sensing target, (referred as EO type-1 for discussion purpose)
    - FFS Applicable for EO type-2
    - FFS EO modelling impacts the target channel and/or the background channel
  + Option 3: EO is modeled and its location is determined from a stochastic clutter generated following the cluster generation in TR 38.901
    - FFS details
  + Option 4: EO is not modelled
  + Other options are not precluded
  + Note: it is not precluded that multiple options can be supported in the channel modelling

Agreement

The following options are considered for further study to model the target channel for a target

* Option 1: modelled by concatenation of path(s) from Tx to target and from target to Rx
* Option 2: modelled by Tx-to-Rx path(s) satisfying Tx-target-Rx geometry
* Option 3: combination of Option 1 and Option 2

Agreement

If a target is modelled with single scattering point, the following options to model RCS of the target are considered for further study.

* + Option 1: Random RCS value generated by a statistical distribution, depending on the factor(s) having impacts on the RCS modelling.
    - FFS the distribution.
    - FFS the factor(s)
  + Option 2: Deterministic RCS value is defined by a function and/or a table, depending on the factor(s) having impacts on the RCS modelling
    - Note: Constant RCS for a target type can be a special case of Option 2
    - FFS the factor(s)
    - FFS details of function and/or table
  + Option 3: combination of Option 1 & 2, e.g., RCS value is generated by combining a deterministic component and a randomly generated component.
  + FFS application of each option to large scale fading and/or small scale fading
  + FFS target with multiple scattering points

Agreement

* Interested companies are encouraged to submit validation results together with their proposal for ISAC channel modelling
* Up to each company to select the way for validation
  + Option 1: Experimental results
  + Option 2: Experimental results to validate a ray-tracing model, then the ray-tracing based results to validate the ISAC channel model
    - Note: the layout of the scenario used for validation is up to company choice

Agreement

ISAC channel model for link level simulation is to be discussed after the system level channel model is sufficiently stable with basic functionalities.

### RAN1 #117 (May 2024)

Agreement

* Multiple sensing targets can be modelled in the ISAC channel of a pair of sensing Tx and sensing Rx
  + FFS whether to model a propagation path from Tx to Rx interacting with more than one sensing target
* The same sensing target can be modelled in the ISAC channels of multiple pairs of sensing Tx and Rx

Agreement

* For discussion purpose, the propagation paths in the target channel are classified
  + The direct path, i.e., LOS ray from Tx to target + LOS ray from target to Rx
  + The indirect paths, i.e., any propagation path other than the direct path, including
    - LOS ray from Tx to target + NLOS ray from target to Rx
    - NLOS ray from Tx to target + LOS ray from target to Rx
    - NLOS ray from Tx to target + NLOS ray from target to Rx
* For radio propagation Case 1,
  + For a direct path, the following parameters are [deterministically] generated at least based on the geometry location of Tx, target and Rx
    - AoA/ZoA at Rx
    - AoD/ZoD at Tx
    - AoA/ZoA/AoD/ZoD at target
    - delay
    - FFS initial phase
    - Doppler
    - FFS power/polarization including the impact of RCS
    - FFS the number of direct path(s) for a target
  + FFS on detailed modelling of indirect path(s)
* FFS on details of modelling of indirect paths in radio propagation Case 2/3/4
* To generate the channel coefficients of direct/indirect path(s) in the target channel, the channel coefficient generation function in step 11 in section 7.5 of TR 38.901 (e.g., formula 7.5-22) is used as the start point
  + Note: modification to step 11 is deemed necessary
  + FFS adding impact of small scale RCS
  + FFS Doppler

Agreement

* Spatial consistency should be supported for ISAC channel
* Spatial consistency should be supported based on movement of sensing Tx, sensing target and/or sensing Rx
  + FFS EO handling

Agreement

When the stochastic cluster is used to generate the indirect paths in the target channel of a target

* + The stochastic cluster generation in section 7, TR 38.901 is used as starting point.
    - FFS a stochastic cluster is generated between Tx and Rx satisfying Tx-target-Rx geometry, or between Tx/Rx and target
      * FFS modification to stochastic cluster generation in section 7, TR 38.901
      * FFS use of sub-cluster to model the indirect paths

Note: RAN1 continues studying using EO to generate the indirect paths in the target channel of a target

Agreement

When the stochastic cluster is used to model indirect path in the target channel

* For bistatic, the LOS condition from Tx to target and from target to Rx is determined separately for a target
  + FFS: The correlation of LOS condition of Tx-target and Rx-target links of a target
* For monostatic, a same LOS condition is determined for Tx to target and target to Rx
* The LOS condition from Tx to target and/or from target to Rx is determined with the LOS probability
  + The probability schemes in existing 3GPP TRs, e.g., TR 38.901. TR 36.777, TR 37.885, etc. are considered as start point
  + FFS: How to consider the impacts of target height on LOS probability.

Agreement

When stochastic cluster is used to model indirect path in the target channel, down-select between the following options

* Option 1: modelled by concatenation of path(s) from Tx to target and from target to Rx
  + For each of the Tx-target link and target-Rx link,
    - The parameters delay, power, angle, [initial phase], [Doppler] of NLOS ray(s) in the link Tx-to-Target or Target to RX are generated
      * FFS following cluster generation in section 7, 38.901
    - The target channel is generated by concatenating the parameters of the Tx-target link and target-Rx link.
      * FFS on Convolutional or 1-by-1 coupling or 1-to-many coupling
  + FFS how to combine the clusters in target channel and the clusters in background channel
* Option 2: modelled by Tx-to-Rx path(s) satisfying Tx-target-Rx geometry of the direct path
  + The parameters delay, power, angle, initial phase of a stochastic (sub-)cluster between Tx and Rx are generated following cluster generation in section 7, 38.901
    - The parameters [delay], [power], [angle], [Doppler] of the (sub-)cluster are updated by the target property
  + FFS how to combine the clusters in target channel and the clusters in background channel

### RAN1 #118 (Aug. 2024)

Agreement

if RCS related coefficient of a scattering point is included in small scale, the RCS related coefficients are separately determined for different pairs of incident/scattered ray(s) at the scattering point.

Agreement

For radio propagation Case 1, for modelling the target channel of a target with single scattering point,

* To model a direct path, a single LOS ray from Tx to target and a single LOS ray from target to Rx are generated
  + AoA/ZoA of the direct path at Rx, AoD/ZoD of the direct path at target are generated at least based on the 3D location of target and Rx in the global coordinate system
  + AoD/ZoD of the direct path at Tx, AoA/ZoA of the direct path at target are generated at least based on the 3D location of Tx and target in the global coordinate system
  + The Delay of the direct path = (d3D\_tx\_target + d3D\_target\_rx)/c
  + The Doppler of the direct path is generated by spherical unit vectors by AoD/ZoD at Tx, by spherical unit vectors by AoA/ZoA at Rx, and velocity of Tx, target and Rx
  + The power of the direct path is generated as the product of the power of the LOS ray from Tx to target, the power of the LOS ray from target to Rx, and the effect of RCS
  + FFS initial phase
  + FFS how to model RCS, polarization of target
* FFS number of direct paths
* FFS on detailed modelling of indirect path(s)
* FFS applicability of direct path generation to each scattering point when the target is modelled as multiple scattering points

Agreement

For the target channel of a target with single scattering point, when stochastic cluster is used to model an indirect path in the target channel,

* An indirect path in small scale is modelled by concatenation of path(s) from Tx to target and from target to Rx, i.e., Option 1 in the agreement of RAN1 #117
  + AoD/ZoD/AoA/ZoA from Tx to target or from target to Rx are
    - generated for a LOS ray at least based on the 3D location of Tx/Rx and target in the global coordinate system
    - stochastically generated for a NLOS ray using section 7, 38.901 as starting point
  + Delay is sum of delay of LOS/NLOS ray from Tx to target and the LOS/NLOS ray from target to Rx
  + Doppler is generated by spherical unit vector by AoD/ZoD at Tx and velocity of Tx, by spherical unit vector by AoA/ZoA at Rx and velocity of Rx, and by spherical unit vectors by AoA/ZoA/AoD/ZoD at target and velocity of target
    - FFS The mobility of stochastic clutter
  + The power of the indirect path is generated as the product of the power of the LOS/NLOS ray from Tx to target, the power of the LOS/NLOS ray from target to Rx and the effect of RCS
  + FFS initial phase
  + FFS how to model effect of RCS at target
  + FFS whether/how to model polarization at target
  + FFS How to reduce complexity
  + FFS applicability of the indirect path generation to each/a single scattering point when the target is modelled as multiple scattering points

Working assumption

The RCS related coefficient of a scattering point can be modelled with two components, i.e., linear value RCS = A\*B

* A first RCS component A (*m*2) is included in large scale
  + FFS the first RCS component is deterministic or stochastic
  + FFS The first component is dependent on incident and scattered directions at target
* A second RCS component B (unit ratio) is included in small scale
  + FFS The second component is dependent on incident and scattered directions at target
  + FFS the second RCS component is deterministic or stochastic or combination
* Note: RCS component A or B can be disabled by setting its linear value to 1
  + Whether to disable a component can be discussed per target type
* FFS how to determine A and B for each target
* FFS whether/how to model polarization impact at target
* FFS whether/how to normalize power accounting for target channel and background channel

Agreement

The impact of a scattering point of the target in the target channel is modelled by a scalar RCS value times a complex-valued 2x2 polarization matrix , i.e.,

* + FFS whether is angular/ray-dependent or independent
  + FFS whether polarization matrix is modelled assuming specular reflection or random coefficient for diffraction or scattering
  + FFS whether polarization matrix is explicitly modelled or merged with other polarization matrixes from Tx to target and/or from target to Rx

Agreement

For modeling stochastic cluster in background channel, in order to define the background channel for TRP-UE and UE-TRP bistatic sensing mode,

* The large scale and small scale parameters defined in TR 38.901, TR 37.885, TR 36.777 are used as start point

In order to define the background channel for TRP-TRP and UE-UE bistatic sensing mode,

* RAN1 to study how to model background channel
  + Option 1: The large scale and small scale parameters defined in TR 38.901, TR 38.858, 37.885, 38.859 are used as start point
  + Option 2: New channel model based on measurement results or ray-tracing model validated by experimental results

FFS whether/how to do power normalization between target channel and background channel

Agreement

In order to define the background channel for TRP and UE mono-static sensing mode,

* RAN1 to study how to model the background channel
  + Option 1: randomly drop at least one virtual Rx, and then the background channel is generated based on the channel generated as TR 38.901 between the real Tx and each virtual Rx for a scenario
    - FFS EO is modelled in the background channel
  + Option 2: New channel model based on measurement results or ray-tracing model validated by experimental results or radar literatures
    - FFS EO is modelled in the background channel
  + Option 3: the locations of clusters in the target channel are deterministically generated, then the background channel is generated using the clusters with the determined locations.
  + Other options are not precluded

Agreement

When EO type-2 is modelled, specular reflection is considered to model EO type-2 using section 7.6.8 of TR 38.901 as reference

* As starting point, the effect of type-2 EO (i.e., in the path node1-EO-node2) is modelled as , b is a scaling factor (e.g., c equals to relative to LOS ray in section 7.6.8 in TR 38.901)
  + FFS any update to
  + FFS any update taking EO orientation into account
* FFS any changes based on section 7.6.8 of TR 38.901 if EO type-2 has finite size
* FFS whether diffraction and scattering can be considered in addition to specular reflection
* EO type-2 is an optional modelling component if supported in a sensing scenario
  + FFS which deployment scenario(s) EO type-2 will apply

### RAN1 #118bis (Oct. 2024)

Agreement

RAN1 strives to define a single option per target per monostatic/bistatic sensing mode from the following two options to generate RCS values/patterns for a scattering point of a target.

* Option 2: The RCS=A\*B of a scattering point can be generated by
  + The component A is commonly applied to any incident/scattered angles at the scattering point
    - A is [mean] RCS value. FFS value(s) A
      * Note: Mean RCS value is defined as the mean value of the distribution of RCS
  + The component B
    - B is generated by [log-normal] distribution, the related [log-normal] distribution has mean μ=1 and variance V, FFS σ2
      * B is separately generated for each direct/indirect path at the scattering point. FFS correlation dependent on the incident/scattered angles of the direct/indirect paths
  + FFS whether/how power of all generated direct/indirect paths need to be normalized considering impact of RCS
* Option 3: The RCS=A\*B=A\*B1\*B2 of a scattering point can be generated by
  + The component A is commonly applied to any incident/scattered angles at the scattering point
    - FFS: A = 1 m2 or [mean] RCS value
      * Note: Mean RCS value is defined as the mean value of the distribution of RCS
  + The component B is further split into B1, B2, i.e., B=B1\*B2
    - B1 is deterministic based on incident/scattered angles
      * FFS: B1 is defined by a function or by a table
    - B2 is generated by [log-normal] distribution, the related [log-normal] distribution has mean μ=1 and variance V, FFS σ2
      * B2 is separately generated for each direct/indirect path at the scattering point. FFS correlation dependent on the incident/scattered angles of the direct/indirect paths
  + FFS whether/how power of all generated direct/indirect paths need to be normalized considering impact of RCS

Agreement

RCS Option 3 is selected to model RCS of UAV with single scattering point for monostatic

* + B2 of UAV is modelled using log-normal distribution for monostatic
  + Different mean RCS values can be supported for UAV due to different size, shape, frequency, etc.
  + For UAV of small size (option 2 for UAV size in UAV parameters table)
    - B1=1
    - A is mean RCS value
  + For UAV of large size (option 1 for UAV size in UAV parameters table)
    - B1 have dependency on incident/scattered angles
    - A is mean RCS value

Agreement

To model the effect of polarization for each direct/indirect path:

* Polarization of a direct/indirect path is product of polarization matrix of Tx-target link, the target, and the target-Rx link
  + Total polarization of a direct/indirect path is *CPMtx,sp,rx= CPMsp,rx* . *CPMsp* . *CPMtx,sp*
    - For a LOS ray from Tx to target or from target to Rx, for *CPMtx,sp* or *CPMsp,rx*
    - For a NLOS ray generated by a stochastic cluster from Tx to target or from target to Rx, *CPMtx,sp* or *CPMsp,rx* is generated by XPR ratio ** and initial random phases referring to TR 38.901 as start point
    - FFS how to normalize on *CPMtx,sp,rx*
    - FFS *CPMsp* of a scattering point of the target
* FFS: how to model the effect of polarization when EO type-2 is present

Agreement

A single direct path is modeled for a scattering point of target

* In each of the Tx-target and target RX links, the first NLOS cluster is generated with same delay as the LOS ray (when the absolute delay modelling of as in section 7.6.9, TR 38.901 is not applied) and with the same direction as the LOS ray.
  + FFS how to generate NLOS cluster when is applied

Agreement

In order to generate each of the Tx-target link and target-Rx link in the target channel, the large scale and small scale parameters defined in existing 3GPP TRs, e.g., TR 38.901. TR 36.777, TR 37.885, TR 38.858, TR 38.859, TR 38.802, TR 38.854, etc. are used as starting point

Agreement

On the background channel for TRP-TRP and UE-UE bistatic sensing mode, the large scale and small scale parameters defined in TR 38.901, TR 38.858, 37.885, 38.859 are used as starting point

* Update on values of the LSP/SSP parameters can be discussed based on validation data acquired by measurement or ray-tracing model
  + FFS The power threshold for removing clusters in step 6, i.e., -25 dB is revised to X<-25 dB. FFS X
* FFS whether/how to resolve the inconsistency between TRP-TRP channel according to TR 38.858 and the TRP-target (UAV) channel according to TR 36.777 when UAV and TRP are set to same height

Agreement

3D spatial consistency needs to be studied for at least UAV scenario

Agreement

In LOS condition between sensing Tx/Rx and target, the power of LOS ray is generated following power of LOS ray in TR 38.901.

Agreement

The following options are to be studied for the concatenation of Tx-target and target-Rx link in the target channel

* Direct path (if present) is always kept
* Indirect paths of LOS+NLOS, NLOS+LOS (if present) are generated
* On other indirect paths of NLOS + NLOS
  + Option 0: ray level full convolution between Tx-target link and target-Rx link for radio propagation Case 1/2/3/4
  + Option 0A: ray level full convolution between Tx-target link and target-Rx link only for radio propagation Case 4
  + Option 1: cluster level full convolution between Tx-target link and target-Rx link, then 1-by-1 coupling rays within each pair of clusters for radio propagation Case 1/2/3/4
  + Option 1A: cluster level full convolution between Tx-target link and target-Rx link, then 1-by-1 coupling rays within each pair of clusters only for radio propagation Case 4
  + Option 2: cluster level 1-by-1 coupling between Tx-target link and target-Rx link, then 1-by-1 coupling rays within each pair of clusters for radio propagation Case 1/2/3/4
  + Option 2A: cluster level 1-by-1 coupling between Tx-target link and target-Rx link, then 1-by-1 coupling rays within each pair of clusters only for radio propagation Case 4
  + Option 3: ray level 1-by-1 coupling between Tx-target link and target-Rx link for radio propagation Case 1/2/3/4
  + Option 3A: ray level 1-by-1 coupling between Tx-target link and target-Rx link only for radio propagation Case 4
* Note: reducing the number of rays per cluster and/or reducing the number of clusters can be considered for the options above
* Any indirect path with power metric less than [threshold] is dropped
  + the power metric of a path is the product of power of a ray in Tx-target link, power of a ray in target-Rx link and RCS of the pair of rays
  + FFS power normalization of target channel after path dropping
  + FFS the set of remaining indirect paths can be updated during movement of Tx, target or Rx

### RAN1 #119 (Nov. 2024)

Agreement

Bistatic RCS values for a scattering point of a target are obtained by fixing an incident direction in LCS of target and varying the scattered directions in LCS of target; then changing to other incident direction.

Agreement

* To generate indirect paths of NLOS ray + NLOS ray in the target channel
  + Option 0 is recommended, i.e., ray level full convolution between Tx-target link and target-Rx link for radio propagation Case 1/2/3/4
  + Option 3 to generate a reduced number of indirect paths of NLOS ray + NLOS ray is recommended, i.e., ray level 1-by-1 random coupling between Tx-target link and target-Rx link is supported for radio propagation Case 1/2/3/4
    - If number of rays in the two links are different, e.g., M1, M2 respectively for link 1 and link 2,
      * If M1<M2, randomly M1 rays are selected in link 2, otherwise randomly M2 rays are selected in link 1
  + Other methods are up to company choice for complexity reduction
  + Both option 0 and 3 will be calibrated independently. Company should report which option is used in calibration
* The power threshold for path dropping is X=[-25] dB
  + X is relative to the strongest indirect path in the target channel
* FFS: further power normalization of target channel is performed after path dropping,
* Note: power normalization when target channel and background channel are combined can be discussed separately
* FFS The set of remaining indirect paths can be updated during movement of Tx, target or Rx

Agreement

The following RCS models are supported when human is modelled with single scattering point for monostatic, where different RCS values and/or models can be supported for human due to different size, shape, frequency, etc.

* Model 1
  + B1=0 dB
  + A is mean RCS value
  + B2 is modelled using log-normal distribution
* Model 2
  + B1 have dependency on incident/scattered angles, with further down-selection among the alternatives below:
    - Alt 1: formulated similar as the antenna radiation power pattern in 38.901
    - Alt 2: a function
    - Alt 3: Lookup table
  + B2 is modelled using log-normal distribution
  + FFS RCS component A
* FFS: conditions for using which model

Agreement

The following RCS model is supported when vehicle is modelled with single scattering point for monostatic, where different RCS values can be supported for vehicle due to different size, shape, frequency, etc.

* + B1 have dependency on incident/scattered angles, with further down-selection among the alternatives below:
    - Alt 1: formulated similar as the antenna radiation power pattern in 38.901
    - Alt 2: a function
    - Alt 3: Lookup table
  + B2 is modelled using log-normal distribution
  + FFS RCS component A

Agreement

When vehicle is modelled with multiple scattering points for monostatic, where different RCS values can be supported for vehicle due to different size, shape, frequency, etc.

* the recommended five scattering points are located in front, left, back, right and roof side of the vehicle
* the following RCS model is supported for each scattering point
  + B1 have dependency on incident/scattered angles, with further down-selection among the alternatives below:
    - Alt 1: formulated similar as the antenna radiation power pattern in 38.901
    - Alt 2: a function
    - Alt 3: Lookup table
  + B2 is modelled using log-normal distribution
  + FFS RCS component A

Agreement

EO type-1 (when modelled) is modelled in the same way as a sensing target in the ISAC channel model.

Agreement

* If blockage/forward scattering between sensing targets is not considered, a propagation path from Tx to Rx interacting with more than one sensing targets is not modelled
* FFS whether/how blockage/forward scattering can be modelled in the target channel.

Agreement

* Doppler for a target including both macro-Doppler and micro-Doppler can be modeled using a unified formula,

Where,

* + - is the spherical unit vector at receiver for the link from Rx to the scattering point
    - is the spherical unit vector at transmitter for the link from Tx to the scattering point
    - is the spherical unit vector at the scattering point for the link from the scattering point to Rx
    - is the spherical unit vector at the scattering point for the link from the scattering point to Tx
  + Dual mobility model in 7.6.10, TR 38.901 is used as start point to model Doppler effect due to movement of stochastic clusters, i.e.,
    - is only applicable for indirect path
    - Support one term of for indirect path of LOS ray+NLOS ray, NLOS ray+LOS ray
    - Support two terms of for indirect path of NLOS ray+NLOS ray
  + Doppler is separately determined for each of the multiple scattering points of a target
  + can include macro-Doppler and/or micro-Doppler motion,
  + FFS: maximum speed of moving scatterers
  + FFS: ratio of moving scatterers among all scatterers

Agreement

* The following options are supported to generate the combined ISAC channel
  + Option 1: The ISAC channel of a pair of sensing Tx/Rx is obtained by summing the target channel(s) and background channel, i.e., power normalization is not performed.
  + Option 2: As an additional modelling component, power normalization is performed when summing the target channel(s) and background channel, to keep the same/similar channel power as the background channel without target. Down select between
    - Alt 1: Power normalization on both target channel and background channel
    - Alt 2: Power normalization on background channel only
    - Alt 3: the target channel of a target will replace one cluster in the background channel
* FFS Blockage is modelled for the background channel due to sensing target and/or EO type-2
* FFS condition to select option, e.g. depending on scenario, sensing mode, number of target/EO type-2

Agreement

To model the polarization matrix of a direct/indirect path at a scattering point of an object other than EO type-2, the polarization matrix of the scattering point, i.e., is modelled by and initial random phases , i.e.,

* + The initial random phase is [uniformly distributed within
  + FFS correlation between
  + FFS specular reflection
  + FFS: CPM normalization

The following options are considered for further study, down select one option from the following

* Option 1: , is generated for path i, where is XPR ratio
  + is randomly generated by log-normal distribution. FFS mean/variance of the distribution
* Option 2: , are variables generated for path i
* Option 3: are variables generated for path i
  + defined in LCS
* Option 4: , is generated for path i

Agreement

The finite size of the EO type-2 affects identification of specular reflection point. In the target channel, EO type-2 is modelled only if the specular reflection point is in the area of the EO type-2.

Agreement

Component B2 of RCS is upper bounded by kσ dB for the log-normal distribution, where σ is the standard deviation of B2 in dB. FFS the value of k.

Agreement

When the EO type-2 is modelled in the target channel, down select between the following options to determine the LOS condition of the Tx-target link and target-Rx link

* Option A: If type-2 EO is in the LOS ray of one link, the link is determined as NLOS condition, and otherwise use the LOS probability equation to determine the LOS/NLOS condition
  + FFS changes to the LOS probability defined in existing TRs
  + FFS details on blockage by EO type-2
* Option B: Use the LOS probability equation to determine the LOS/NLOS condition of one link, and then the impacts of type-2 EO is modeled by a blockage model

### RAN1 #120 (Feb. 2024)

Agreement

For bistatic/monostatic RCS

* RCS values/pattern for a scattering point of a target for bistatic sensing is generated by A\*B1\*B2 (i.e., Option 3 from the agreement in RAN1 #118bis)
* RCS values/pattern obtained by setting the same incident/scattered angle in the RCS model for bistatic sensing should be aligned with RCS for monostatic sensing

Agreement

RCS model and application in ISAC channel generation

* To define the RCS model (RCS=A\*B1\*B2) for a scattering point of a target, when the target type is vehicle, large size UAV, human with RCS model 2, AGV
  + The values/pattern of the product of component A and B1, i.e., A\*B1 is given per target type, expressed in dBsm scale
  + Component A is expressed in dBsm scale. B1 is dependent on A\*B1 and value of component A.
    - A is equal to a single value per target type
      * FFS: this allows different values for the same target type with different size, if needed
      * FFS: this allows different values for monostatic and bistatic sensing, if needed
  + Component B2 follows log-normal distribution. The mean and variance used to characterize satisfied a fixed relation .
* In the procedure of generating ISAC target channel, B1\*B2 is applied after coupling of rays for a STX-SPST link and the corresponding SPST-SRX link before path dropping
* In the procedure of generating ISAC target channel, the following power scaling factor is applied in the last step in target channel generation (i.e., step 14 in the running CR).

Where,

* + - is pathloss between Tx and SPST, where is the distance between Tx and SPST
    - is pathloss between Rx and SPST, where is the distance between SPST and Rx
    - is the value of RCS component A
    - are shadow fading respectively generated for the Tx- SPST link and SPST -Rx link referring to step 4 in section 7.5, TR 38.901
    - Note: for monostatic sensing,

Agreement

RCS upper bound: k equals to 3 is adopted to derive the upper bound of RCS component B2, kσ, where σ is the standard deviation of B2 in dB

Agreement

For vehicle with single/multiple scattering points:

* For mono-static, the RCS=A\*B=A\*B1\*B2 for a scattering point of a vehicle is generated by
  + The values/pattern A\*B1, i.e., is deterministic based on incident/scattered angles

Where,

*,*

*,*

For example, in case of vehicle with multiple scattering points:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* |
| *Left* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* |
| *Back* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* |
| *Right* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* |
| *Front* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* |
| *Roof* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* | *[ ]* |

* + Note: the applicable angular range is 360 degrees per row in horizontal domain in case of vehicle with multiple scattering points, and the applicable angular range is < 360 degrees per row in horizontal domain in case of vehicle with a single scattering point.
    - FFS: angular continuity

Agreement

For mono-static, the following values of component A, B2 are agreed for UAV of small size

* + Component A: -12.81 dBsm
  + Component B1: 0 dB (already agreed in RAN1#118bis)
  + Component B2:
    - standard deviation: 3.74 dB

Agreement

For mono-static, the following values of component A, B2 are agreed for RCS model 1 of human

* + Component A: -1.37 dBsm
  + Component B1: 0 dB (already agreed in RAN1#118bis)
  + Component B2:
    - standard deviation: 3.94 dB

Agreement

To model polarization matrix of a direct/indirect path i of a scattering point of a target

* + in Rel-19 study item (e.g., UAV, human, vehicle, AGV), , , i.e.,

Where,

* + - is XPR ratio is randomly generated by log-normal distribution per target type
    - The initial random phase is uniformly distributed within
  + FFS: spatial consistency of random phase when a scattering point moves
  + FFS: whether the base station rotation procedure in 38.901 can be reused to support rotation of the target

Agreement

For reducing options for reference TRs: for sensing scenario UMi, UMa, RMa, InH, InF, UMi-AV, UMa-AV, and RMa-AV, the reference TR to generate a TRP-TRP channel is:

* TRP-TRP link of scenario UMi, UMa, InH, and InF following the option based on TR 38.901 defined in section A.3 of TR 38.858
  + For InF, hUE is changed to the same height as the BS
* TRP-UE link of scenario RMa defined in section 7 of TR 38.901 by setting hUE=35m
* FFS: whether to add very low power clusters

Agreement

For sensing scenario UMi, UMa, RMa, InH, InF, UMi-AV, UMa-AV, and RMa-AV, the reference TR to generate a UE-UE channel is

* UE-UE link of scenario UMi, UMa, InH, and InF following the option based on TR 38.901 defined in section A.3 of TR 38.858
* TRP-UE link of scenario RMa defined in section 7 of TR 38.901 by setting hBS =1.5m
* FFS: whether to add very low power clusters

Agreement

The reference TR to generate a TRP-UE channel is

|  |  |  |
| --- | --- | --- |
| TRP | normal UE | UMi, UMa, RMa, InH, InF, UMi-AV, UMa-AV, and RMa-AV   * Option 1: TRP-UE link of scenario UMi, UMa, RMa, InH, and InF in section 7 of TR 38.901   Highway and Urban grid   * Option 1: P2B link of scenario Highway and Urban grid in section 6 of TR 37.885   HST   * Option 1: TRP-UE link of scenario RMa in section 7 of TR 38.901 for FR1 and TRP-UE link of scenario UMa in section 7 of TR 38.901 for FR2 |
| TRP | vehicle UE | Highway and Urban grid   * Option 1: V2B link of scenario Highway and Urban grid in section 6 of TR 37.885   UMi, UMa, and RMa   * Option 1: TRP-UE link of scenario UMi, UMa, and RMa in section 7 of TR 38.901 |
| TRP | aerial UE | UMa-AV, UMi-AV, and RMa-AV   * Option 1:   + TRP-aerial UE link of scenario UMa-AV, UMi-AV, and RMa-AV in section Annex A and B of TR 36.777 for FR1   + FFS reuse the channel model of scenario UMa-AV, UMi-AV, and RMa-AV of FR1 for FR2 |

Working assumption

For modelling background channel for monostatic sensing:

**Solution A: (previous Option 1)**

* drop N reference point(s) following certain distribution, and then the background channel is generated based on the channel generated as in existing TR between the real Tx and the reference point for a scenario.
  + The distance between Tx and the reference point, and the height of the reference point follow Gamma distribution,

1

* + FFS: value of N (N<4)
* FFS: whether to add additional very low power clusters
* FFS: any update to parameters e.g. angular distribution and delay spread

Working assumption

Absolute delay model (referring to 7.6.9 in TR 38.901 as starting point) is a mandatory feature for both target channel and background channel for ISAC for UMi, UMa, InH, InF

* Related model referring to values from 7-24GHz study item

Agreement

When absolute delay model is configured, it applies to all NLOS clusters in each of Tx-target and target-Rx links and background channel.

* For bistatic sensing: Different values of are separately generated for the Tx-target link, target-Rx link and the background channel
* For monostatic sensing: the same value of is used for Tx-target link and target-Rx link, and a different value of is separately generated for the background channel

Agreement

The existing spatial consistency model in TR 38.901 is reused to model correlation of links between one TRP and different STs/UEs.

Agreement

Spatial consistency is not modelled at least for the following links

* Case 1: the links from/to two non-co-located TRPs
  + Link TRP1-X and link TRP2-X, where node X can be a target, a UE or another TRP
  + Link TRP1-X and link TRP2-Y, where node X, Y can be a target, a UE or another TRP
* Case 2: the two links with different LOS/NLOS condition
* Case 3: background channel for monostatic vs. any link (Tx-ST, ST-Rx, background channel) for bistatic

Agreement

Spatial consistency is needed to model correlation of the following links from ST-UT links and UT-UT links

* Case 5: links between same UT and two nodes X/Y, subjected to correlation distance, i.e., link UT1-X and link UT1-Y, where nodes X/Y can be target or UT
* Case 6: links between same target and two nodes X/Y, subjected to correlation distance, i.e., link target1-X and link target1-Y, where nodes X, Y are different UTs
* Case 7: link X1-Y1 and link X2-Y2, subjected to correlation distance, where X1, X2, Y1, Y2 are 4 different nodes
* FFS: Spatial consistency between multiple scattering points of the same target



Agreement

Correlation type is introduced for large scale parameter, cluster specific parameter and ray specific parameter of ST-UT links and UT-UT links

* Definition of link Correlated: parameters for any two links between STs/UTs are correlated, subjected to correlation distance.

Table 4: Correlation type for links between STs/UTs

|  |  |
| --- | --- |
| Parameters | Correlation type |
| Delays | link Correlated |
| Cluster powers | link Correlated |
| AOA/ZOA/AOD/ZOD offset | link Correlated |
| AOA/ZOA/AOD/ZOD sign | link Correlated |
| Random coupling | link Correlated |
| XPR | link Correlated |
| Initial random phase | link Correlated |
| LOS/NLOS states | link Correlated |
| Blockage (Model A) | All-correlated |
| O2I penetration loss | All-correlated |
| Indoor distance | All-correlated |
| Indoor states | All-correlated |

* Note: it is not precluded more parameters for spatial consistency can be discussed and added in the table

Agreement

* For target channel
  + The power threshold for removing clusters in step 6 in section 7.5, TR 38.901, i.e., -25 dB is reused to generate Tx-target link and target-Rx link
  + The power threshold for path dropping after concatenation is relaxed to [X=-40] dB
* For background channel
  + The power threshold for removing clusters in step 6 in section 7.5, TR 38.901, i.e., [-25 dB] is reused to generated the background channel
    - FFS: whether to add additional very low power clusters
    - FFS: The reference power for removing cluster is the min (max. Tx-target link cluster power, max. target-Rx link cluster power)

Agreement

If EO type-2 is modelled in an indirect path, only specular reflection is modeled for EO type-2

* polarization of the indirect path is product of polarization matrix of the target-Rx link, the target, and the Tx-target link, i.e., *CPMtx,sp,rx= CPMsp,rx* . *CPMsp* . *CPMtx,sp*
  + For the specular reflected ray generated by a EO type-2 in the Tx-target link or the target-Rx link (i.e., Tx-EO type-2-target, or target-EO type-2-Rx), *CPMtx,sp* or *CPMsp,rx* is the polarization matrix of EO type-2
  + To generate polarization matrix of EO type-2, the procedure in [R1-2409394, R1-2410648] is taken as starting point
    - FFS applicability if the surface of EO type-2 is tilted

Agreement ([Post-120-ISAC-01])

On the monostatic RCS of vehicle with single scattering point,

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* |
| *Left* | 90 | 26.90 | 79.70 | 44.42 | 20.75 | 13.68 | [30°,180° ] | (45°,135°] |
| *Back* | 180 | 36.32 | 79.65 | 36.73 | 14.56 | 7.50 | [30°,180° ] | (135°,225°] |
| *Right* | 270 | 26.90 | 79.70 | 44.42 | 20.75 | 13.68 | [30°,180° ] | (225°,315°] |
| *Front* | 0 | 40.54 | 71.75 | 29.13 | 15.52 | 8.45 | [30°,180° ] | (-45°, 45°] |
| *Roof* | - | - | 0.00 | 18.13 | 21.26 | 14.19 | [0°,30° ) | [0°,360°) |

* + When is in the range [0°,30° ),
* The standard deviation of component B2 is 3.41 dB

Agreement ([Post-120-ISAC-01])

On the monostatic RCS for each scattering point of vehicle with multiple scattering points,

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* |
| *Left* | 90 | 26.90 | 79.70 | 44.42 | 20.60 | 20.52 | [0°,180° ] | [0°,360°] |
| *Back* | 180 | 36.32 | 79.65 | 36.73 | 13.90 | 13.82 | [0°,180° ] | [0°,360°] |
| *Right* | 270 | 26.90 | 79.70 | 44.42 | 20.60 | 20.52 | [0°,180°] | [0°,360°] |
| *Front* | 0 | 40.54 | 71.75 | 29.13 | 14.99 | 14.91 | [0°,180° ] | [0°,360°] |
| *Roof* | - | - | 0.00 | 18.13 | 21.12 | 21.05 | [0°,180° ] | [0°,360°] |

* + For the scattering point associated with roof of the vehicle,
* The standard deviation of component B2 is 3.41 dB

Agreement ([Post-120-ISAC-01])

On the monostatic RCS for UAV with large size and AGV

* The monostatic RCS for a scattering point of the target is generated by
  + The values/pattern A\*B1, i.e., is deterministic based on incident/scattered angles

Where,

*,*

*,*

* + FFS how many rows of the values/pattern A\*B1 are defined for the target
    - Note: each row has a defined applicable range of and
* FFS human RCS model 2

### RAN1 #120bis (Apr. 2024)

Agreement

In order to generate Tx-target link, target-Rx link and the background channel, the above table on reference TRs (excluding the already agreed part) is adopted for the mapping between reference TRs and a pair of nodes (STX, SRX, target)

* + Note: continue discussion for updating the table with RSU type UE
  + FFS: the generation of background channel based on reference TRs is subject to the addition of low-energy clusters

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **Node 1** | **Node 2** | **Existing TRs as starting point** |
| 1 | TRP | TRP | Highway   * TRP-UE link of scenario RMa in section 7 of TR 38.901 by setting hUE=35m for FR1 * TRP-TRP link of scenario UMa following the option based on TR 38.901 defined in section A.3 of TR 38.858   Urban grid   * TRP-TRP link of scenario UMa following the option based on TR 38.901 defined in section A.3 of TR 38.858   HST   * TRP-UE link of scenario RMa in section 7 of TR 38.901 by setting hUE=35m for FR1 * TRP-TRP link of scenario UMa in section A.3 of TR 38.858 for FR2 |
| 4 | TRP | aerial UE | UMa-AV, UMi-AV, and RMa-AV   * Reuse the channel model of scenario UMa-AV, UMi-AV, and RMa-AV of FR1 for FR2 |
| 5 | normal UE | normal UE | For pedestrian type UE:  Highway and Urban grid   * P2P link in section 6 of TR 37.885   HST   * TRP-UE link of scenario RMa in section 7 of TR 38.901 for FR1, e.g., hBS=1.5m, UE-UE link of scenario UMa following the option based on TR 38.901 defined in section A.3 of TR 38.858 for FR2 |
| 6 | normal UE | vehicle UE | UMi, UMa, RMa   * UE-UE link of scenario UMi, UMa following the option based on TR 38.901 defined in section A.3 of TR 38.858 * TRP-UE link of scenario RMa defined in section 7 of TR 38.901 by setting hBS =1.5m   For pedestrian type UE:  Highway and Urban grid   * V2P link in section 6 of TR 37.885 |
| 7 | normal UE | aerial UE | UMi-AV, UMa-AV, and RMa-AV   * TRP-aerial UE link of UMi-AV in Annex A and B of TR 36.777 by setting hBS =1.5m for FR1   + LOS probability is not reused, FFS new LOS probability   + FFS pathloss model, shadowing fading * Working assumption: Reuse the channel model of scenario UMa-AV, UMi-AV, and RMa-AV of FR1 for FR2   + The corresponding parameter values in FR2 are used |
| 8 | vehicle UE | vehicle UE | Highway and Urban grid   * V2V link of scenario Highway and Urban grid in section 6 of TR 37.885   UMi, UMa, and RMa   * UE-UE link of scenario UMi, UMa following the option based on TR 38.901 defined in section A.3 of TR 38.858 * TRP-UE link of scenario RMa defined in section 7 of TR 38.901 by setting hBS =1.5m |
| 9 | aerial UE | aerial UE | UMi-AV, UMa-AV, RMa-AV   * TRP-aerial UE link of UMi-AV in Annex A and B of TR 36.777 by setting height of TRP equal to the height of the first aerial UE for FR1   + LOS probability is not reused, FFS new LOS probability   + FFS pathloss model, shadowing fading, angular spread * Working assumption: Reuse the channel model of scenario UMa-AV, UMi-AV, and RMa-AV of FR1 for FR2   + The corresponding parameter values in FR2 are used |

Agreement

To generate the parameters (in the steps before concatenation), the large-scale parameters and the small-scale parameters used to generate the Tx-target link are respectively the same as that of the target-Rx link for monostatic sensing, where departure angle on one link and arrival angle on the other link are reciprocal.

* + FFS: whether this applies to initial phase

Agreement

Normalization on the product of three polarization matrixes of a direct/indirect path generated by stochastic cluster, i.e., *CPMtx,sp,rx= CPMsp,rx* . *CPMsp* . *CPMtx,sp* is supported

* + The scaling factor is

Agreement

Power normalization of target channel after path dropping of the target channel is not supported.

Agreement

On the monostatic RCS for human with RCS model 2

* The monostatic RCS for a scattering point of the target is generated by
  + The values/pattern A\*B1, i.e., is deterministic based on incident/scattered angles

Where,

* + FFS how many rows of the values/pattern A\*B1 are defined for the target
    - Note: each row has a defined applicable range of and
  + Note: whether the RCS is elevation angle dependent or dependent on both elevation and horizontal angles can be separately discussed

Agreement

The following mean and standard deviation values of XPR of targets are agreed for monostatic sensing and bistatic sensing as follows:

* UAV: (13.75, 7.07) dB
* Human: (19.81, 4.25) dB
* Vehicle: (21.12, 6.88) dB

Agreement

When spatial consistency is enabled, the 1-by-1 random coupling generated by concatenation Option 3 is not updated per simulation drop even if Tx, target, Rx positions change during simulation.

Agreement

The following working assumption is confirmed

|  |
| --- |
| Working assumption  Absolute delay model (referring to 7.6.9 in TR 38.901 as starting point) is a mandatory feature for both target channel and background channel for ISAC for UMi, UMa, InH, InF   * Related model referring to values from 7-24GHz study item |

Working assumption

For vehicle with single/multiple scattering points, the bistatic RCS is generated by

* The values/pattern of A\*B1 of bistatic RCS is given by:

where

* + is applied to the within 0~180 degrees. k1= 6 and k2=1.65. is the ~~absolute~~ bistatic angle between the incident ray and scattering ray within the plane of incident direction () and scattering direction ().
  + The angles of () are the projections of the bisector angle on the vertical plane and the horizontal plane, respectively.
    - FFS: RCS value when is 180 degrees
  + The effect of forward scattering is -Inf in Rel-19
  + 5 sets of parameters *Applicable Range of* and *Applicable Range of* are applicable as defined for the monostatic RCS of vehicle with single/multiple SPSTs
  + ~~FFS: how to avoid angular discontinuity~~
  + Continue study on a new formula for to resolve the issue of angular discontinuity.
    - The new formula should retain following property: the linear bistatic RCS for a vehicle with single scattering point is the sum of the bistatic RCS of the multiple scattering points of the vehicle
    - the following formula can be a reference for the study

Note: the working assumption agreed on Thursday was updated on Friday as follows: k1= 6 and k2=1.65

Agreement

On background channel for mono-static sensing, the following details are provided:

* reference points are dropped for one Tx, based on the Gamma distribution for distance and height of reference point.
* The LOS AOD between Tx and the first reference point, which is denoted as AOD1, is generated based on uniform distribution .
* The LOS AOD between Tx and the second reference point is AOD1 +
* The LOS AOD between Tx and the third reference point is AOD1 +
* The background channel is generated based on the channel generated as in existing TR between the real Tx and the reference point assuming NLOS condition.
* The antenna field pattern and array orientation of reference point are set same as Tx.
* Arrival angles for both azimuth and elevation and are set equal to departure angles
* The absolute delay model d3D and as agreed for bistatic sensing for the same sensing scenario applies. Down-select one option from the following:
* Option 0: no scaling factor is applied to d3D
* Option 1: An offset is applied to d3D, i.e., d3D-c1
* Option 2: A scaling factor d\_s is multiplied to d3D, i.e., d3D\*d\_s. d\_s is a value within range [0, 1].
* Note: The adjustment of absolute delay doesn’t impact the generation of NLOS clusters between the Tx and each reference point
* The mono-static background channel for the Tx would be sum of channels of the links between the Tx and all related reference points, which is
* FFS: Doppler frequency in background channel for monostatic sensing
* The rays in a stochastic cluster with ZOA at BS less than D degree are dropped
* D=[90] for RMa,
* D=[60] for UMa
* D=[50] for UMi
* Note: this threshold for ZOA is not applicable to other sensing scenarios

Agreement

To generate the background channel, the power threshold (-25 dB) for removing clusters in step 6 in section 7.5, TR 38.901 is reused.

Agreement

The ISAC background channel can be generated between a sensing Tx and a sensing Rx or RP (relevant for monostatic case) via the following steps:

* Step 1: generate a first set of clusters/rays according to TR 38.901(or other related TRs)
* Step 2: generate a second set of NLOS clusters/rays according to TR 38.901 (or other related TRs), where the power of the second set of clusters/rays should be scaled down such that
* is the power of the NLOS cluster with the strongest power from the first set.
* is the power of the n-th cluster from the second set.
* Where, N is the number of clusters, M is the number of rays within each cluster, value of G relates to power
  + *N*=360, *M*=1, *G* = -25dB, no further change from 38.901, 36.777, 38.858 (i.e., utilizing the same DS, ASA, ASD, ZSA, ZSD, , as used for the first step)
* The step 2 is an additional modeling component

Agreement

For human as a sensing target with a single scattering point, the height of the scattering point is 1.5 m.

Agreement

In sensing scenario UMi, UMa, RMa, if the height of a scattering point of target is less than 1.5m, for pathloss calculation, down-selection one of the options below:

* + Option 4: use in Table 7.4.1-1: Pathloss models in TR 38.901
  + Option 5: use hUT 1.5 m for pathloss calculation

Agreement

For sensing scenario UMi, UMa, RMa, UMi-AV, UMa-AV and RMa-AV, the height of a scattering point of a target is used to calculate the LOS probability and pathloss, regardless of the lower bound in the existing TRs that are referred to generate ISAC channel.

* + FFS for the case where the height of a scattering point of target is less than 1.5m in sensing scenario UMi, UMa, RMa

Agreement ([Post-120bis-ISAC-02])

On the monostatic RCS of UAV of large size,

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* |
| *Left* | *90°* | *7.13°* | *90°* | *8.68°* | *7.43* | *14.30* | *[45°,135°]* | *[45°,135°]* |
| *Back* | *180°* | *10.09°* | *90°* | *11.43°* | *3.99* | *10.86* | *[45°,135°]* | *[135°,225°]* |
| *Right* | *270°* | *7.13°* | *90°* | *8.68°* | *7.43* | *14.30* | *[45°,135°]* | *[225°,315°]* |
| *Front* | *0°* | *14.19°* | *90°* | *16.53°* | *1.02* | *7.89* | *[45°,135°]* | *[-45°,45°]* |
| *Bottom* | */* | */* | *180°* | *4.93°* | *13.55* | *20.42* | *[135°,180°]* | *[0°,360°]* |
| *Roof* | */* | */* | *0°* | *4.93°* | *13.55* | *20.42* | *[0°,45°]* | *[0°,360°]* |

* + When is in the range [0°,45° ] or [135°,180°],
* The standard deviation of component B2 is 2.50 dB

Agreement ([Post-120bis-ISAC-02])

On the monostatic RCS of AGV with single scattering point,

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  | *Applicable Range of* | *Applicable Range of* |
| *Front* | *0°* | *13.68°* | *90°* | *13.68°* | *13.02* | *23.29* | *[30°,180°]* | *[-45°,45°]* |
| *Left* | *90°* | *15.53°* | *75°* | *20.03°* | *7.33* | *17.60* | *[30°,180°]* | *[45°,135°]* |
| *Back* | *180°* | *12.49°* | *90°* | *11.89°* | *11.01* | *21.28* | *[30°,180°]* | *[135°,225°]* |
| *Right* | *270°* | *15.53°* | *75°* | *20.03°* | *7.33* | *17.60* | *[30°,180°]* | *[225°,315°]* |
| *Roof* | */* | */* | *0°* | *11.44°* | *11.79* | *22.06* | *[0°,30°]* | *[0°,360°]* |

* + When is in the range [0°,30° ),
* The standard deviation of component B2 is 2.51 dB

Agreement ([Post-120bis-ISAC-02])

The values of the parameters to generate background channel for TRP monostatic sensing for each sensing scenario are provided in the following table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | | TRP monostatic sensing | | | | |
| Uma /  Urban grid /  Highway(FR2) /  HST(FR2) | UMi | Rma /  Highway(FR1) /  HST(FR1) | Indoor office | Indoor Factory |
| Distribution of 2D distance between Tx and reference points |  | 10.3370 | 6.1996 | 6.2025 | 4.236 | 0.039836 |
|  | 0.1317 | 0.1558 | 0.0391 | 0.19255 | 0.179783 |
|  | 68.7778 | 15.2697 | 1.2940 | 4.99 | 1.130020 |
| Distribution of height of reference points |  | 16.2253 | 12.0487 | 0.0007 | 1.3293 | 0.283447 |
|  | 1.9218 | 2.3261 | 5.0146 | 0.1442 | 0.435965 |
|  | 2.6142 | 0.0157 | 0.0522 | -13.19 | -17.043530 |
| ~~scaling factor d\_s to d3D (if validated)~~ | |  |  |  |  |  |
| Threshold D for ZOA | | 80 | 50 | 90 | N/A | N/A |

Note 1: Distributions of height and distance of reference point are not subject to geographical constraints on UT given in TR 38.901 for the corresponding deployment scenario.

Note 2: The reference points for generating the TRP monostatic background channel have no mobility, i.e. 0 km/h.

Agreement ([Post-120bis-ISAC-02])

The values of the parameters to generate background channel for UT monostatic sensing for the following sensing scenarios are provided in the following table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Scenario | | UT monostatic sensing | | | | |
| Uma /  Urban grid /  Highway(FR2) /  HST(FR2) | UMi | Rma /  Highway(FR1) /  HST(FR1) | Indoor office | Indoor Factory |
| Distribution of 2D distance between Tx and reference points |  | 2.9072 | 10.0220 | 10.2421 | 4.3733 | 0.231418 |
|  | 0.1031 | 1.2522 | 0.0526 | 0.4457 | 0.128133 |
|  | 3.8471 | 11.0040 | 3.3131 | 4.6302 | 2.004903 |
| Distribution of height of reference points |  | 1.6640 | 3.0487 | 0.3175 | 0.2974 | 0.462968 |
|  | 1.6215 | 1.9128 | 1.4150 | 0.4103 | 0.281526 |
|  | -1.4205 | 0.1785 | 1.5906 | 2.9711 | -16.921515 |
| ~~scaling factor d\_s to d3D (if validated)~~ | |  |  |  |  |  |
| Threshold D for ZOA | | 80 | 50 | 90 | N/A | N/A |

Note 1: Distributions of height and distance of reference point are not subject to geographical constraints on TRP given in TR 38.901 for the corresponding deployment scenario.

Note 2: The reference points for generating the UT monostatic background channel has the same velocity as UT.

Note 3: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0

Agreement ([Post-120bis-ISAC-02])

The values of the parameters to generate background channel for UT monostatic sensing for the following sensing scenarios are provided in the following table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Scenario | | UT monostatic sensing | | |
| UMa-AV | UMi-AV | RMa-AV |
| Distribution of 2D distance between Tx and reference points |  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| Distribution of height of reference points |  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| ~~scaling factor d\_s to d3D (if validated)~~ | |  |  |  |
| Threshold D for ZOA | |  |  |  |

Note 1: Distributions of height and distance of reference point are not subject to geographical constraints on TRP given in TR 38.901 for the corresponding deployment scenario.

Note 2: The reference points for generating the UT monostatic background channel has the same velocity as UT.

Note 3: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset should be set as 0

### RAN1 #121 (May 2024)

**Agreement**

Confirm the following working assumption with updates in red.

Working assumption

For vehicle with single/multiple scattering points, the bistatic RCS is generated by

* The values/pattern of A\*B1 of bistatic RCS is given by:

where

* + is applied to the within 0~180 degrees. k1= 6 and k2=1.65. is the bistatic angle between the incident ray and scattering ray within the plane of incident direction () and scattering direction ().
  + The angles of () are the projections of the bisector angle on the vertical plane and the horizontal plane, respectively.
    - ~~FFS: RCS value when is 180 degrees~~
  + The effect of forward scattering is -Inf in Rel-19
  + 5 sets of parameters *Applicable Range of* and *Applicable Range of* are applicable as defined for the monostatic RCS of vehicle with single/multiple SPSTs
  + ~~Continue study on a new formula for to resolve the issue of angular discontinuity.~~ 
    - ~~The new formula should retain following property: the linear bistatic RCS for a vehicle with single scattering point is the sum of the bistatic RCS of the multiple scattering points of the vehicle~~
    - ~~the following formula can be a reference for the study~~

**Agreement**

The agreement on bistatic RCS for vehicle is reused for large size UAV and AGV.

* + For large size UAV, k₁=6.05 and k₂=1.33
  + For AGV, k₁=12 and k₂=1.45

**Agreement**

AGV can be modelled with multiple scattering points.

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **in [**°**]** | **in [**°**]** | **in [**°**]** | **in [**°**]** |  |  | ***Range of*  in [**°**]** | ***Range of*  in [**°**]** |
| Front | 0° | 13.68° | 90° | 13.68° | 13.00 | 30.26 | [0,180] | [0,360] |
| Left | 90° | 15.53° | 75° | 20.03° | 7.27 | 24.53 | [0,180] | [0,360] |
| Back | 180° | 12.49° | 90° | 11.89° | 10.98 | 28.24 | [0,180] | [0,360] |
| Right | 270° | 15.53° | 75° | 20.03° | 7.27 | 24.53 | [0,180] | [0,360] |
| Roof | / | / | 0° | 11.44° | 11.77 | 29.03 | [0,180] | [0,360] |

* + Note: For the scattering point associated with roof of the AGV, .
  + Note: the measurements from companies are done by AGV option 1.

**Agreement**

* The bistatic RCS of UAV with small size is modelled as
  + The values/pattern of A\*B1 is given by
    - Component A, i.e., : same as component A of mono-static RCS for UAV of small size
    - dB, where is the bi-static angle between incident ray and scattered ray, is within 0 and 180 degree
    - The effect of forward scattering is -Inf in Rel-19
  + Component B2: same as component B2 of mono-static RCS for UAV of small size
* The bistatic RCS of Human with RCS model 1 is modelled as
  + The values/pattern of A\*B1 is given by
    - Component A, i.e., : same as component A of mono-static RCS for Human with RCS model 1
    - dB, where is the bi-static angle between incident ray and scattered ray, is within 0 and 180 degree
    - The effect of forward scattering is -Inf in Rel-19
  + Component B2: same as component B2 of mono-static RCS for Human with RCS model 1

**Agreement**

On the monostatic RCS of human with RCS model 2,

* The values/pattern of component A\*B1 are generated by the following parameters

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | in [°] | in [°] | in [°] | in [°] |  |  | *Range of*  in [°] | *Range of*  in [°] |
| Front | 0 | 216.65 | 90 | 55.7 | 2.14 | 7.7 | [0,180] | [-90, 90] |
| Back | 180 | 216.65 | 90 | 55.7 | 2.14 | 7.7 | [0,180] | [90,270] |

* The standard deviation of component B2 is 3.94 dB

**Agreement**

The agreement on bistatic RCS for vehicle with single scattering point is reused to model bistatic RCS of human with RCS model 2

* + k1=0.5714 and k2=0.1

**Agreement**

The following values of the RCS component A are applied to both monostatic and bistatic RCS of the target.

* + UAV with large size: -5.85 dBsm
  + Human with RCS model 2: -1.37 dBsm
    - Note: measurement is based on adult
  + Vehicle: 11.25 dBsm
    - Note: measurement is based on vehicle type 1 and 2
  + AGV: -4.25 dBsm
    - Note: measurement is based on AGV option 1

Note: component A on its own may not fully reflect the RCS in the target channel. This note will not be captured in the TR.

**Agreement**

The mean and standard deviation values of XPR of sensing target AGV for monostatic sensing and bistatic sensing are (9.60, 6.85) dB.

**Conclusion**

The component B2 of two different targets are generated independently.

**Conclusion**

The component XPR/initial random phase of two different targets are generated independently.

**Agreement**

In order to generate Tx-target link, target-Rx link and the background channel between a RSU-type UE and another node (TRP, pedestrian UE, vehicle UE, RSU-type UE), the following reference TRs are adopted

|  |  |  |  |
| --- | --- | --- | --- |
| **Case** | **Tx/Rx** | **Rx/Tx** | **Existing TRs as starting point** |
|  | TRP | RSU-type UE | Highway and Urban grid   * B2R link in section 6 of TR 37.885 |
|  | RSU-type UE | normal UE | Highway and Urban grid   * V2V link in section 6 of TR 37.885, with antenna height at RSU is 5m |
|  | RSU-type UE | RSU-type UE | Highway and Urban grid   * V2V link in section 6 of TR 37.885, with antenna height at RSU is 5m |
|  | RSU-type UE | vehicle UE | Highway and Urban grid   * V2V link in section 6 of TR 37.885, with antenna height at RSU is 5m |

**Agreement**

The initial random phase (generated in Step 10, section 7.5, TR38.901) is the same for the same ray in Tx-target link and target-Rx link of a target for monostatic sensing.

**Agreement**

For UMi-AV and RMa-AV with aerial UE as sensing transmitter or receiver, the values of parameters to generate background channel for UT monostatic sensing are provided in the following table

|  |  |  |  |
| --- | --- | --- | --- |
| Scenario | | UT monostatic sensing | |
| UMi-AV | RMa-AV |
| Distribution of 2D distance between Tx and reference points |  |  |  |
|  |  |  |
|  |  |  |
| Distribution of height of reference points |  |  |  |
|  |  |  |
|  |  |  |

Note 1: Distributions of height and distance of reference point are not subject to geographical constraints on TRP for the corresponding deployment scenario.

Note 2: The reference points for generating the UT monostatic background channel have the same velocity as UT.

Note 3: In the UT monostatic sensing in UMa and UMi scenario, the ZOD offset in the background channel should be set as 0

**Agreement**

To generate the background channel for TRP monostatic sensing and UT monostatic sensing, ‘ +’ is used to model the absolute delay between the Tx and each reference point.

**Agreement**

Power threshold for path dropping after concatenation is up to -40dB for target channel for option 3. Up to company to choose a value in the implementation.

Power threshold for path dropping after concatenation is up to -25dB for target channel for option 0. Up to company to choose a value in the implementation.

For calibrations for both option 0 and option 3, power threshold for path dropping after concatenation is -40dB for target channel.

**Agreement**

To generate the absolute delay model for sensing scenarios Urban grid, highway and HST, for both target channel and background channel

* For Urban grid, the values of parameters for of scenarios UMa are reused.
* For Highway, the values of parameters for of scenarios RMa and UMa are reused for FR1 and FR2 respectively.
* For HST, the values of parameters for of scenarios RMa and UMa are reused for FR1 and FR2 respectively.

Note: no measurements on of the 3 scenarios are submitted in Rel-19.

**Agreement**

Spatial consistency is not modelled for

* the links that are generated referring to channel models with parameter values of different communication scenarios
  + E.g., between TRP-target/UT link in one scenario and target/UT-UT link in another scenario
* the background channels for TRP monostatic sensing of different TRPs

**Agreement**

Spatial consistency is not modelled between TRP-target/UT link and target/UT-UT link for sensing scenario UMi, InH and InF.

**Agreement**

Spatial consistency is not modelled between TRP-TRP link and any other links for ISAC channel.

**Agreement**

Spatial consistency can be enabled for multiple scattering points of a target.

Spatial consistency, if enabled, for the links between BS/UT and multiple scattering points of a target are modelled as if multiple scattering points are multiple targets.

**Agreement**

The existing horizontal correlation distance in Table 7.6.3.1-2 in TR38.901 is used as the correlation distance for 3D spatial consistency for ISAC channel at least for UAV scenario, within same ‘Applicability range in terms of aerial UE height (defined in 36.777)’.

**Agreement**

EO type-2 can be modelled in NLOS condition.

**Agreement**

In sensing scenario UMi, UMa, if the height of a scattering point of target is less than 1.5m, for pathloss calculation,

* + use hUT 1.5 m for breakpoint distance (dBP) calculation
  + Note: hUT 1.5 m is only used for dBP calculation. The exact h\_UT of the scattering point is still used to determine all other parameters of ISAC channel, e.g., delay, AOD/ZOD/AOA/ZOA, etc.

**Agreement**

On background channel modelling,

* Spatial consistency is not supported for TRP monostatic sensing across different TRPs
* Spatial consistency is not supported for UE monostatic sensing across different UEs
* Spatial consistency is not supported across different Reference Points for same TRP for TRP monostatic sensing
* Spatial consistency is not supported across different Reference Points for same UE for UE monostatic sensing

**Agreement**

* RCS component B2 of different direct/indirect paths of a target in the target channel are generated independently.
* On the RCS component B2 of a direct/indirect path of a target in the target channel, the same value of B2 applies to a path before the value of B2 is updated.
  + Note: whether/how/when to update B2 can be discussed in evaluation phase or up to companies’ choices

**Agreement**

* XPR of different direct/indirect paths of a target in the target channel are generated independently.
* On the XPR of a direct/indirect path of a target in the target channel, the same value of XPR applies to a path before the value of XPR is updated.
  + Note: whether/how/when to update XPR can be discussed in evaluation phase or up to companies’ choices

**Agreement**

* Initial random phase of different direct/indirect paths of a target in the target channel are generated independently.
* On the initial random phase of a direct/indirect path of a target in the target channel, the same value of initial random phase applies to a path before the value of initial random phase is updated.
  + Note: whether/how/when to update initial random phase can be discussed in evaluation phase or up to companies’ choices

**Agreement**

The follow TP is used generate the power (except for the impact of polarization matrix of EO type-2) of the ray specular reflected by an EO type 2 in the STX-SPST link or SPST-SRX link.

|  |
| --- |
| 7.9.5.2 Type-2 environment object **< Unchanged text omitted >**   1. In Step 10 in Clause 7.9.4.1,   for a NLOS ray specularly reflected by a type-2 EO, if present, in the SPST-SRX link and the STX-SPST link is determined as follows.  - If the STX-SPST link is in LOS condition,  - If the STX-SPST link is not in LOS condition, , where is the pathloss of STX-SPST link assuming LOS condition.  - If the SPST-SRX link is in LOS condition,  - If the SPST-SRX link is not in LOS condition, , where is the pathloss of SPST-SRX link assuming LOS condition.  **< Unchanged text omitted >** |

**Agreement**

To generate the absolute delay model for sensing scenarios UMi-AV, UMa-AV and RMa-AV, for both target channel and background channel,

* For the TRP-TRP link and TRP- terrestrial UE link, the values of parameters for of scenarios UMi, UMa and RMa are respectively reused.
* For the terrestrial UE- terrestrial UE link, the values of parameters for of scenarios UMi are reused.
* For the TRP- aerial UE link, the values of parameters for of scenarios UMi, UMa and RMa are respectively reused.
* For the terrestrial UE- aerial UE link, the values of parameters for of scenarios UMi are reused.
* For the aerial UE- aerial UE link, the values of parameters for of scenarios UMi are reused.

Note: no measurements on of the scenarios UMi-AV, UMa-AV and RMa-AV are submitted in Rel-19.

**Agreement**

* Remove the brackets for first sub-bullet under Step 4 for Clause 7.9.4.2 in the CR to TR 38.901.
* On the absolute delay of the background channel for both TRP and UE monostatic sensing, three are independently generated and respectively applied to the 3 channels between the STX/SRX and the 3 RPs.

**Agreement**

To generate the channel between an aerial UE and a normal UE,

* The LOS probability is generated by:

|  |  |  |
| --- | --- | --- |
| Low-UAV | Mid-UAV | High-UAV |
| UMi in Table 7.4.2-1 in TR 38.901 for UMi-AV/UMa-AV/RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ | UMi-AV in Table B-1 in TR 36.777 for BS to [high] UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ |

* The pathloss and shadow fading are generated using TRP-aerial UE link of UMi-AV in Annex A and B of TR 36.777 by setting hBS =1.5m for FR1

Note:

* The height ranges of low-UAV, Mid-UAV and High-UAV are defined following the applicability range in terms of aerial UE height in Table B-1: LOS probability in TR 36.777
* The second height range for UMi-AV is further divided into 2 regions, i.e., [22.5, 100] and [100, 300] for mid-UAV and high-UAV, respectively.

**Conclusion**

No further study on power normalization of target channel and background channel of ISAC channel in Rel-19

* + Note: sub-section “7.9.5.3 Power normalization across target channel and background channel” in the TR remains as a placeholder with the following text.
    - To combine the target channel and the background channel, power normalization can be applied to keep the same/similar channel power as the background channel without sensing target.

**Agreement**

The polarization matrix of a direct/indirect path i of a scattering point of a target is defined in LCS.

**Agreement**

To generate the channel between a first aerial UE with height h1 and a second aerial UE with height h2, abs(h1-hBS) <= abs(h2-hBS),

* The LOS probability between the two aerial UEs is generated by:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Low-UAV | Mid-UAV | High-UAV |
| Low-UAV | UMi in Table 7.4.2-1 in TR 38.901 for UMi-AV/UMa-AV/RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ | UMi-AV in Table B-1 in TR 36.777 for BS to [high] UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ |
| Mid-UAV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ | UMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV  RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region | 1 |
| High-UAV | UMi-AV in Table B-1 in TR 36.777 for BS to [high] UAV region for UMi-AV/UMa-AV/[RMa-AV]  ~~RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region~~ | 1 | 1 |

* The pathloss and shadow fading between two aerial UEs are generated using TRP-aerial UE link of UMi-AV in Annex A and B of TR 36.777 by setting height of TRP equal to the height of the first aerial UE.

Note:

* The height ranges of low-UAV, Mid-UAV and High-UAV are defined following the applicability range in terms of aerial UE height in Table B-1: LOS probability in TR 36.777
* The second height range for UMi-AV is further divided into 2 regions, i.e., [22.5, 100] and [100, 300] for mid-UAV and high-UAV, respectively.

**Agreement**

Update the agreements on LOS probability calculation for channel between an aerial UE and a normal UE as follows.

|  |  |  |
| --- | --- | --- |
| Low-UAV | Mid-UAV | High-UAV |
| UMi in Table 7.4.2-1 in TR 38.901 for UMi-AV/UMa-AV/RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region for RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to high UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to high UAV region for RMa-AV |

**Agreement**

Update the agreements on LOS probability calculation for channel between two aerial UE as follows.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Low-UAV | Mid-UAV | High-UAV |
| Low-UAV | UMi in Table 7.4.2-1 in TR 38.901 for UMi-AV/UMa-AV/RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region for RMa-AV | UMi-AV in Table B-1 in TR 36.777 for BS to high UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to high UAV region for RMa-AV |
| Mid-UAV | UMi-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region for RMa-AV | UMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region for UMi-AV/UMa-AV  RMa-AV in Table B-1 in TR 36.777 for BS to mid UAV region | 1 |
| High-UAV | UMi-AV in Table B-1 in TR 36.777 for BS to high UAV region for UMi-AV/UMa-AV~~/[RMa-AV]~~  RMa-AV in Table B-1 in TR 36.777 for BS to high UAV region for RMa-AV | 1 | 1 |

**Agreement**

To determine the LOS condition of any link in ISAC channel model, when EO type-2 is modelled, the following two options are agreed as solutions:

* Option A: If type-2 EO is in the LOS ray of the link, the LOS probability is p, p=0, and otherwise use the LOS probability equation defined in existing TRs to determine the LOS/NLOS condition
* Option C: Use the LOS probability equation to determine the LOS/NLOS condition of the link.

Note1: in which conditions/scenarios to use option A or option C can be determined in future evaluations.

Note2: as already agreed, monostatic background channel is always NLOS

**Agreement**

EO type-2 can be optionally modelled in background channel when EO type-2 is modelled in target channel.

**Conclusion**

Other than RCS for human, vehicle, AGV, UAV, no other RCS for other objects is introduced in Rel-19.

* Future studies are not precluded for adding RCS of other objects/sizes for modelling target or EO type-1, based on validation results from companies.

**Conclusion**

Delete subsection 7.9.6 from the draft CR. For ISAC, no enhancement to existing TR38.901 LLS channel model is introduced in Rel-19.

**Agreement**

* The existing blockage model A/B procedures can be reused to model the blocking effect due to a target as an optional feature
  + Applicable to the LOS/NLOS rays in the background channel of the target
  + Applicable to the LOS/NLOS rays in the Tx-target and target-Rx link of another target
* The location, orientation and size of the target as a blocker is known before applying the blockage model A/B.

**Agreement**

* The square brackets on formula 7.9.5-10 (copied below) in the draft CR are removed

The effective polarization matrix of the type-2 EO reflection path is given by

[ (7.9.5-10)]

* Encourage companies to check and compare with the results that can be obtained with Alt2 and Alt3 below. If problem is found, RAN1 will revise TR 38.901 by new CR.

Alt2

[ (7.9.5-10)]

With reusing the legacy transformation method for deriving and .

Alt3

[ (7.9.5-10)]

Where,

- . represents the normal vector of the incident plane. , in which and . represents the spherical basis vector of incident ray in vertical direction. represents the spherical basis vector of incident ray in horizontal direction. .

- . represents the polar basis vector of scattering ray in vertical direction. represents the polar basis vector of scattering ray in horizontal direction. . .

**Conclusion**

There is no consensus to introduce an exact formula for micro-Doppler in Rel-19. The placeholder in the channel impulse response is kept in the draft CR.