**3GPP TSG RAN WG1 Meeting #120** **R1-2500413**
**Athens, Greek, February 17th – 21st, 2025**

**Agenda Item:** 9.7.1

**Source:** EURECOM

**Title:** Discussion on ISAC deployment scenarios and requirements

**Document for:** Discussion and decision

## 1. Introduction

According to the SI for Release 19 ISAC [1], the objective of this SI is as follows:

> The study should aim at a common modelling framework capable of detecting and/or tracking the following example objects and to enable them to be distinguished from unintended objects:
>
> - UAVs
> - Humans indoors and outdoors
> - Automotive vehicles (at least outdoors)
> - Automated guided vehicles (e.g. in indoor factories)
> - Objects creating hazards on roads/railways, with a minimum size dependent on frequency
>
> All six sensing modes should be considered (i.e. TRP-TRP bistatic, TRP monostatic, TRP-UE bistatic, UE-TRP bistatic, UE-UE bistatic, UE monostatic).
>
> Frequencies from 0.5 to 52.6 GHz are the primary focus, with the assumption that the modelling approach should scale to 100 GHz. (If significant problems are identified with scaling above 52.6 GHz, the range above 52.6 GHz can be deprioritized.)
>
> For the above use cases, sensing modes and frequencies:
>
> - Identify details of the deployment scenarios corresponding to the above use cases.

The following agreements were made in RAN1#116:

> **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:

- 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.
- 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.
- Sensing target: target that need to be sensed by deriving characteristics of the objects within the environment from the sensing signal.
- Background environment: background (clutter and/or environmental objects) that are not the sensing target(s).
- Mono-static sensing: sensing where the sensing transmitter and sensing receiver are co-located in the same TRP or UE.
- Bi-static sensing: sensing where the sensing transmitter and sensing receiver are in different TRPs or UEs.
- Multi-static sensing: sensing where there are multiple sensing transmitters and/or multiple sensing receivers, for a sensing target.
- Sensing signal: Transmissions on the 3GPP radio interface that can be used for sensing purposes.

The following agreements were made in RAN1#116b:

**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] | | |

The following agreements were made in RAN1#117:

**Agreement**

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

- 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.
- 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]<br>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<br>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<br>[FFS specific velocity(ies) or random distribution]<br>[FFS vertical plane velocity] |
| | 3D distribution | [Uniform between a minimum and maximum height]<br>[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 | | FFS |

| | |
|---|---|
| sensing target/[unintended objects] | |
| 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<br><br>Note 1: Other Rx/Tx properties (e.g. mobility) can also be taken from the corresponding communication scenario.<br><br>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 |

The following agreements were made in RAN1#118:

**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]<br>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.<br>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.<br>Vertical velocity: 0km/h, optional {20, 40} km/h<br>NOTE2: 3D mobility can be horizontal only or vertical only or a combination for each sensing target<br>FFS: time-varying velocity. |
| | 3D distribution | Horizontal plane:<br>Option A: *N* targets uniformly distributed within one cell.<br>Option B: *N* targets uniformly distributed per cell.<br>Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries. |

| | | |
|---|---|---|
| | | FFS: Value of *N*, defined area, and other distributions<br><br>Vertical plane:<br>Option A: Uniform between 1.5m and 300m.<br>Option B: Fixed height value chosen from {25, 50, 100, 200, 300} m assuming vertical velocity is equal to 0.<br>FFS Other options are not precluded.<br>Note2: target(s) are outside the minimum distance to the Tx/Rx |
| | Orientation | Random in horizontal domain |
| | Physical characteristics (e.g., size) | Size:<br>• Option 1: 1.6m x 1.5m x 0.7m<br>• Option 2: 0.3m x 0.4m x 0.2m<br>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.<br>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<br>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.

The following agreements were made in RAN1#118b:

**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

<table>
<tr><th colspan="2">Parameters</th><th>Values</th></tr>
<tr><td colspan="2">Applicable communication scenarios</td><td>Highway, Urban Grid. NOTE1</td></tr>
<tr><td colspan="2">Sensing transmitters and receivers properties</td><td>Rx/Tx locations are selected among the TRPs and UEs (e.g., VRU, vehicle, RSU-type UEs) locations in the corresponding communication scenario. NOTE2<br>FFS: Option 2: ISD between TRPs of Urban Grid is 250 meters</td></tr>
<tr><td rowspan="6">Sensing target</td><td>LOS/NLOS</td><td>LOS and NLOS (including NLOSv)</td></tr>
<tr><td>Outdoor/indoor</td><td>Outdoor</td></tr>
<tr><td>Mobility (horizontal plane only)</td><td>Based on TR37.885 mobility for urban grid or highway scenario</td></tr>
<tr><td>Distribution (horizontal)</td><td>Based on dropping in TR37.885 per urban grid or highway communication scenario</td></tr>
<tr><td>Orientation</td><td>Lane direction in horizontal plane</td></tr>
<tr><td>Physical characteristics (e.g., size)</td><td>Type 1/2 (passenger vehicle)<br>Type 3 (truck/bus)<br>Vehicle type distribution per TR 37.885 as a starting point<br>FFS: Other sizes, additional distributions, and vehicle types, e.g. one new type of e-scooter/motorcycle/bike</td></tr>
<tr><td colspan="2">Minimum 3D distances between pairs of Tx/Rx and sensing target</td><td>Option 1: Min distances based on min. TRP/UE distances defined in TR37.885 as a starting point.<br>Option 2: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx</td></tr>
<tr><td colspan="2">Minimum 3D distance between sensing targets</td><td>Option 1: At least larger than the physical size of a sensing target<br>Option 2: Fixed value, [x] m. value of x is FFS</td></tr>
<tr><td colspan="2">Environment Objects, e.g., types, characteristics, mobility, distribution, etc.</td><td>EO Type 2 for Urban Grid<br>• FFS: details, e.g. 4 walls (as EO type 2) per building of size [413mx230mx20m]</td></tr>
</table>

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]<br>Indoor room [TR38.808] | UMi, Uma, RMa [TR38.901] |
| Sensing transmitters and receivers properties | Rx/Tx Locations<br>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<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h | Option 1: 0km/h<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 10km/hr |

| | | | |
|---|---|---|---|
| | | and 3km/hr | |
| Sensing target | Outdoor/indoor | Indoor | Outdoor |
| | 3D mobility | Option 1: 0km/h<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 3km/hr<br>(horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 10km/hr<br>(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<br>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):<br>• Child: 0.2m x 0.3m x 1m<br>• Adult Pedestrian: 0.5m x 0.5m x 1.75m | Size (Length x Width x Height):<br>• Child: 0.2m x 0.3m x 1m<br>• 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<br><br>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<br><br>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<br><br>Option 2: Fixed value, [x] m. value of x is FFS | Option 1: At least larger than the physical size of a sensing target<br><br>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<br>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<br><br>Rx/Tx Mobility for UEs<br>- Option 1: 0 km/h<br>- Option 2: 3km/h<br>- 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<br>- Option 1: Uniform distribution in the range of up to 30 km/h<br>- Option 2: Fixed velocities [3, 10] km/h |
| | 3D distribution | Option A: Uniformly distributed in the convex hull of the horizontal BS deployment<br><br>Option B: Uniformly distributed in horizontal plane |
| | Orientation | Horizontal plane only |
| | Physical characteristics (e.g., size) | Size (L x W x H)<br>- Option 1: 0.5m x 1.0m x 0.5m<br>- Option 2: 1.5 m x 3.0m x 1.5 m<br>- 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<br>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<br>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.<br>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<br><br>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<br><br>Adult: 0.5m x 0.5m x 1.75m<br><br>For animals:<br><br>Size: 1.5m x 0.5m x 1 m<br><br>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<br><br>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<br><br>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<br>• 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.

The following agreements were made in RAN1#119:

**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]<br><br>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.<br><br>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.<br><br>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<br>~~FFS: time-varying velocity.~~<br>NOTE 3: time-varying velocity may be considered for future evaluations. |
| | 3D distribution | Horizontal plane:<br>Option A: *N* targets uniformly distributed within one cell.<br>Option B: *N* targets uniformly distributed per cell.<br>Option C: *N* targets uniformly distributed within an area not necessarily determined by cell boundaries.<br>~~FFS: Value of *N*, defined area, and other distributions~~<br>*N* = {1, 2, 3, 4, 5}<br>NOTE4: *N*=0 may be considered for the evaluation of false alarm<br><br>Vertical plane:<br>Option A: Uniform between 1.5m and 300m.<br>Option B: Fixed height value chosen from {25, 50, 100, 200, 300} m assuming vertical velocity is equal to 0.<br>~~FFS Other options are not precluded.~~<br>~~NOTE5: target(s) are outside the minimum distance to the Tx/Rx~~ |
| | Orientation | Random in horizontal domain |

| | | |
|---|---|---|
| | Physical characteristics (e.g., size) | Size:<br>• Option 1: 1.6m x 1.5m x 0.7m<br>• Option 2: 0.3m x 0.4m x 0.2m<br>~~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.<br>NOTE5: the sensing target is assumed in the far field of sensing Tx/Rx<br>~~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<br>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<br>~~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)<br>Type 3 (truck/bus)<br>Vehicle type distribution per TR 37.885 as a starting point<br>~~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.<br>~~Option 2: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~<br>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<br>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<br>- ~~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]<br>Indoor room [TR38.808] | UMi, Uma, RMa [TR38.901] |
| Sensing transmitters and receivers properties | Rx/Tx Locations<br>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<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 3km/hr | Option 1: 0km/h<br>Option 2: 3km/h<br>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<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 3km/hr<br>(horizontal plane with random direction straight-line trajectory) | Option 1: 0km/h<br>Option 2: 3km/h<br>Option 3: Uniform distribution between 0km/h and 10km/hr<br>(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<br>~~FFS: Value of N~~<br>NOTE1: *N*=0 may be considered for the evaluation of false alarm | Option A: *N* targets uniformly distributed within one cell.<br>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~~<br><br>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):<br>- Child: 0.2m x 0.3m x 1m<br>- Adult Pedestrian: 0.5m x 0.5m x 1.75m | Size (Length x Width x Height):<br>- Child: 0.2m x 0.3m x 1m<br>- 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~~<br><br>~~Option 2:~~ Min distances defined in TR 38.901 and TR36.843 and TR38.859as a starting point | ~~Option 1: Min. distance is larger than the min. far-field distance of the sensing Tx/Rx~~<br><br>~~Option 2:~~ Min distances defined in TR 38.901 and TR36.843 and TR38.859 as a starting point |

| | | |
|---|---|---|
| | NOTE2: the sensing target is assumed in the far field of 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<br><br>Option 2: Fixed value, [x] m. value of x is FFS | Option 1: At least larger than the physical size of a sensing target<br><br>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<br><br>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<br><br>Rx/Tx Mobility for UEs<br>- Option 1: 0 km/h<br>- Option 2: 3km/h<br>- 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<br>- Option 1: Uniform distribution in the range of up to 30 km/h<br>- Option 2: Fixed velocities [3, 10] km/h |
| | 3D distribution | Option A: Uniformly distributed in the convex hull of the horizontal BS deployment<br><br>Option B: Uniformly distributed in horizontal plane |
| | Orientation | Horizontal plane only |
| | Physical characteristics (e.g., size) | Size (L x W x H)<br>- Option 1: 0.5m x 1.0m x 0.5m<br>- Option 2: 1.5 m x 3.0m x 1.5 m<br>- 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~~<br><br>~~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<br>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 | 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. |

| | | |
|---|---|---|
| NOTE2 | | ~~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<br><br>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<br><br>Adult: 0.5m x 0.5m x 1.75m<br><br>For animals:<br><br>Size: 1.5m x 0.5m x 1 m<br><br>~~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~~<br><br>~~Option 2:~~ based on min TRP/UE distances defined in TR37.885 and TR38.802 and TR36.843 and TR38.859<br><br>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<br><br>Option 2: Fixed value, ~~[~~10~~]~~ m. ~~value of x is FFS~~ |
| Environment objects, e.g., types, characteristics, | | EO Type 2 for Urban Grid |

| | |
|---|---|
| mobility, distribution, etc. | - ~~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.

In this contribution, the deployment scenarios and evaluation metrics of ISAC will be discussed.

# 2. Discussion

### 2.2.1 UAV use cases

The parameters of CM calibration for full calibration for UAV use cases are shown in Table 1.

**Table 1. The parameters of CM calibration for full calibration for UAV use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | UMa-AV<br>19 macro sites, 3 sectors per site |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site |
| Carrier Frequency | FR1: 6 GHz;<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz;<br>FR2: 120 kHz |
| BS height | 25m |
| BS antenna configurations | For FR1:<br>(M,N,P,Mg,Ng;Mp,Np) = (8,8,2,1,1;2,8)<br>(dH,dV) = (0.5, 0.8)λ, +45°/-45° polarization<br>For FR2:<br>(M,N,P,Mg,Ng;Mp,Np) = (4,16,2,2,2; 1,1)<br>(d_H,d_V ) = (0.5, 0.5)λ, (dH,g, dV,g) = (4.0, 2.0)λ, +45°/-45° polarization |
| BS antenna electrical downtilting | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |

| | |
|---|---|
| BS Tx power | FR1: 49dBm<br>FR2: 35dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT distribution | 10 terrestrial UEs per cell |
| UT attachment | Based on pathloss with a margin |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:10dB |
| Fast fading channel | Fast fading channel is modeled |
| Sensing target distribution | Uniform between 1.5m and 300m |
| Sensing target mobility | Horizontal : uniform distribution between 0 and 180 km/h<br>Vertical : 0 km/h |
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Minimum 3D distance between sensing targets | 10 m |
| Metrics | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) |

The parameters of CM calibration for large scale for UAV use cases are shown in Table 2.

**Table 2. The parameters of CM calibration for large scale for UAV use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | UMa-AV<br>19 macro sites, 3 sectors per site |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site |
| Carrier Frequency | FR1: 6 GHz;<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz;<br>FR2: 120 kHz |
| BS height | 25m |
| BS antenna configurations | For FR1: |

| | |
|---|---|
| | (M,N,P,Mg,Ng;Mp,Np) = (8,8,2,1,1;2,8)<br>(dH,dV) = (0.5, 0.8)λ, +45°/-45° polarization<br>For FR2:<br>(M,N,P,Mg,Ng;Mp,Np) = (4,16,2,2,2; 1,1)<br>(d_H,d_V ) = (0.5, 0.5)λ, (dH,g, dV,g) = (4.0, 2.0)λ, +45°/-45° polarization |
| BS antenna electrical downtilting | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |
| BS Tx power | FR1: 49dBm<br>FR2: 35dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (1,1,2,1,1;1,1) |
| UT distribution | 10 terrestrial UEs per cell |
| UT attachment | Based on pathloss with a margin |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:10dB |
| Fast fading channel | Fast fading channel is not modeled |
| Sensing target distribution | Uniform between 1.5m and 300m |
| Sensing target mobility | Horizontal : uniform distribution between 0 and 180 km/h<br>Vertical : 0 km/h |
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 10 m |
| Minimum 3D distance between sensing targets | 10 m |
| Metrics | Coupling loss based on PL<br>Wideband SIR and SINR based on geometry (based on pathloss) |

**Proposal 1: The parameters of CM calibration for full calibration for UAV use cases are shown in Table 1.**

**Proposal 2: The parameters of CM calibration for large scale for UAV use cases are shown in Table 2.**

### 2.2.2 Human indoor/outdoor use cases

The parameters of CM calibration for full calibration for human indoor/outdoor use cases are shown in Table 3.

**Table 3. The parameters of CM calibration for full calibration for human indoor/outdoor use cases**

| Parameters | Indoor values | Outdoor values |
|---|---|---|
| Scenario | Indoor office<br>120m*50m*3m<br>ISD: 20m | UMa, UMi |
| Sensing mode | All sensing modes | All sensing modes |
| Sectorization | single sector per site | 3 sectors per site |
| Carrier Frequency | FR1: 6 GHz;<br>FR2: 30 GHz | FR1: 6 GHz;<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz;<br>FR2: 120 kHz | FR1: 30 kHz;<br>FR2: 120 kHz |
| BS height | 3m | UMa: 25m; UMi: 10m |
| BS antenna configurations | For FR1:<br>(M,N,P,Mg,Ng;Mp,Np) = (4,4,2,1,1; 4,4) ,<br>(dH,dV) = (0.5, 0.5)λ, +45°/-45° polarization<br>For FR2:<br>(M,N,P,Mg,Ng;Mp,Np)= (16,8,2,1,1; 1,1) ,<br>(dH,dV) = (0.5, 0.5)λ, +45°/-45° polarization | [M,N,P,Mg,Ng]=[4,4,2,1,2], dv=dh=0.5λ, dvg=dhg=2.5λ |
| BS antenna electrical downtilting | 102 degrees | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles | |
| BS Tx power | FR1: 24dBm<br>FR2: 23dBm | FR1:<br>UMa: 49dBm; UMi: 44dBm<br>FR2:<br>UMa: 37dBm; UMi: 37dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB | FR1: 5dB |

| | | |
|---|---|---|
| | FR2: 7dB | FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1;1,1) | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1;1,1) |
| UT distribution | 100% indoor, uniformly distributed over the area of the convex hull of the TRP deployment | uniformly distributed |
| UT attachment | / | / |
| Polarized antenna modelling | Model 2 in TR 38.901 | |
| UT noise figure | FR1:9dB<br>FR2:10dB | FR1:9dB<br>FR2:10dB |
| Fast fading channel | Fast fading channel is modeled | Fast fading channel is modeled |
| Sensing target distribution | 5 targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment | 5 sensing targets uniformly distributed within the center cell |
| Sensing target mobility | 3 km/h | 3 km/h |
| Large-scale RCS for each scattering point | The mean value of target RCS | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | TR 38.901 as a starting point | TR 38.901 as a starting point |
| Minimum 3D distance between sensing targets | At least larger than the physical size of a sensing target | At least larger than the physical size of a sensing target |
| Metrics | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) |
| UT height | 1.5m | 1.5m |
| UT Tx power | 23dB | 23dB |

**Table 4. The parameters of CM calibration for large scale for human indoor/outdoor use cases**

| **Parameters** | **Indoor values** | **Outdoor values** |
|---|---|---|
| Scenario | Indoor office<br>120m*50m*3m<br>ISD: 20m | UMa, UMi |
| Sensing mode | All sensing modes | All sensing modes |
| Sectorization | single sector per site | 3 sectors per site |

| | | |
|---|---|---|
| Carrier Frequency | FR1: 6 GHz;<br>FR2: 30 GHz | FR1: 6 GHz;<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz;<br>FR2: 120 kHz | FR1: 30 kHz;<br>FR2: 120 kHz |
| BS height | 3m | UMa: 25m; UMi: 10m |
| BS antenna configurations | For FR1:<br>(M,N,P,Mg,Ng;Mp,Np) = (4,4,2,1,1; 4,4) ,<br>(dH,dV) = (0.5, 0.5)λ, +45°/-45° polarization<br>For FR2:<br>(M,N,P,Mg,Ng;Mp,Np)= (16,8,2,1,1; 1,1) ,<br>(dH,dV) = (0.5, 0.5)λ, +45°/-45° polarization | [M,N,P,Mg,Ng]=[4,4,2,1,2], dv=dh=0.5λ, dvg=dhg=2.5λ |
| BS antenna electrical downtilting | 102 degrees | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles | |
| BS Tx power | FR1: 24dBm<br>FR2: 23dBm | FR1:<br>UMa: 49dBm; UMi: 44dBm<br>FR2:<br>UMa: 37dBm; UMi: 37dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1;1,1) | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1;1,1) |
| UT distribution | 100% indoor, uniformly distributed over the area of the convex hull of the TRP deployment | uniformly distributed |
| UT attachment | / | / |
| Polarized antenna modelling | Model 2 in TR 38.901 | |
| UT noise figure | FR1:9dB<br>FR2:10dB | FR1:9dB<br>FR2:10dB |

| | | |
|---|---|---|
| Fast fading channel | Fast fading channel is not modeled | Fast fading channel is not modeled |
| Sensing target distribution | 5 targets uniformly distributed over the horizontal area of the convex hull of the TRP deployment | 5 sensing targets uniformly distributed within the center cell |
| Sensing target mobility | 3 km/h | 3 km/h |
| Large-scale RCS for each scattering point | The mean value of target RCS | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | TR 38.901 as a starting point | TR 38.901 as a starting point |
| Minimum 3D distance between sensing targets | At least larger than the physical size of a sensing target | At least larger than the physical size of a sensing target |
| Metrics | Coupling loss – serving cell (based on LOS pathloss)<br>Geometry (based on LOS pathloss) with and without white noise. | Coupling loss – serving cell (based on LOS pathloss)<br>Geometry (based on LOS pathloss) with and without white noise. |

**Proposal 3: The parameters of CM calibration for full calibration for human indoor/outdoor use cases are shown in Table 3.**

**Proposal 4: The parameters of CM calibration for large scale for human indoor/outdoor use cases are shown in Table 4.**

### 2.2.3 Automotive vehicles use cases

The parameters of CM calibration for full calibration for Automotive vehicles use cases are shown in Table 5.

**Table 5. The parameters of CM calibration for full calibration for Automotive vehicles use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | Urban grid, Highway |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |

| | |
|---|---|
| BS height | Urban grid: 25m<br>Highway: 35m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |
| BS antenna electrical downtilting | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |
| BS Tx power | FR1: 49dBm<br>FR2: 43dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1,1,1) |
| UT distribution | Uniform distribution |
| UT attachment | Based on pathloss |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is modeled |
| Sensing target distribution | Dropping option A in 37.885 |
| Sensing target mobility | Based on Option A deployment in TR37.885 for Urban grid |
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | Min distances based on min. TRP/UE distances defined in TR37.885 as a starting point. |
| Minimum 3D distance between sensing targets | 10 m |
| Metrics | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) |
| UT height | Vehicle UT: 1.6m<br>Pedestrian UE: 1.5m<br>RSU: 5m |
| UT Tx power | 23dBm |

The parameters of CM calibration for large scale for Automotive vehicles use cases are shown in Table 6.

**Table 6. The parameters of CM calibration for large scale for Automotive vehicles use cases**

| Parameters | Values |
|---|---|
| Scenario | Urban grid, Highway |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |
| BS height | Urban grid: 25m<br>Highway: 35m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |
| BS antenna electrical downtilting | 102 degrees |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |
| BS Tx power | FR1: 49dBm<br>FR2: 43dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np) = (2,2,1,1,1,1,1) |
| UT distribution | Uniform distribution |
| UT attachment | Based on pathloss |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is not modeled |
| Sensing target distribution | Dropping option A in 37.885 |
| Sensing target mobility | Based on Option A deployment in TR37.885 for Urban grid |
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | Min distances based on min. TRP/UE distances defined in TR37.885 as a starting point. |
| Minimum 3D distance between sensing targets | 10 m |
| Metrics | Coupling loss based on PL<br>Wideband SIR and SINR based on geometry (based on pathloss) |

**Proposal 5: The parameters of CM calibration for full calibration for Automotive vehicles use cases are shown in Table 5.**

**Proposal 6: The parameters of CM calibration for large scale for Automotive vehicles use cases are shown in Table 6.**

### 2.2.4 AGV use cases

**The parameters of CM calibration for full calibration for AGV use cases are shown in Table 7.**

**Table 7. The parameters of CM calibration for full calibration for AGV use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | Indoor factory |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |
| BS height | 8m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |
| BS antenna electrical downtilting | / |
| Antenna virtualization | / |
| BS Tx power | 24dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | / |
| UT distribution | Uniform distribution |
| UT attachment | Based on RSRP |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is modeled |
| Sensing target distribution | 5 targets uniformly distributed in the convex hull of the horizontal BS deployment |
| Sensing target mobility | Uniform distribution between 0km/h and 30km/h |

| | |
|---|---|
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 0m |
| Minimum 3D distance between sensing targets | At least larger than the physical size of a sensing target |
| Metrics | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) |

**The parameters of CM calibration for large scale for AGV use cases are shown in Table 8.**

**Table 8. The parameters of CM calibration for large scale for AGV use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | Indoor factory |
| Sensing mode | TRP bistatic/monostatic |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |
| BS height | 8m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |
| BS antenna electrical downtilting | / |
| Antenna virtualization | / |
| BS Tx power | 24dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | / |
| UT distribution | Uniform distribution |
| UT attachment | Based on pathloss |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is not modeled |
| Sensing target distribution | 5 targets uniformly distributed in the convex hull of the horizontal BS deployment |

| | |
|---|---|
| Sensing target mobility | Uniform distribution between 0km/h and 30km/h |
| Large-scale RCS for each scattering point | The mean value of target RCS |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 0m |
| Minimum 3D distance between sensing targets | At least larger than the physical size of a sensing target |
| Metrics | Coupling loss based on PL<br>Wideband SIR and SINR |

**Proposal 7: The parameters of CM calibration for full calibration for AGV use cases are shown in Table 7.**

**Proposal 8: The parameters of CM calibration for large scale for AGV use cases are shown in Table 8.**

### 2.2.5 Objects creating hazards on roads/railways use cases

The parameters of CM calibration for full calibration for objects creating hazards on roads/railways use cases are shown in Table 9.

**Table 9. The parameters of CM calibration for full calibration for objects creating hazards on roads/railways use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | Highway |
| Sensing mode | All 6 sensing modes |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |
| BS height | 35m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |
| BS antenna electrical downtilting | 102 degree |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |
| BS Tx power | FR1: 49dBm<br>FR2: 43dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |

| | |
|---|---|
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(2,2,1,1,1,1,1) |
| UT distribution | / |
| UT attachment | / |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is modeled |
| Sensing target distribution | Uniformly distributed in horizontal plane |
| Sensing target mobility | 10km/h |
| Large-scale RCS for each scattering point | / |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 35m |
| Minimum 3D distance between sensing targets | 10m |
| Metrics | CDF of coupling loss<br>CDF of Delay Spread and Angle Spread (ASD, ZSD, ASA, ZSA) |
| UT height | Vehicle UT: 1.6m<br>Pedestrian UE: 1.5m<br>RSU: 5m |
| UT Tx power | 23dBm |

The parameters of CM calibration for large scale for objects creating hazards on roads/railways use cases are shown in Table 10.

**Table 10. The parameters of CM calibration for large scale for objects creating hazards on roads/railways use cases**

| **Parameters** | **Values** |
|---|---|
| Scenario | Highway |
| Sensing mode | All 6 sensing modes |
| Sectorization | 3 sectors per site, 30, 150 and 270 degrees |
| Carrier Frequency | FR1: 6 GHz<br>FR2: 30 GHz |
| Subcarrier spacing | FR1: 30 kHz<br>FR2: 120 kHz |
| BS height | 35m |
| BS antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(16,16,1,1,1,1,1) |

| | |
|---|---|
| BS antenna electrical downtilting | 102 degree |
| Antenna virtualization | DFT precoding according to TR 36.897 with application of panning and tilting angles |
| BS Tx power | FR1: 49dBm<br>FR2: 43dBm |
| Bandwidth | FR1: 100MHz<br>FR2: 400MHz |
| BS noise figure | FR1: 5dB<br>FR2: 7dB |
| UT antenna configurations | (M,N,P,Mg,Ng;Mp,Np)=(2,2,1,1,1,1,1) |
| UT distribution | / |
| UT attachment | / |
| Polarized antenna modelling | Model 2 in TR 38.901 |
| UT noise figure | FR1:9dB<br>FR2:13dB |
| Fast fading channel | Fast fading channel is not modeled |
| Sensing target distribution | Uniformly distributed in horizontal plane |
| Sensing target mobility | 10km/h |
| Large-scale RCS for each scattering point | / |
| Minimum 3D distances between pairs of Tx/Rx and sensing target | 35m |
| Minimum 3D distance between sensing targets | 10m |
| Metrics | CDF of coupling loss |

**Proposal 9: The parameters of CM calibration for full calibration for objects creating hazards on roads/railways use cases are shown in Table 9.**

**Proposal 10: The parameters of CM calibration for large scale for objects creating hazards on roads/railways use cases are shown in Table 10.**

# 3. Conclusions

In this contribution, the following proposals are put forward:

**Proposal 1: The parameters of CM calibration for full calibration for UAV use cases are shown in Table 1.**

**Proposal 2: The parameters of CM calibration for large scale for UAV use cases are shown in Table 2.**

**Proposal 3: The parameters of CM calibration for full calibration for human indoor/outdoor use cases are shown in Table 3.**

**Proposal 4: The parameters of CM calibration for large scale for human indoor/outdoor use cases are shown in Table 4.**

**Proposal 5: The parameters of CM calibration for full calibration for Automotive vehicles use cases are shown in Table 5.**

**Proposal 6: The parameters of CM calibration for large scale for Automotive vehicles use cases are shown in Table 6.**

**Proposal 7: The parameters of CM calibration for full calibration for AGV use cases are shown in Table 7.**

**Proposal 8: The parameters of CM calibration for large scale for AGV use cases are shown in Table 8.**

**Proposal 9: The parameters of CM calibration for full calibration for objects creating hazards on roads/railways use cases are shown in Table 9.**

**Proposal 10: The parameters of CM calibration for large scale for objects creating hazards on roads/railways use cases are shown in Table 10.**

## References


[1] RP-234069, "New SID: Study on Channel modelling for Integrated Sensing And Communication (ISAC) for NR", Nokia, Nokia Shanghai Bell, 3GPP TSG RAN meeting #102, Edinburgh, UK, 11th-15th December, 2023.

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[3] 3GPP RAN1 #116 Minutes report, Athens, Greece, 26th February – 1st March.

[4] 3GPP RAN1 #116b Minutes report, Changsha, China, 15th -19th April.

[5] 3GPP RAN1 #117 Minutes report, Fukuoka, Japan, 20th -24th May.

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[7] 3GPP RAN1 #118b Minutes report, Hefei, China, 14th -18th October.

[8] 3GPP RAN1 #119 Minutes report, Orlando, US, 18th - 22nd November.