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3GPP TSG RAN Meeting #102
Edinburgh, Scotland, December 11-15, 2023

RP-232872

Agenda item: 9.1.1.7

# Views on ISAC study in Rel-19

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# Discussion status on ISAC

- Based on the discussion in RANP #101 meeting, the following way forward for ISAC seems agreeable:
  - If not already done in SID, a RAN-led study objective to select a small number of ISAC use cases from TR22.837, and to identify appropriate corresponding information needed for point 2 below, i.e. scenarios, frequency ranges and sensing modes.
  - A RAN1-led study objective to define channel modelling details for sensing using 38.901 (if applicable to the selected use cases) as a starting point, and taking into account relevant measurements, including:
    - Modelling of sensing targets, including, for example (if needed by the selected use cases), radar cross-section (RCS), mobility and clutter/scattering patterns;
    - Spatial consistency.
  - This objective to start after completion of the first (RAN-led) objective if not already done in SID.

- Among the possible areas, we see stronger need for the ISAC compared to the others. In the following, we focus on the ISAC including the possibility of RAN plenary involvement.


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# Requirement for ISAC from SA

- Based on the use cases for ISAC in TR 22.837, three types of scenarios are derived in TS 22.137 as follows, and RAN is expected to study the enabling technologies afterward.

| Scenario | Sensing service category | Sensing service description in a target sensing service area |
|---|---|---|
| Object detection and tracking | 1 | Indoor/outdoor (e.g., detection of human, UAV) |
| | 2 | Outdoor (e.g., detection of human, UAV) requiring higher performance than category 1 |
| | 3 | Indoor/outdoor (e.g., detection tracking of human, animal, UAV) |
| | 4 | Indoor/outdoor (e.g., detection tracking of human, animal, UAV, AGV, vehicle) requiring higher performance than category 3 |
| | 5 | Indoor/outdoor (e.g., detection tracking of human, animal, UAV, AGV, vehicle) requiring higher performance than category 4 |
| Environment monitoring | 6 | Nature of environments monitored by sensing. |
| Motion monitoring | 7 | Human motions and activities obtained by sensing. |
| | 8 | Human hand gestures obtained by sensing |


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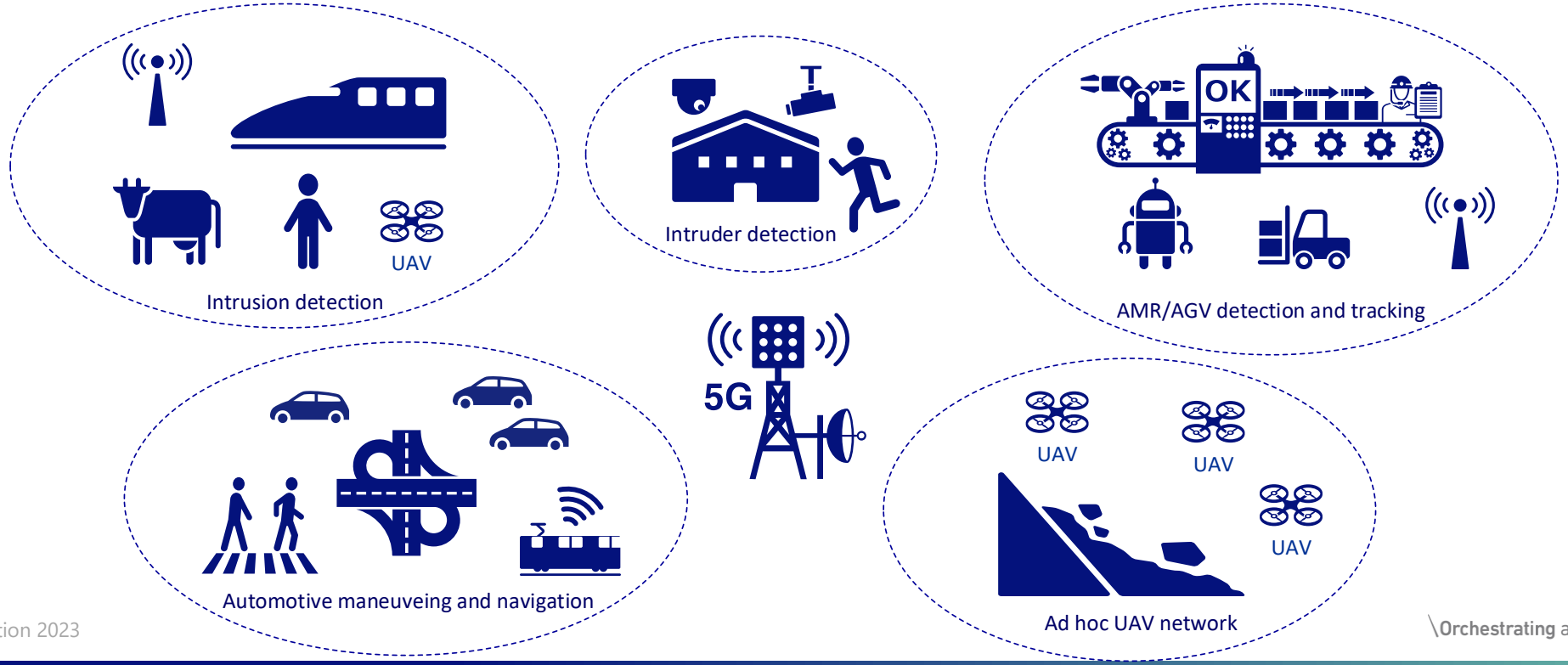
# Prioritized Use Cases of ISAC in Rel-19

- The following use cases included in the "object detection and tracking" scenario have broader availability, and should be with higher priority during Rel-19 discussion:
  - Intrusion detection
    - Including detection of intruder, pedestrian/animal, UAV, etc.
  - Device detection and tracking
    - Automotive maneuvering/navigation/parking, UAV, AMR, AGV, etc.





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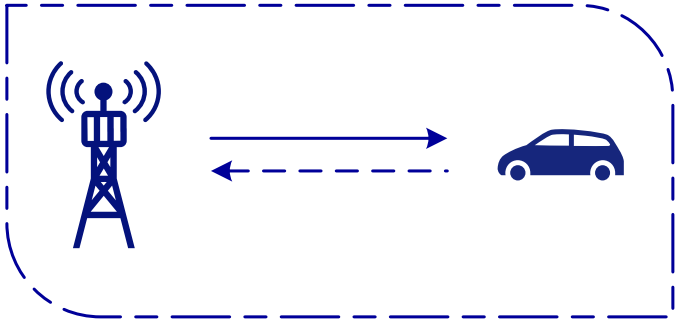
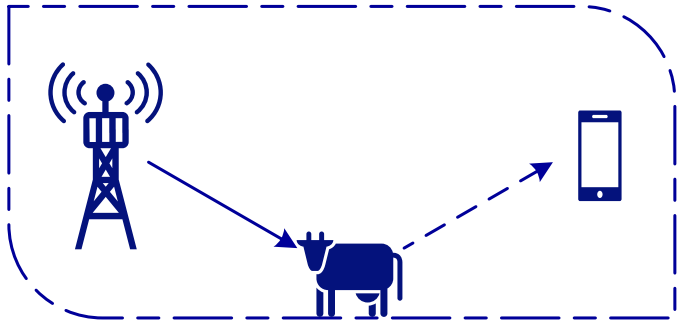
# Sensing Modes of ISAC

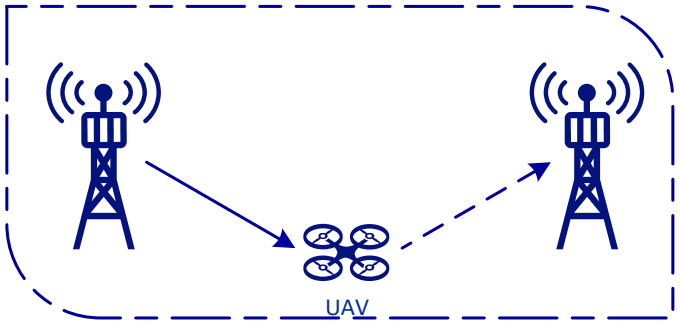
- Based on the use cases described in TR 22.837, relevant sensing modes should be summarized as follows:



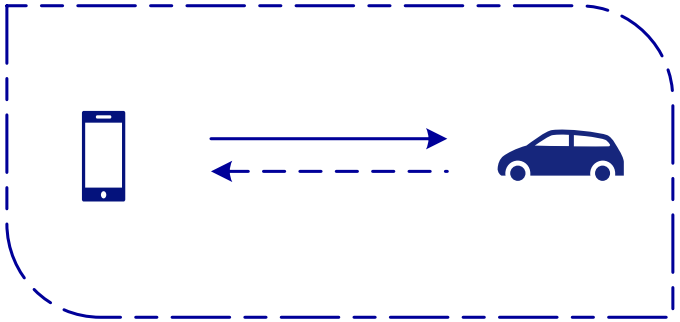
**Mode 1: gNB mono-static sensing**



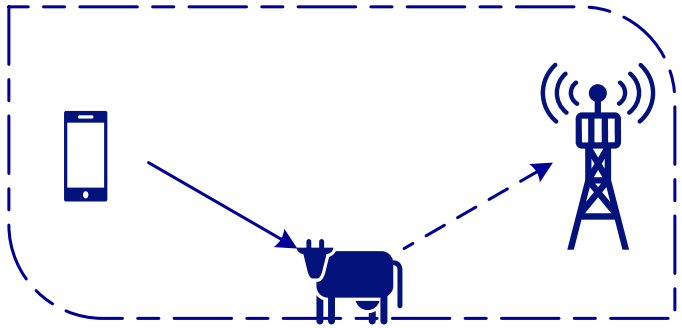
**Mode 2: gNB-to-UE bi-static sensing**



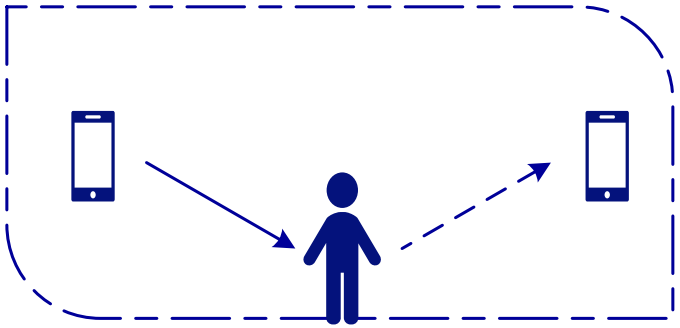

**Mode 3: gNB-to-gNB bi-static sensing**



**Mode 4: UE mono-static sensing;**



**Mode 5: UE-to-gNB bi-static sensing;**



**Mode 6: UE-to-UE bi-static sensing**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# Prioritized Sensing Modes in Rel-19

- Considering the requirements of typical use cases of ISAC and setting a reasonable workload, it is proposed to study only some of the sensing modes in Rel-19:
  - **Mode 2 and Mode 5 should be prioritized;**
    - gNB-to-UE bi-static sensing based on NR DL positioning schemes;
    - UE-to-gNB bi-static sensing based on NR UL positioning schemes;
  - Mode 3 and Mode 6 may be studied if the workload allows;
  - Mode 1 and Mode 4 should be deprioritized due to the duplexing constraints;


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# Channel Model and Performance Metric

- Channel model for ISAC should be discussed based on TR 38.901 in Rel-19;
  - In channel model discussion, the prioritized use cases and sensing modes should be taken into account;
  - The following issues should be considered in channel model study:
    - Models for sensing target, e.g., shape, size, RCS (Radar Cross Section);
    - Signal reflecting/scattering from a sensing target, especially for a moving sensing target;
    - Sensing clusters Vs communication clusters;
    - Environment impact;

- Performance metrics for ISAC should be identified;
  - The following items should be considered:
    - Sensing range;
    - Sensing accuracy, e.g., horizontal position/vertical position/velocity/angle;
    - Sensing resolution, e.g., distance/velocity/angle;


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# Objectives for ISAC

- Start a study item for ISAC first from RAN-level study on scenarios and requirements of sensing based on 3GPP network and determine prioritized use cases and sensing modes in Rel-19.

- On top of the RAN-level study outcome, start a WG-level SI:
  - Study simulation model, channel model, and performance metric of ISAC system.
  - Study framework, mechanism, and procedure to support sensing function;
    - Discuss the Sensing Function entity and interface: independent SF with a new interface, SF embedded in LMF, and if SF with a direct interface to RAN, etc.
    - Discuss what is new to E1/F1/Xn/Ng interface and procedure by considering the sensing service.
  - Study resource schemes of sensing and communication;
    - Resource division/multiplexing between sensing and communication: TDM/FDM/SDM, etc.
  - Study and identify potential schemes of sensing;
    - Sensing signal/waveform: combined with communication signal, non-OFDM signal, etc.


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# Summary

- Support SI for ISAC study in Rel-19:
  - RAN-level SI:
    - Study scenarios and requirements of sensing based on 3GPP network and determine prioritized use cases in Rel-19;
    - Study available sensing modes and determine prioritized sensing modes in Rel-19;
  - WG-level SI:
    - Study channel model and performance metrics based on the prioritized use cases and sensing modes;
    - Study potential sensing schemes for the prioritized use cases and sensing modes;


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