# ETSI GR ISC 001 V1.1.1 (2025-03)


# Integrated Sensing And Communications (ISAC); Use Cases and Deployment Scenarios



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***ETSI***

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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# Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Integrated Sensing And Communications (ISAC).



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# Executive summary

The present document identifies 18 advanced use cases relying on Integrated Sensing And Communications (ISAC) and their technological benefits. Described use cases bring societal benefits in various fields such as healthcare, public safety, transportation, robotics, smart factories or smart cities.

Described use cases are analysed to highlight consolidated requirements and KPIs that future 6G communications systems need to ensure to support these advanced use cases. The present document formulates considerations on deployment scenarios, suitable frequency bands, sensing modes, and integration levels. The present document also gives an overview of challenges associated with the described use cases.

Finally, the present document draws conclusions and formulates recommendations in terms of needed future work on ISAC channel modelling, measurements, evaluation methodology, system and radio access network architectures, security, privacy, trustworthiness, and sustainability for ISAC.

# Introduction

There is currently an increased interest for ISAC from the whole research ecosystem (including worldwide standardization bodies, industrial individual members and stakeholder associations, academia, strategic national and regional collaborative projects, etc.). In this context, the present document proposes new use cases to be potentially supported by future 6G systems.

# 1 Scope

The scope of the present document is to:

- Define 6G use cases for integrated sensing and communications.
- Identify and describe the corresponding deployment scenarios and the potentially suitable frequency bands.
- Define, characterize and evaluate the relevance of different sensing types and integration levels, and their mapping to the selected use cases/deployments.
- Identify requirements and define key performance/value indicators for the identified use cases.

# 2 References

## 2.1 Normative references

Normative references are not applicable in the present document.

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.



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# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

Void.

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| 3GPP | 3rd Generation Partnership Project |
| 6GS | 6th Generation System |
| ADAS | Advanced Driver Assistance Systems |
| ADS-B | Automatic Dependent Surveillance-Broadcast |
| AGV | Automated Guided Vehicles |
| AI | Artificial Intelligence |

| | |
|---|---|
| AMR | Autonomous Mobile Robots |
| ANSP | Air Navigation Service Provider |
| AP | Antenna Pannel |
| API | Application Programming Interface |
| AV | Aerial Vehicles |
| AWGN | Additive White Gaussian Noise |
| BLE | Bluetooth® Low Energy |
| BPS | Body Proximity Sensor |
| BS | Base Station |
| BVLoS | Beyond Visual Line of Sight |
| CIS | Common Information Services |
| C-ITS | Cooperative Intelligent Transport Systems |
| CLSK | Commando Luchtstrijdkrachten |
| CN | Core Network |
| CPE | Customer Premises Equipment |
| CPR | Consolidated Potential functional Requirements |
| CPS | Cyber-Physical System |
| CR | Cooperative Robot |
| CRLB | Cramer-Rao lower bound |
| CSI | Channel State Information |
| CTR | Controlled Traffic Regions |
| DT | Digital Twin |
| DUT | Device Under Test |
| EIRP | Effective Isotropic Radiated Power |
| FCC | Federal Communications Commission |
| FWA | Fixed Wireless Access |
| GDPR | General Data Protection Regulation |
| gNB | 3GPP Radio Access Point (gNodeB) |
| GNSS | Global navigation satellite system |
| GPU | Graphic processing unit |
| HAPS | High-Altitude Platform Station |
| HD | High Definition |
| I2O | Indoor to Ourdoor |
| IC | In Coverage |
| ICNIRP | International Commission on Non-Ionizing Radiation Protection |
| IoT | Internet of Things |
| ISAC | Integrated Sensing And Communications |
| KPI | Key Performance Indicator |
| LAPS | Low-Altitude Platform Station |
| LIDAR | Light Detection and Ranging |
| LoS | Line of Sight |
| LVNL | Luchtverkeersleiding Nederland |
| MaaS | Mobility as a Service |
| ML | Machine Learning |
| MNO | Mobile Network Operator |
| MPE | Maximum Permissible Exposure |
| MPR | Maximum Power Reduction |
| NB-IoT | Narrow Band Internet of Things |
| NCR | Network Controlled Repeater |
| NL | Netherlands |
| NLoS | Non Line of Sight |
| NTN | Non-Terrestrial Networks |
| O2I | Outdoor to Indoor |
| OoC | Out of Coverage |
| OPEX | Operating Expenses |
| PD | Power Density |
| PR | Potential Requirement |
| PRS | Positioning Reference Signal |
| QoS | Quality of Service |
| RAN | Radio Access Network |
| R-CPS | Realtime Cyber-Physical System |
| RCS | Radar Cross-Section |

| | |
|---|---|
| RF | Radiofrequency |
| RGB | Red Green Blue |
| RIS | Reconfigurable Intelligent Surfaces |
| RMa | Rural Macro |
| SAR | Specific Absorption Rate |
| SBA | Service-Based Architecture |
| SDO | Standard Development Organization |
| SNR | Signal to Noise Ratio |
| STA | Station |
| TPU | Tensor Processing Unit |
| TR | Technical Report |
| TRP | Transmission Point |
| TS | Technical Specification |
| UAV | Unmanned Aerial Vehicle |
| UE | User Equipment |
| UMa | Urban Macro |
| UMi | Urban Micro |
| USSP | UTM-Space Service Provider |
| UTM | Unmanned Aircraft System Traffic Management |
| UWB | Ultra-WideBand |
| V2V | Vehicle to Vehicle |
| V2X | Vehicle to Everything |
| VRU | Vulnerable Road User |
| WBPMP | Walking, (e-)Biking, Public transport, Mobility as a service and Private car |
| WG | Working Group |
| WI | Work Item |
| XR | eXtended Reality |



# 4 Foundations of integrated sensing and communications



## 4.1 Sensing modes

The term "sensing mode" describes the topology consisting of one or more sensing nodes and their role. Sensing nodes may be User Equipment's (UEs) or Transmission Points (TRPs) that may act as a sensing transmitter and/or sensing receiver.

There are six unique sensing modes:

- TRP-TRP bistatic;
- TRP monostatic;
- TRP-UE bistatic;
- UE-TRP bistatic;
- UE-UE bistatic; and
- UE monostatic.

These basic modes may be extended to multi-static variants by adding additional UE(s) or TRP(s) to any of the six basic modes as sensing transmitter(s) and/or receiver(s).

## 4.2 Integration levels

The term "integration level" describes how communication and sensing functionalities are combined in one system. It is commonly categorized in multiple levels, reaching from loose integration to tight integration with variable granularity [i.41].

Loose integration refers to the case where the two functionalities are realized rather on a standalone basis with some level of coordination, e.g. on application level, or by combining dedicated sensors and communication hardware on a site.

Tight integration refers to a joint waveform or joint signal design that is suitable for both tasks.

Intermediate integration may refer to anything in between.

## 4.3 System terminology for sensing-enabled 6G systems

For the purposes of the present document, the following terms apply:

- **Sensing Signal** is a transmitted signal from a Sensing Transmitter for the purpose of sensing. The signal can be 6G or non-6G.
- A **Sensing Transmitter** is a 6G or non-6G entity that transmits a Sensing Signal.
- A **Sensing Receiver** is a 6G or non-6G entity that receives a Sensing Signal and produces Sensing Data. A Sensing Receiver can be co-located with a Sensing Transmitter.
- **Sensing Data** is the 6G or non-6G data produced for sensing purposes.
- A **Sensing Service** is a feature of the 6GS that is offered to service consumers. A Sensing Service provides Sensing Results based on communicated requirements and KPIs.
- A **Sensing Task** consists of activities to perform sensing, including the configuration of the required Sensing Transmitter(s) and Sensing Receiver(s) (if applicable), the collection of Sensing Data, the processing of the Sensing Data and the exposure of the Sensing Results. Each Sensing Task fulfils a Sensing Service request.
- A **Target Sensing Service Area** as defined in clause 3.1 of 3GPP TS 22.137 [i.2].
- The **Sensing Results** may include characteristics of objects (e.g. type, distance, velocity, trajectory, size, shape, material), or other contextual information (e.g. time of generation, environmental information) about objects in the Target Sensing Service Area.

NOTE: It is not precluded that the sensing result exposed to an entity within 6GS or to a third party may in some cases consist of the sensing data itself.

- **Fusion** refers to a process to join two or more streams of Sensing Data or Sensing Results together to form one or more Sensing Data or Sensing Result stream(s). Fusion can take place at the origin of the sensing data, along the system entities of a 6GS. The fusion of Sensing Results can also take place along all 6GS system entities. Fusion can also take place in non-6GS entities.

Figure 1 uses the terminology defined above and illustrates the described information flow.