# Integrated Sensing and Communications (ISAC) use case for CATS

draft-bernardos-cats-isac-uc-00

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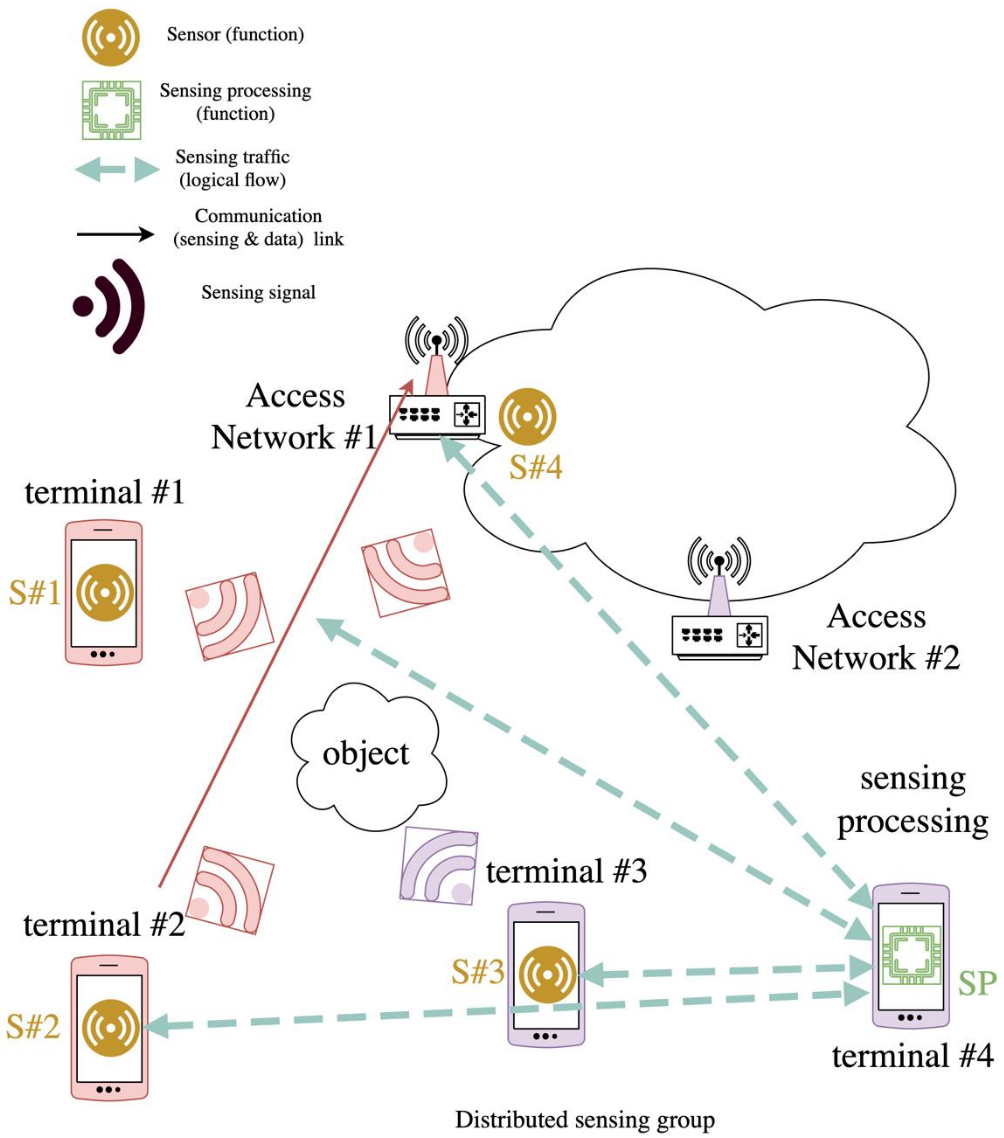
# ISAC GREEN UC: use case description




- Integrated Sensing and Communications (ISAC) enables wireless networks to perform simultaneous data transmission and environmental sensing
- Multiple network nodes collect raw sensing data
- Collected raw data must be aggregated and processed by a designated computing node with sufficient computational resources
  - Capabilities of both sensing and processing might vary depending on available energy
- The ETSI ISAC ISG has been established to explore technical requirements and use cases, while 3GPP has initiated discussions on ISAC-related features within its ongoing research on future 6G systems

# ISAC GREEN UC: proposed UC template

- **Use case description**

General description of the use case

- **(GREEN) Specifics**

(if there are no GREEN specific aspects, then it is not a UC to be documented)

For example, the use case involves components that can report on energy consumption and that might be reconfigured (on a local or global scale) to operate based on energy goals/limitations.

- **Requirements for GREEN**

Examples (can be split into different categories to facilitate a summary at the end of the document):

  - Granularity of measurements should be per component, per line, per port…
  - Ability to switch on/off, put on sleep mode… components
  - Ability to reconfigure hardware mode based on power savings (e.g., reduce reliability or speed)
  - Ability to operate globally (not constrained to just one device) based on power savings/goals (e.g., steer traffic using a different path that consumes less energy)

# Energy-Aware Smart City Traffic Management
## Use case description

- Deployment of ISAC systems in a smart city to monitor and optimize vehicles' traffic flows while minimizing energy consumption of the mobile network
  - The system integrates sensing technologies, such as radar and LIDAR, with communication networks to detect vehicle density, monitor road conditions, and communicate with autonomous vehicles or traffic lights
- ISAC enables minimizing redundant infrastructure (e.g., separate sensors and communication equipment)
  - thus reducing the overall carbon and energy footprint

# Energy-Aware Smart City Traffic Management
## GREEN Specifics

- **Energy Consumption Monitoring:** Each ISAC component (e.g., roadside units, integrated sensors, and communication transceivers) is capable of reporting its energy consumption in real time to the centralized or distributed energy management system
    - Sensing capabilities can be reconfigured depending on energy consumption goals and sensing accuracy
- **Reconfiguration for Energy Efficiency:** The system can dynamically switch between high-resolution sensing modes (e.g., during peak hours) and low-power modes (e.g., during low traffic periods). The network can reconfigure traffic communication paths to prioritize routes or nodes that consume less power, leveraging energy-efficient communication protocols
- **Integration of Local and Global Energy Goals:** The system can operate both locally (e.g., turning off specific roadside units in low-traffic areas) and globally (e.g., modifying traffic patterns across the city) to achieve defined energy consumption goals

# Energy-Aware Smart City Traffic Management
## Requirements for GREEN

1. **Measurement Granularity**
   - Ability to measure energy consumption per ISAC component (e.g., roadside unit, sensor, transceiver)
   - Granular reporting per communication link or sensing mode (e.g., high-power radar mode vs. low-power mode)
2. **Power Control Mechanisms**
   - Ability to switch components on/off or place them in sleep/ standby mode when not in use
   - Support for dynamic adjustment of sensing resolution or communication bandwidth to balance energy savings and system performance
3. **Reconfiguration and Adaptability**
   - Support for hardware reconfiguration (e.g., adaptive sensing modes, transceiver settings) to optimize energy use
   - Mechanisms to steer traffic or adjust network routing based on global or local energy-saving objectives
4. **Global Coordination**
   - Capabilities for cross-domain coordination to enable global optimization (e.g., city-wide traffic rerouting or dynamic resource allocation across different regions)
   - Ability to aggregate and analyze energy consumption data from all ISAC components to inform high-level decision-making
5. **Energy-Aware Standards and Protocols**
   - Communication protocols that minimize power usage while maintaining reliability
   - Interoperability standards for energy-aware reconfiguration across heterogeneous ISAC components and systems

# ISAC GREEN UC: discussion

- ISAC UC (and associated requirements) not covered in existing use cases drafts (draft-stephan-green-use-cases-00)
- Proposal is to include (some) text from draft-bernardos-green-isac-uc-00 into future WG adopted UC draft
- Also to use proposed template to describe all use cases and associated requirements