Session 1

ISAC/JCAS Use-cases and Requirements

Moderator: Dr. Didier Bourse (6G-IA)
SNS Work Programmes Task Force / Core Team Chairman

SNS JU /6G-IA & 5G-ACIA Highlights, Lessons learnt and next steps on ISAC/JCAS

10 October 2025

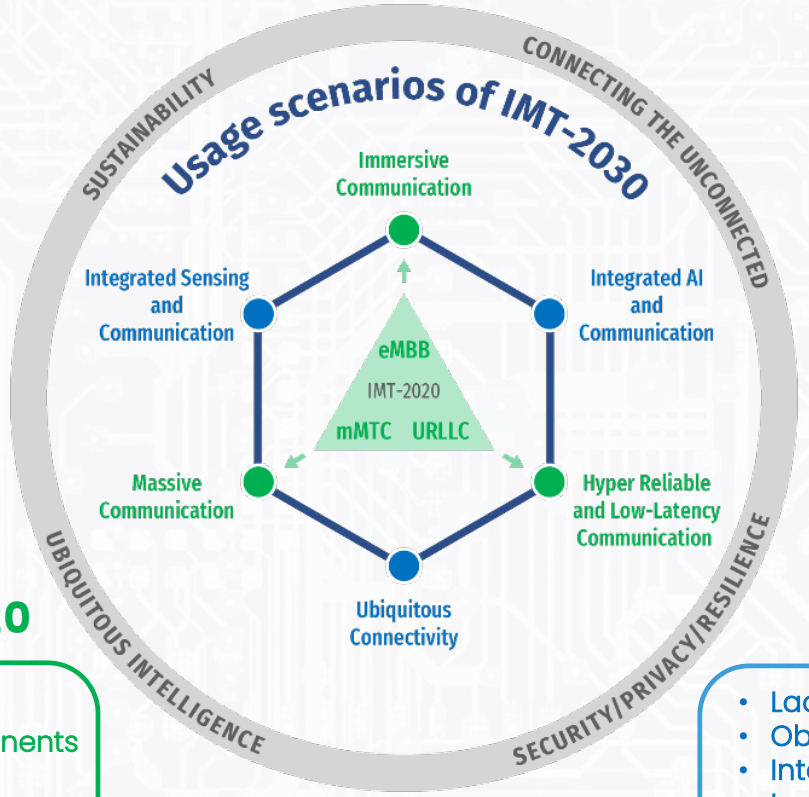
SNS-6G-IA ISAC/JCAS Perspectives (1/4)

INTEGRATED SENSING & COMMUNICATIONS

- Beyond Communication Network Services
- High Data Volume
- Lack of Compact and Complete Data Representation
- Lack of Sensing Control Functions
- Lack of Standard Ways to Select and Configure Sensing Resource
- Lack of Continuity of Service for Sensing Over a Large Area
- Lack of Synchronization Among Distributed Network Elements

EXTENSION OF IMT-2020

- Unsustainable RAN Virtualisation
- Poor Interoperability of RAN components
- Reconfigurable Multi Connectivity
- Integration of localised Networks
- Non-Flexible Service-Centric Design
- Extreme MIMO Processing Complexity
- Growing RU Energy Consumption



AI & COMMUNICATION

- Enable an AI-Assisted Data Driven Architecture in 6G
- AI Models Involved in Decision Automation
- Learning at the Edge: The Scarce Resources Challenge
- Lack of a Unified E2E AIOps Framework and AI Conflict Management
- Efficient Application of AI/ML Algorithms for Automation of Energy-Efficient RAN Operations
- Need for Self-Evolving, Autonomous, and Extendable Systems with Predicting Capabilities

UBIQUITOUS CONNECTIVITY

- Lack of Global, Open, and Easy-to-Use Service APIs
- Obsolete Trust Model Hinders Performance
- Integration among TN and NTN Networks
- Lack of Integration among different AI-Based Deployments
- Challenges in Federation
- Support for Semantic Communications
- Management Plane Centralization

White Paper: https://6g-ia.eu/wp-content/uploads/2024/11/european-vision-for-the-6g-network-ecosystem.pdf
Webinar Video: 6G IA Vision Working Group White Paper: The EUROPEAN VISION For The #6G NETWORK ECOSYSTEM – YouTube
Webinar Slides: 6g-ia-vision-white-paper-v2.0.pdf

SNS-6G-IA ISAC/JCAS Perspectives (2/4)

Integrated Sensing

22 Projects addressing ISAC/JCAS

https://smart-networks.europa.eu/interactive-map-of-sns-projects/

SNS-6G-IA ISAC/JCAS Perspectives (3/4)

Note: As of 09.10.25

VERTICAL ENGAGEMENT TRACKER ▾ | STANDARDS TRACKER ▾ | KPI RADARS ▾

Home / Vertical Engagement Tracker /

Search

Project

Project Open Call 3rd-party funding

SNS JU Call

Vertical Sector

Countries (EU)

Type of Experiment

- Simulation/Emulation
- Demonstration
- Pilot
- Proof of Concept
- Prototype
- Trial

Functionality

- Cloud-Native Architecture
- Enhanced Mobile Broadband (eMBB)
- Holographic Communications

Verticals Cartography

The Verticals Cartography is a monitoring tool that tracks the advancements of Europe's 6G Smart Networks and Services Joint Undertaking (SNS JU) Public Private Partnership. This initiative focuses on developing 6G technology enablers and applications for various market segments. With a collection of use cases, from proofs of concept and prototypes to demonstrations and trials, the Verticals Cartography provides consumers and industry end-users with practical examples of 6G integration into daily life and business.

How to use the Verticals Cartography

Contained within this cartography is a structured mapping of R&D endeavours that address the frontier of 6G technologies. This includes a spectrum of trials, pilots, and use cases executed under the auspices of the SNS JU initiative. These use cases are based on criteria like 1) targeted vertical sectors, 2) location of the experiment, 3) nature of the experiment, and 4) functionalities employed.

To explore the available use cases, simply engage with one of the filters and make your selection, or utilise the search bar for a more directed exploration. If you wish to add your SNS JU project's use cases, fill the questionnaire at **this link**

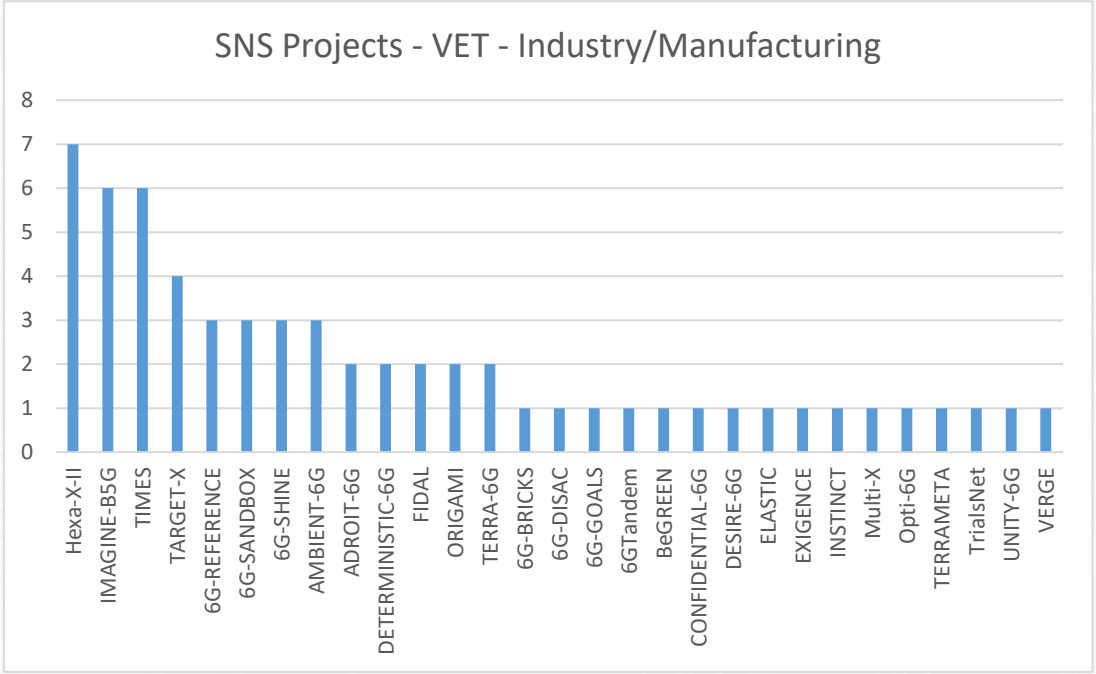
Displaying 1 - 12 of 344

6G-XR
StreamAnalyzerFor5GSlicing
StreamAnalyzerFor5GSlicing directly operates for the 5G Core thus is a...

6G-DALI
AIaaS for CDN apps via cross-testbed decentralized MLOps
Media/xR

FLECON-6G
Public Safety Services
Security/ PPDR

- Verticals Engagement Tracker (VET) including 344 Inputs
- VET including 61 Inputs related to Industry4.0 / Manufacturing



https://sns-trackers.sns-ju.eu/vertical-engagement-tracker

SNS-6G-IA ISAC/JCAS Perspectives (4/4)

- 6G ISAC/JCAS recent SOTA
  - 5G-ACIA White Paper Use Cases and Requirements for Integrated Sensing and Communication (ISAC) in Connected Industries and Automation - 5G-ACIA including https://5g-acia.org/download/22038/?version=a4 released in November 2024.
  - EuCNC & 6GS 2025 Workshop, Special Session and Tutorial Programme – EuCNC organized on 03-06.06.25
  - ETSI BrightTALK online Webinar “6G ISAC: Crystalizing the Use Cases and Their Requirements” organized on 27.06.25 @ 11:00-12:15 CEST (ETSI - Webinar standardization - Webinar Organized by ETSI)
  - 5G-Americas Report 5G Americas Highlights the Strategic Role of Integrated Sensing and Communication for 6G released on 01.07.25 -> Transforming Industries with Integrated Sensing and Communication - 5G Americas and Transforming-Industries-with-Integrated-Sensing-and-Communications.pdf
  - 5G-ACIA online Webinar Reliable and Smart Industrial Connectivity: DetNet and ISAC over 5G - 5G-ACIA organized on 16.07.25 @ 10:00-11:00 CEST

ISAC Use Cases and Requirements

Presenter: Dr Sebastian Robitzsch, InterDigital Europe Ltd

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MultiX Use Cases

	Industrial Collaborative Robots	Contact-free human localization and respiration detection	Smart Home Virtual Security	Low-altitude UAV management	Gesture Recognition in Industrial Environments	Smart Shopping Tracker
Lead	Siemens	KU Leuven	OTE	Telefonica	Siemens	InterDigital
Location	Indoors	Indoors	Indoors/Outdoors	Outdoors	Outdoors	Indoors
Technology	Cellular, Radar, Camera	Cellular, LiDaR, Radar, Camera, Wi-Fi	Cellular, Camera, Wi-Fi	Cellular, Radar, Camera,	Cellular, LiDaR, Radar, Camera,	Cellular, Wi-Fi

MultiX Consolidated Requirements

Sensing Service Area [m^2/3]	Confidence Level [%]	Accuracy of positioning		Accuracy of velocity		Sensing Resolution		Fine Motion Accuracy [m]	Sensing Service Range [m]	Max Sensing Service Latency [s]	Refresh Rate [s]	Missed Detection [%]	False Positive [%]
		Horizontal[m]	Vertical [m]	Horizontal [m/s]	Vertical [m/s]	Range Resolution [m]	Velocity Resolution [m/s]						
[5.0-50]	[95-99.999]	[0.3-10.0]	[0.3-10.0]	[1.0-20]	[1.0-20]	[0.01-0.3]	[0.01-1]	[0.01-0.1]	[10]	[0.01-2]	[0.05-1.0]	[2-10]	[1-5]

iSEE-6G

Integrated Sensing, Energy and Communication for 6G Networks

Presenter: Prof. Konstantinos Maliatsos, University of the Aegean, University of Piraeus, GR

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- Beyond joint communication and sensing. Definition & development of Joint Communication, Computation, Sensing, and Power transfer (JCCSP) unified radio paradigm

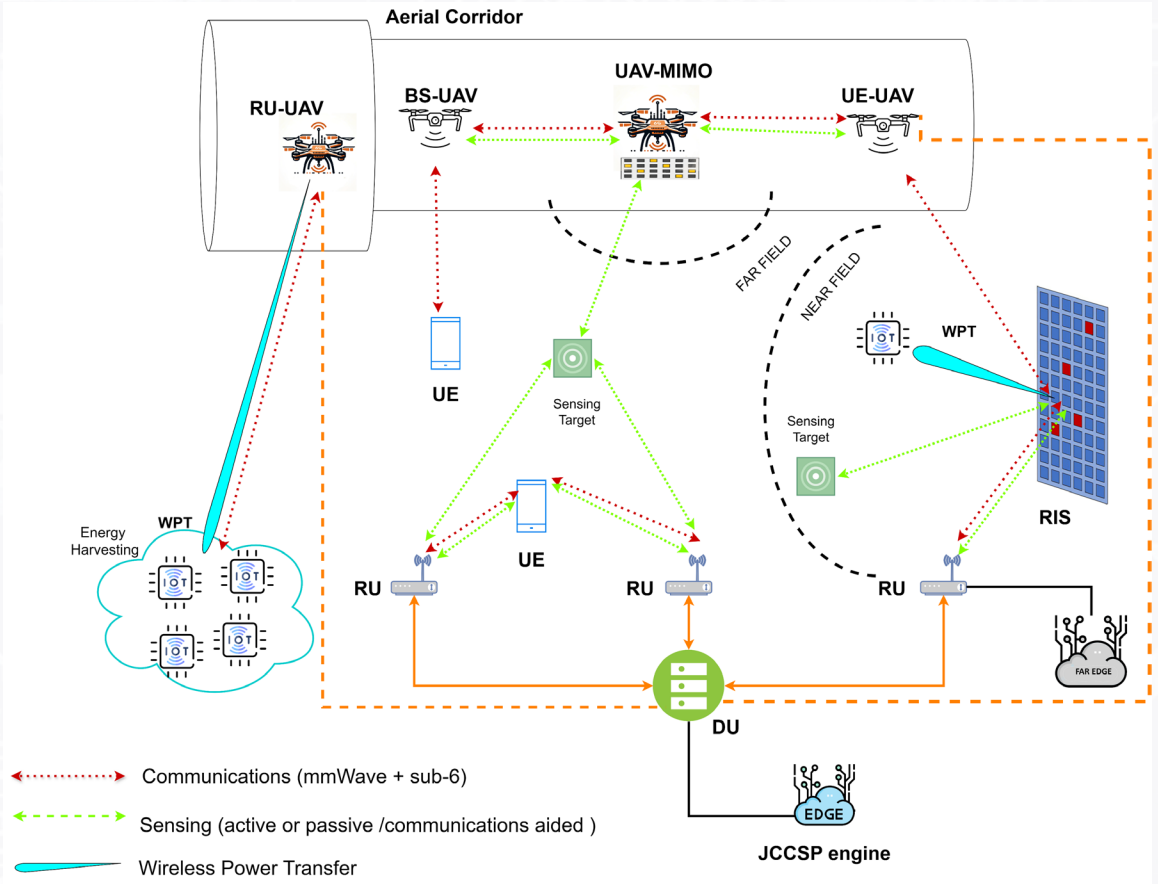
6G-enabled/supported Aerial Corridors

- *JCCSP-oriented passive and active antennas solutions with intelligent reconfiguration capabilities*
- *JCCSP-optimized Physical Layer design*
- *JCCSP-enabled cross-layer schemes design*
- *Positioning with MEC support using 6G and UAVs network.*

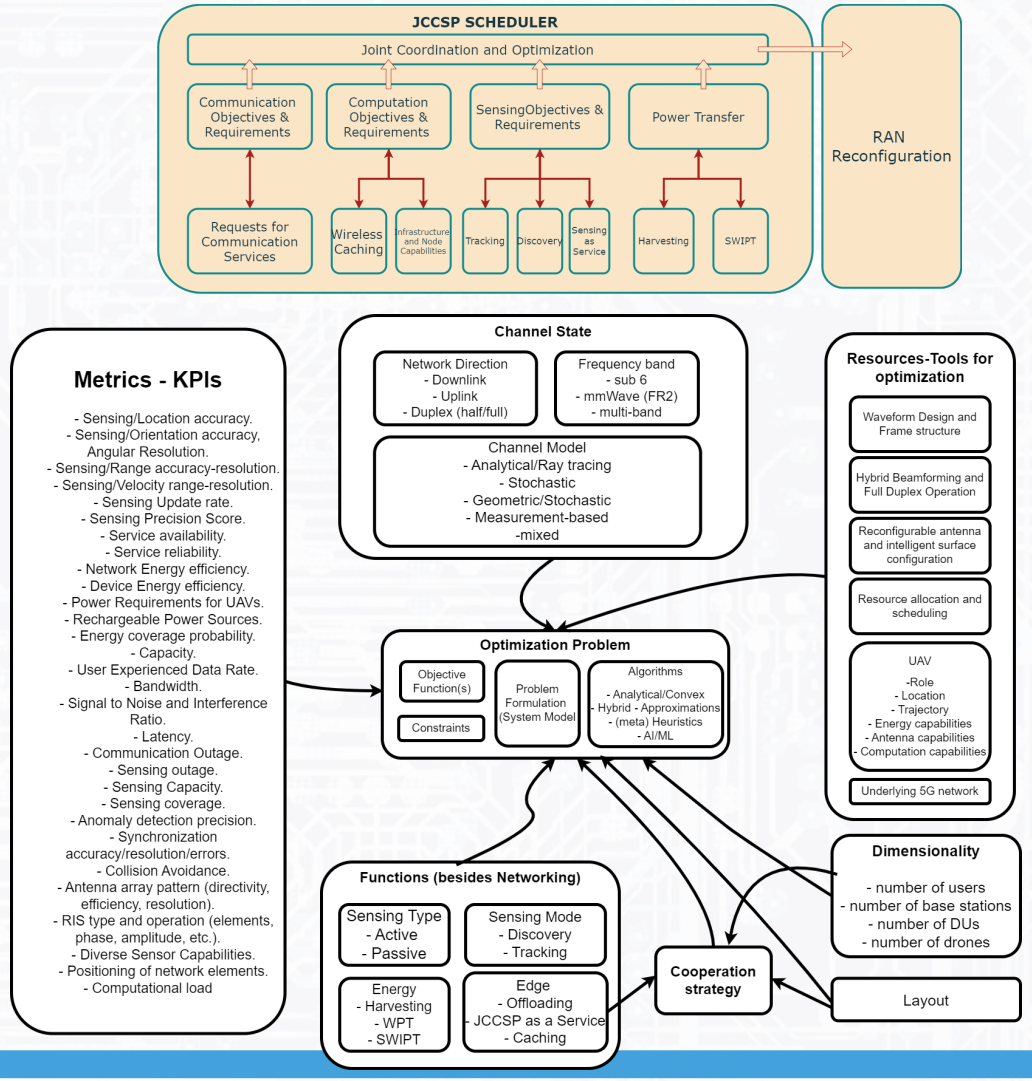
Use Cases

- ISAC in a 6G Cell-free environment.
- UAV corridors.
- Safety enhancement
- Agricultural industrial IoT
- Connected and cooperative autonomous mobility
- Energy harvesting

System Model



ISAC - JCCSP Use-cases and Requirements



Requirements

Category	KPI	Requirements
Sensing	Location accuracy	cm-level
	Orientation accuracy	rad-level
	Range accuracy	cm-level
	Range resolution	cm-level
	Angular resolution	~15 degrees
	Velocity range	-10 m/s to 10 m/s
	Velocity resolution	0.1 - 0.3 m/s
	Update rate	Every 50-100 ms
Latency	End-to-End Service Latency	Below 10 ms
Capacity	User Experienced Data Rate	Up to 1 Gbps
	Bandwidth	60-400 MHz
Service	Service Availability	99%
	Service Reliability	99%
	Network Availability	99%
	Mobility Support	Up to 100 km/h
Energy	Network Energy Efficiency	Investigation required based on routing, sensing, and communication algorithms
	Device Energy Efficiency	Investigation required based on UAV flight optimization
	Power Requirements for UAVs	Continuous operation ≥ 2 hours
Security	Collision Avoidance	99.99% reliability
	Secure Communication Protocols	Lightweight encryption, user authentication, and regulatory compliance

Optical & Wireless ISAC in the ECO-eNET Project

Presenter: Prof. Dan Kilper, Trinity College Dublin

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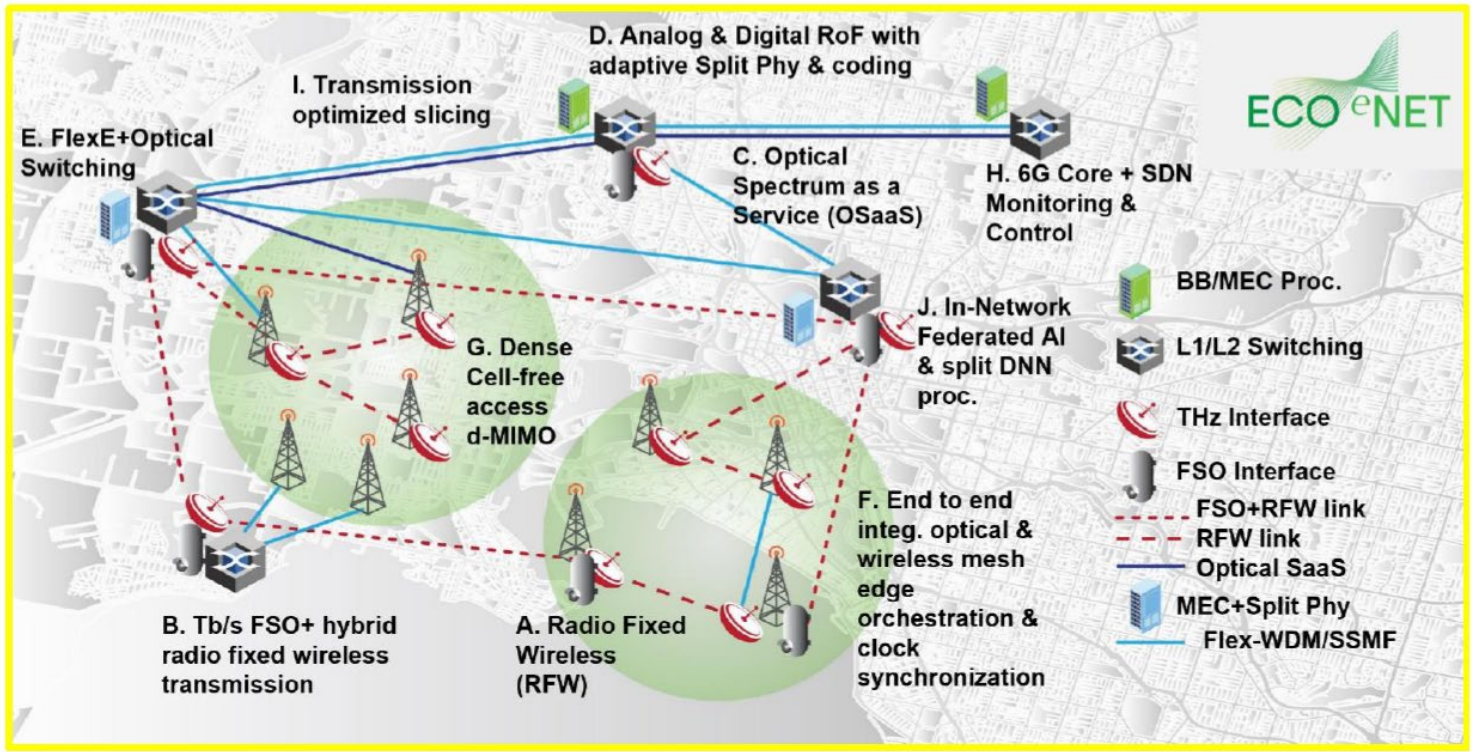
Energy Efficient Confluent Edge Networks



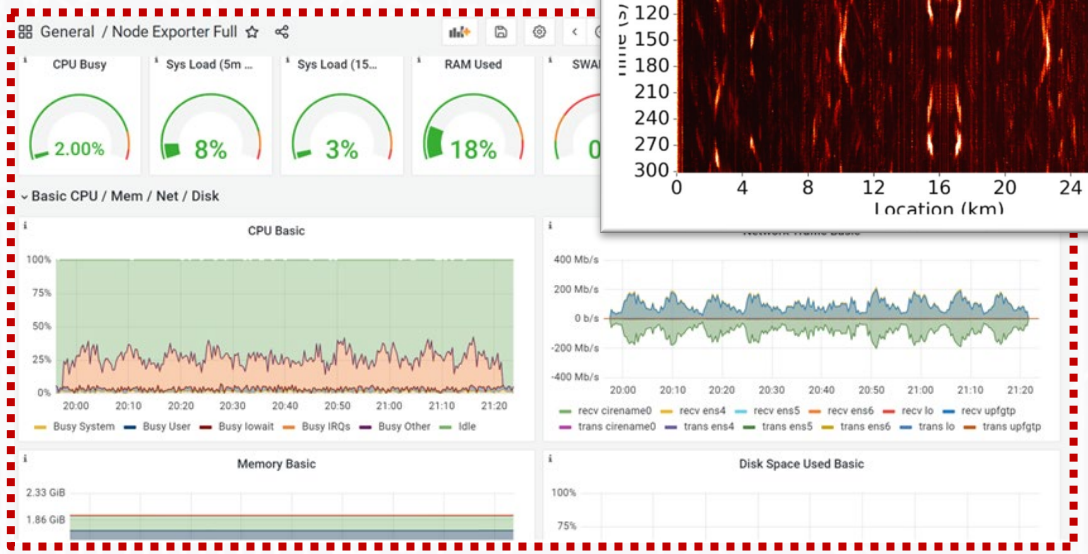
Edge mesh networks through confluence:

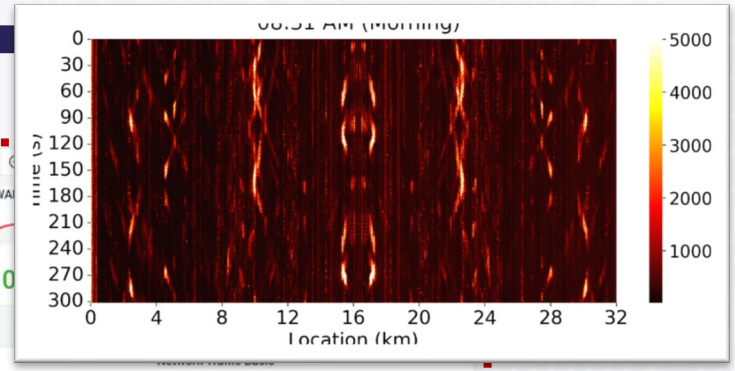
- Unifying fibre, FSO, and sub-THz transmission with Open Optical Spectrum Services to combine digital, analog and sensing signals at the metro edge
- Use fibre sensing and transport of FSO and sub-THz/RF sensing signals
- Use case: resilience of mesh connections at edge, supporting URLLC

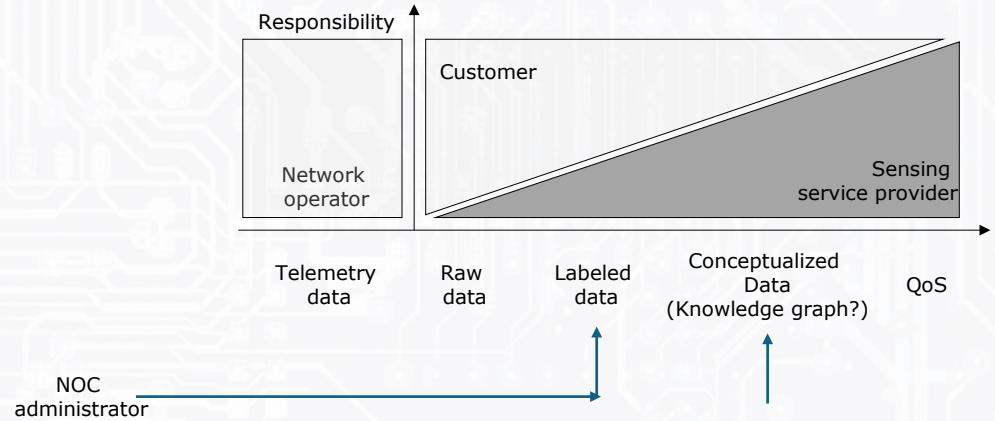
www.eco-enet.eu

Unified Control with Fibre and Wireless Sensing

- Virtualized 6G core Network Functions
  - Management and Orchestration through an NFVO
  - OSM MANO is used to automate NF deployment
    - The characteristics of each VM are portrayed in VNF Descriptors
    - Networking Requirements through the NS Descriptors
- Monitoring platform for 6G Core Functions
  - Network agents placed in every compute and network component.
  - Collect performance metric values from the hosts and expose these to certain interfaces.
  - These values are then retrieved from the monitoring server and are stored in a database for further analysis, visualization, SLA and trending reporting
- The monitoring platform is based on open-source tools, such as Prometheus and Grafana.
- Energy-related data are also collected for every device and stored to Prometheus database.
- Telemetry as a Service: Data processing vs Responsibility







*A. -I. Manolopoulos, V. -M. Alevizaki, M. Anastasopoulos and A. Tzanakaki, "An AI-Assisted Framework for Lifecycle Management of Beyond 5G Services," in IEEE Access, vol. 12, pp. 179449-179463, 2024.

6G-DISAC: Distributed Intelligent Sensing and Communications for 6G

Use cases and requirements for ISAC

Presenter: Giyyarpuram Madhusudan(Orange SA, France)

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Use cases and requirements

- Analysed many use cases from standards and industry forums
- Chose the following criteria for selection:
  - Benefits from DISAC architecture
    - sensing over a wide area with multiple sensing nodes
    - ensure continuity of sensing services
    - use of multimodal sensors
  - Has business potential
  - Has demonstration potential

DISAC-Assisted Parking

Environment Sensing

Multimodality (ISAC, LiDAR, cameras)

Detects parked vehicles, pedestrians, cycles

Both indoor and outdoor environments

Information Fusion and Communication

ISAC fusion at network core

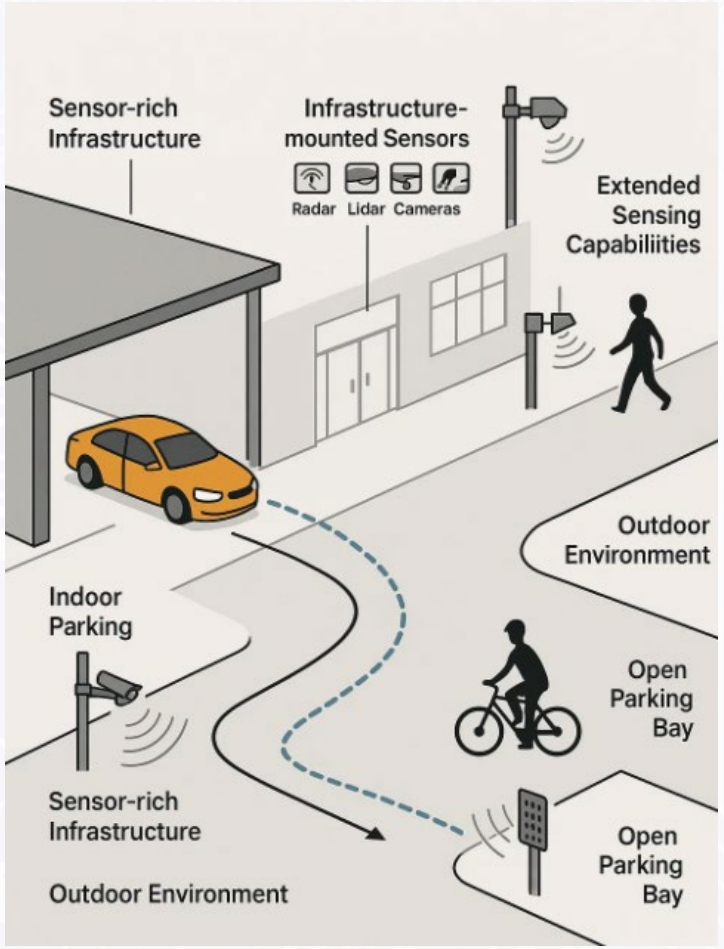
Multimodal fusion with use of semantics

Communication with vehicles to provide real-time feedback

Trajectory computation

A. Vehicle-centric approach

B. Infrastructure-centric approach



6G-MUSICAL

Subtitle

Presenter: Izzat Darwazeh-University College London

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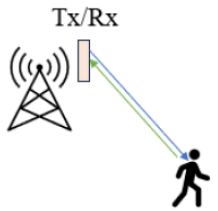
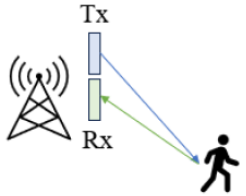
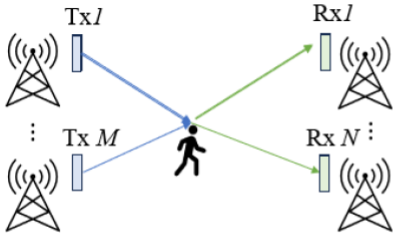
ISAC Scenarios and Architecture Considerations



(a) BS-based monostatic sensing



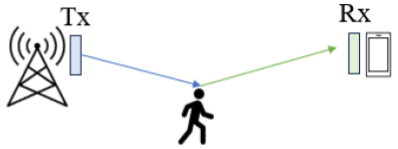
(b) BS-based quasi-monostatic sensing



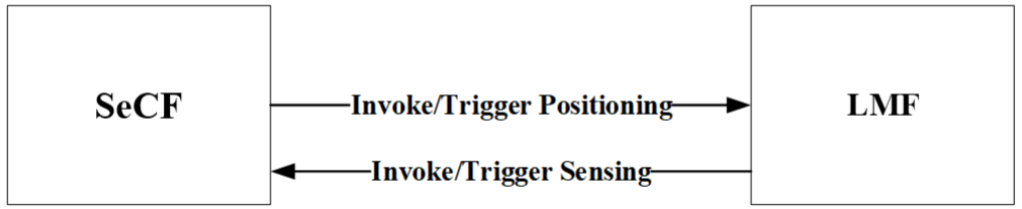
(c) BS-based multi-static sensing with M transmitter and N receiver sensing nodes

(d) BS-based bi-static sensing

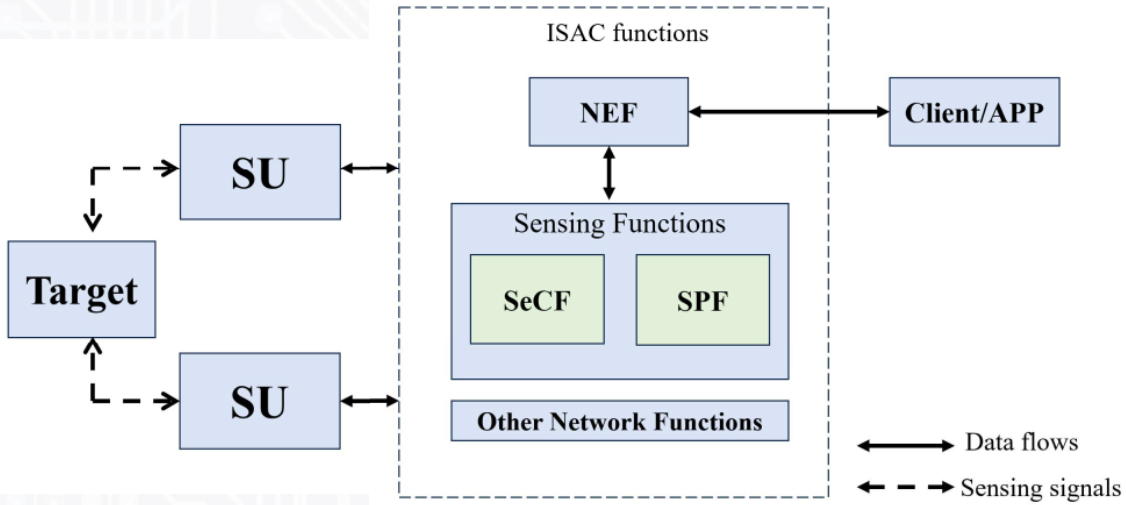
(e) UE/BS-based bi-static sensing
(examples on next slide)



(f) BS/UE-based bi-static sensing



Information exchange between Sensing Control Function (SeCF) and Location Management Function (LMF) to trigger a positioning or sensing service.



ISAC functions comprise Network Exposure, Sensing Control, Sensing Processing and other network functions.

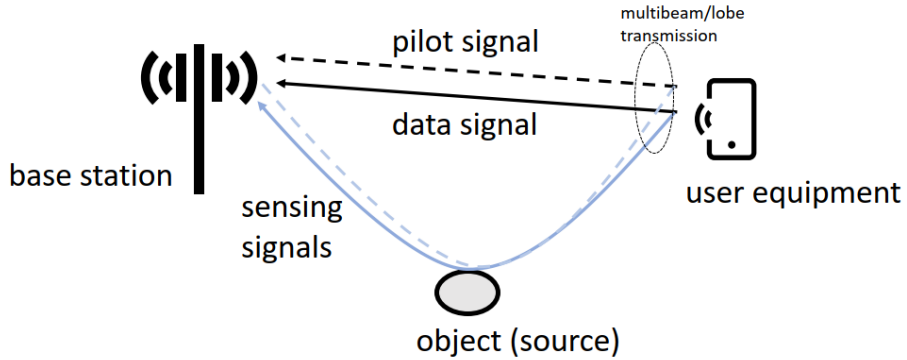
Sensing Functions
- NEF: Network Exposure Function
- **SeCF: Sensing Control Function**
- **SPF: Sensing Processing Function**
- SU: Sensing Unit
- LMF: Location Management Function

The 6G-MUSICAL sensing architecture supports a wide range of integrated sensing, positioning and communication scenarios.

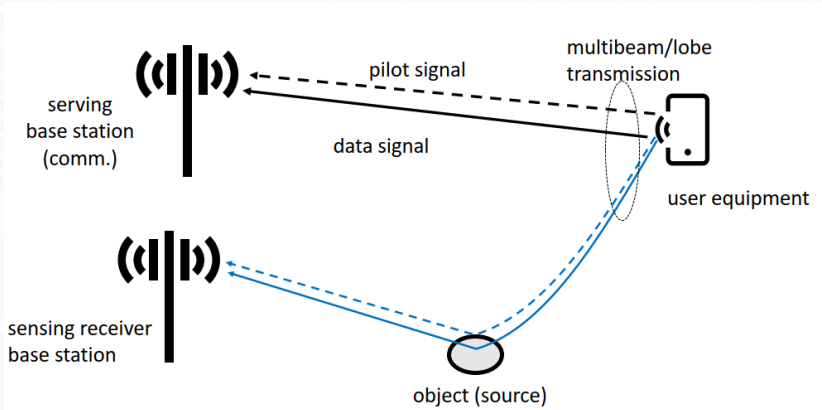
Y. Lyazidi, J. Equi, R. Shreevastav, I. Siomina and G. Fodor, "ISAC Architecture and Sensing Topology Switching in 6G Cellular Networks," *IEEE Conf. Standards for Communications and Networking (CSCN)*, Nov. 2024.

Examples of UE/BS-Based Bistatic Sensing

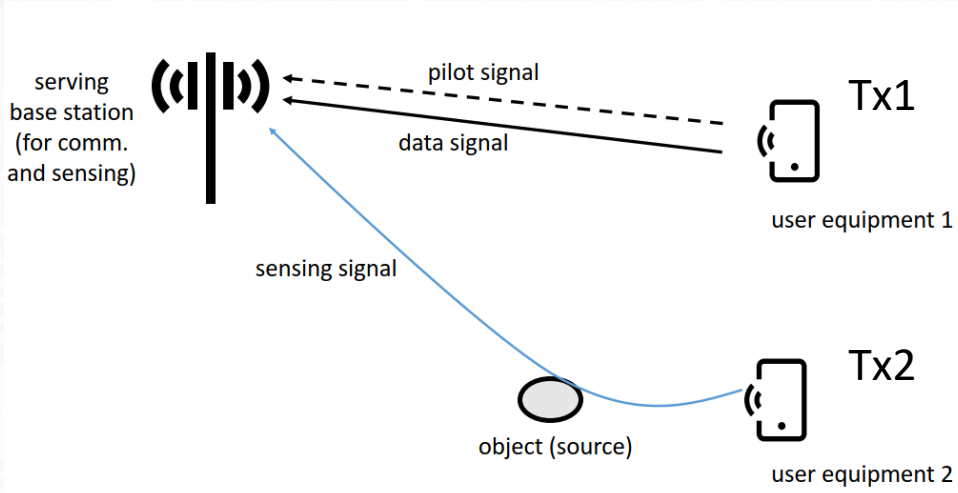
Scenario 1: Power constraint at Tx + ISAC interference at the Rx



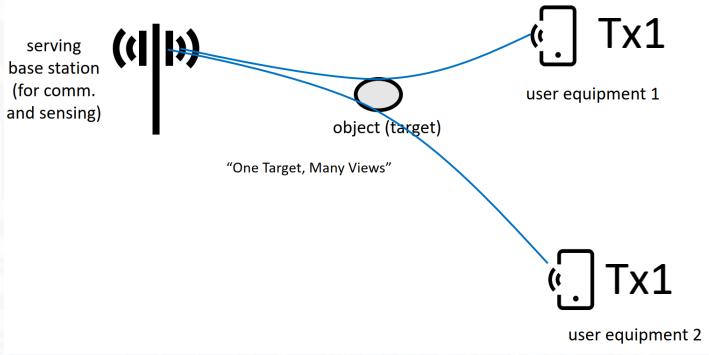
Scenario 2: Power constraint at Tx



Scenario 3: No power constraint at the Tx + Interference at the Rx



Scenario 4: Multiple sensing signals at the Rx (BS) (Collaborative ISAC: Multiple Sensing Tx nodes)



Scenario 2 and Scenario 3 relax the inherent receiver side and transmitter side ISAC trade-offs of Scenario 1.

S. Fodor, G. Fodor, A. Almeida, M. Telek, "Integrated Sensing and Communication Scenarios with Transmitter and Receiver-Side Trade-Offs", *IEEE Symp. On JC&S*, Finland, Feb. 2025.
S. Daei, G. Fodor, M. Skoglund, "One Target, Many Views: Multi-User Fusion for Collaborative Uplink ISAC", *arXiv:*2505.01223, May 2025.

6G-REFERENCE ISAC Scenarios

Presenter: Eric Klumperink

(University of Twente, IC Design group, Enschede, The Netherlands)

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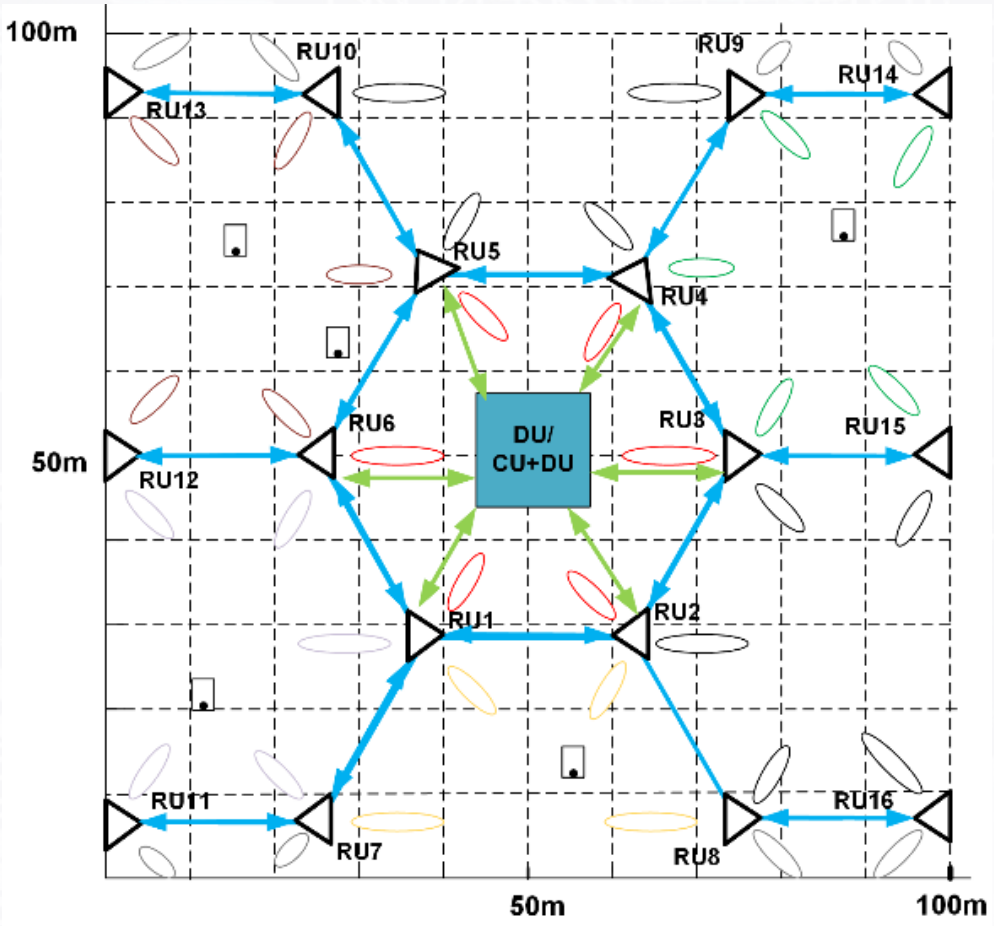
Distributed MIMO exploiting FR3 (15GHz, BW=400MHz)

Over-the-Air Synchronization

ISAC

Low latency Communication

taken from https://hexa-x-ii.eu/wp-content/uploads/2025/05/Hexa-X-II-D1.4_slideset_final.pdf



***Scenario assumptions*:**

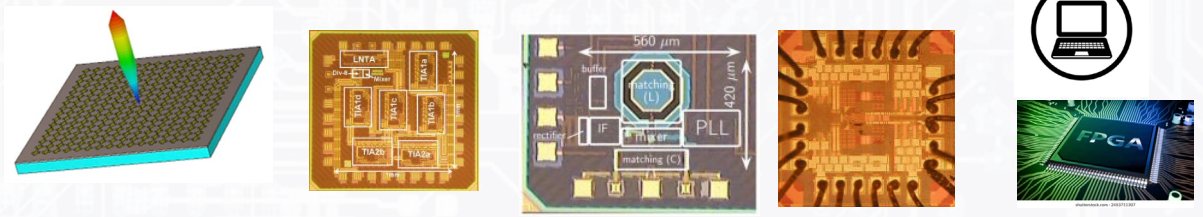
- *Factory Hall scenario (& Urban square)*
- *Densified Distributed MIMO RU-network (grid 25m)*
- *Fiber access only at Distributed/Central Unit (CU/DU)*

Main ISAC Related Project Goals

15GHz Distributed-MIMO Reference hardware design: Antenna Array & critical Chips (22nm FDSOI)

- Filtering Antenna Array: >25dB Tx-Rx Isolation (@ dual polarization!)
- Full-Duplex Self-Interference Rejection <80dB
- Range/doppler specifications: <0.5m & 0.5m/sec
- Over-the-Air frequency-synchronization <1ppb
- Local Oscillator Integrated Jitter <100 fsec
- UTC Time-stamping <100ns
- Holy grail: coherent D-MIMO (<1psec alignment)

What can we achieve in practice??



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6TH GENERATION SMART NETWORKS & SERVICES

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