6G-DISAC
6G for Distributed Intelligent Sensing and Communication

Distributed ISAC
The 6G-DISAC approach

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SNS JU Phase 2
Project introduction Webinar
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6G-DISAC HORIZON PROJECT

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6G SNS

PHASE 2

6G DISAC

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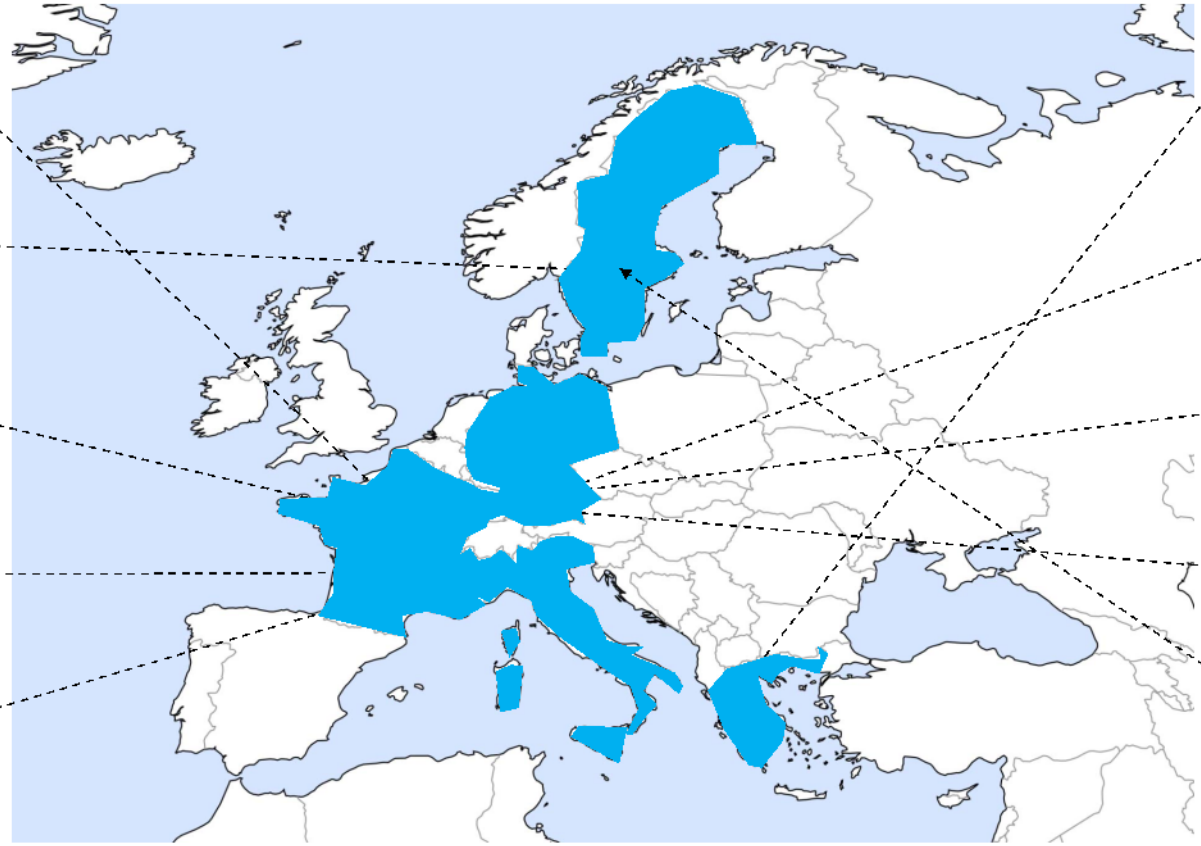


National and Kapodistrian University of Athens

ims Bordeaux

NEC

BOSCH

RadChat

5 EU Member States

10 Consortium Partners

5G PPP PUBLIC-PRIVATE PARTNERSHIP

5G: SENSING & COMMUNICATIONS

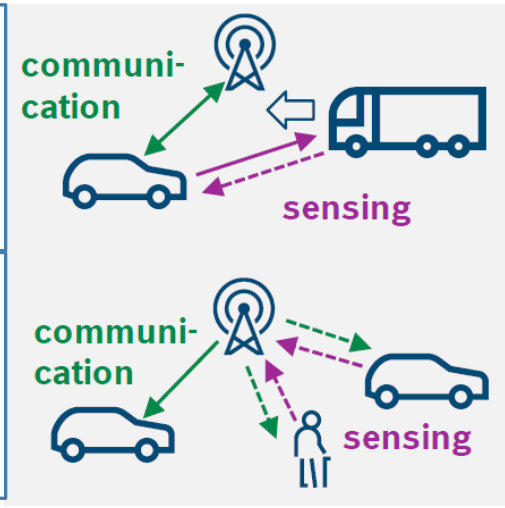
Separated sensing & communication

Separate devices, dedicated spectrum, no interaction

Integration of sensing and communications for mutual benefits

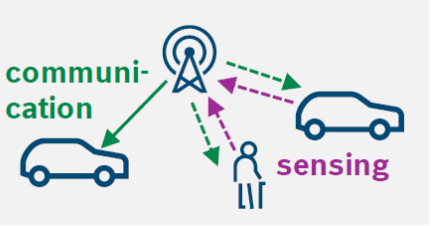
Sensing-assisted communications: Sensing to provide "side information" for improving communication functions (beam alignment, tracking, RIS reconfiguration, fast handover, adaptive modulation & coding, etc.)

Communication-assisted sensing: Communication to **enhance sensing quality** (collaborative sensing, sensor fusion, multi-static radar, etc.)



Common spectrum, infrastructure, leverage wide are mobile coverage

WHY to share same spectrum, HW, power resources?



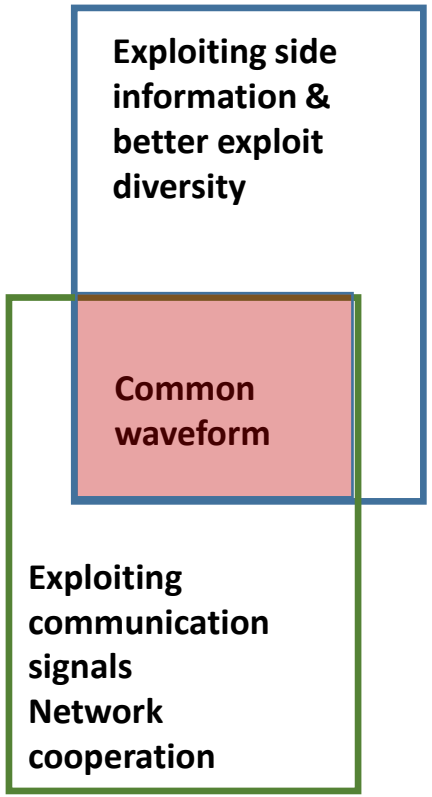
Integrated Sensing & Communications:

Combines communication & sensing functionalities to **re-use hardware, save resources, exploit wide area mobile coverage**, for a **cross-functional benefit**.

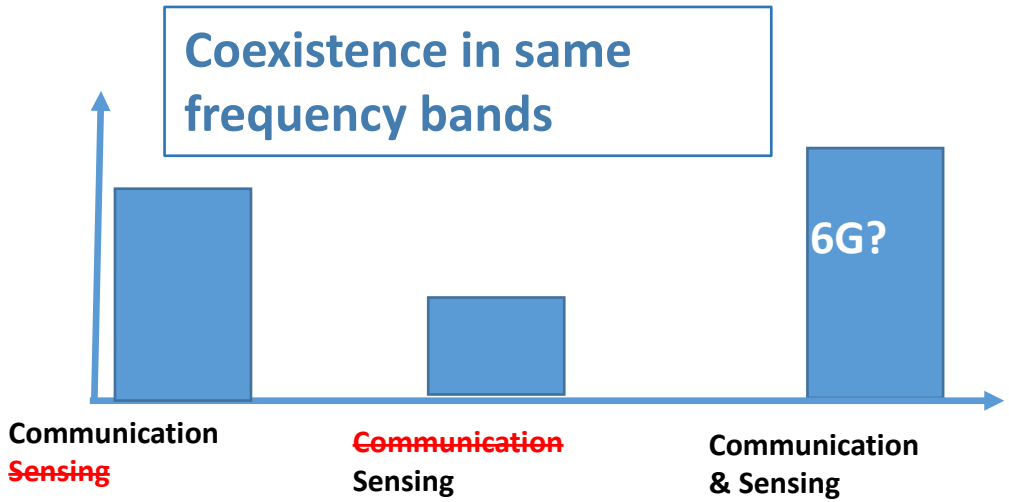
Supports several sensing types

Types of signals involved:

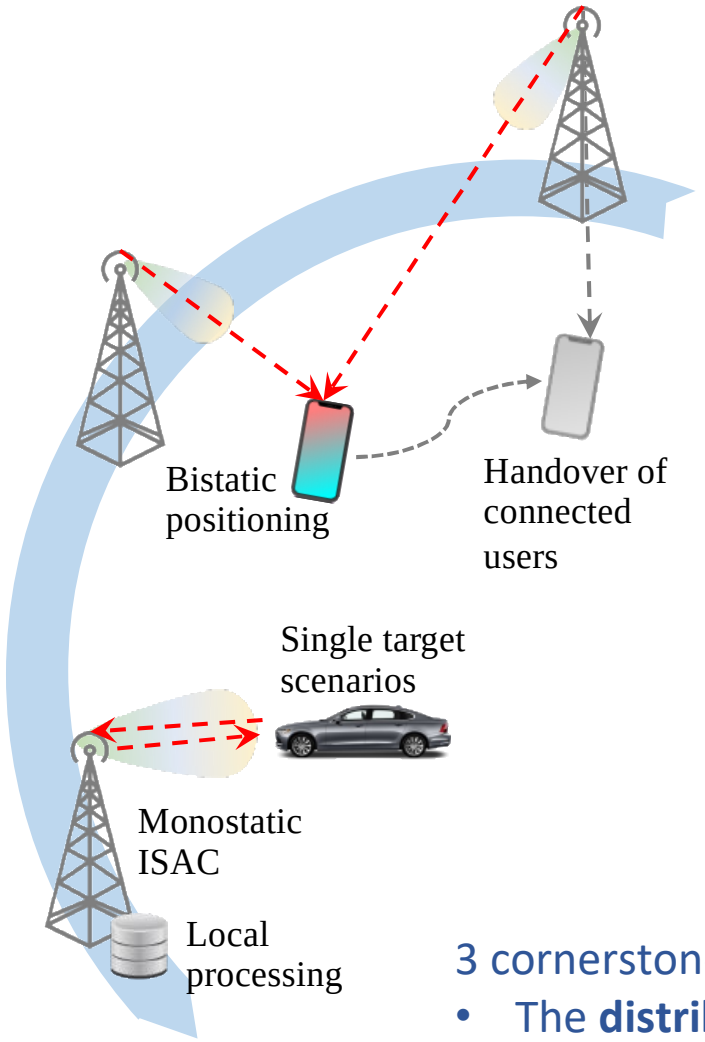
- **Control** (including sync)
- **Transmit** signal (pilot or data)
- **Sharing of measurements** (IQ data or detections) for (multimodal) fusion

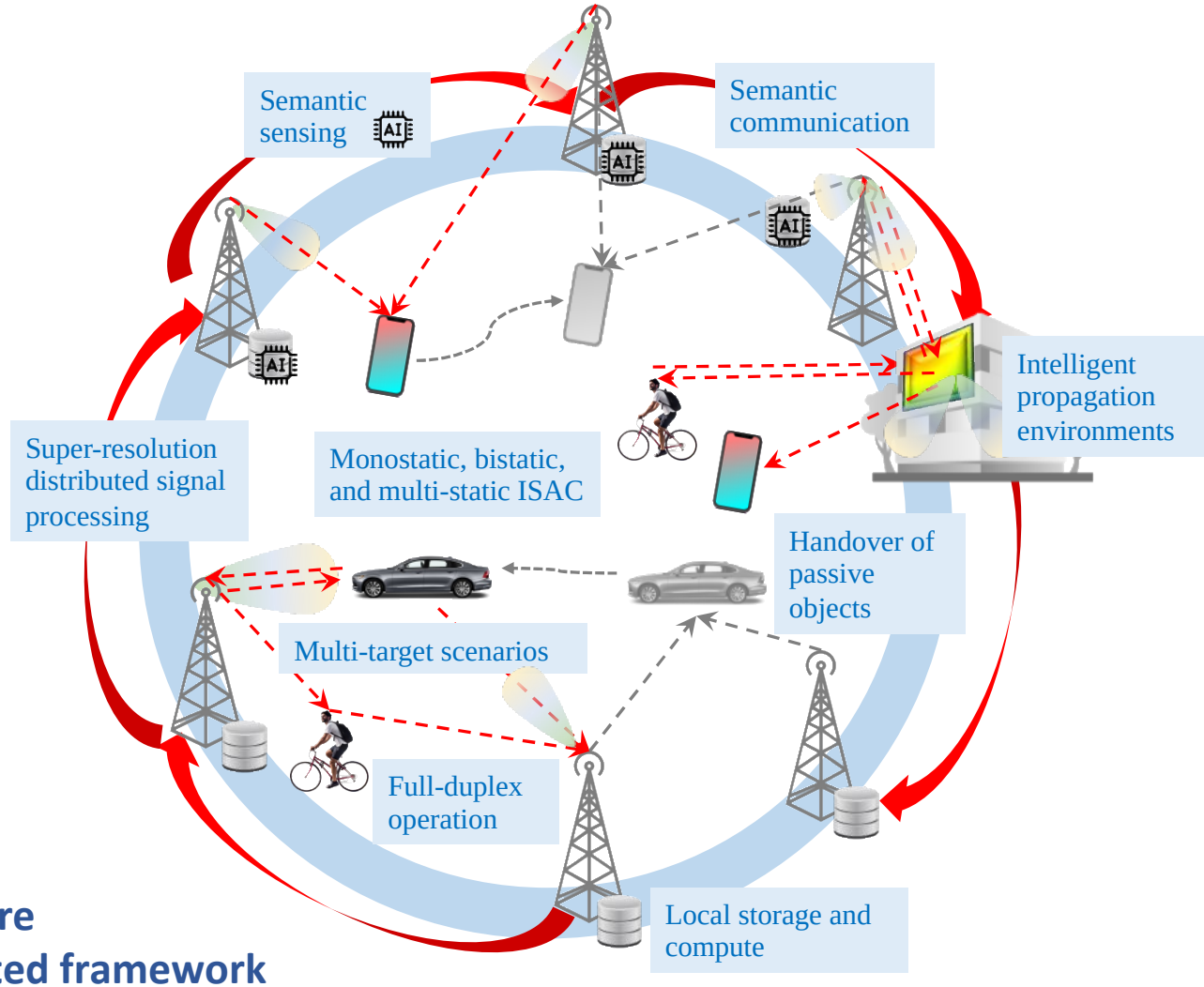


A full cognitive system, aware of its surroundings and adapting intelligently to it



ISAC TO SEMANTIC-AWARE DISTRIBUTED ISAC

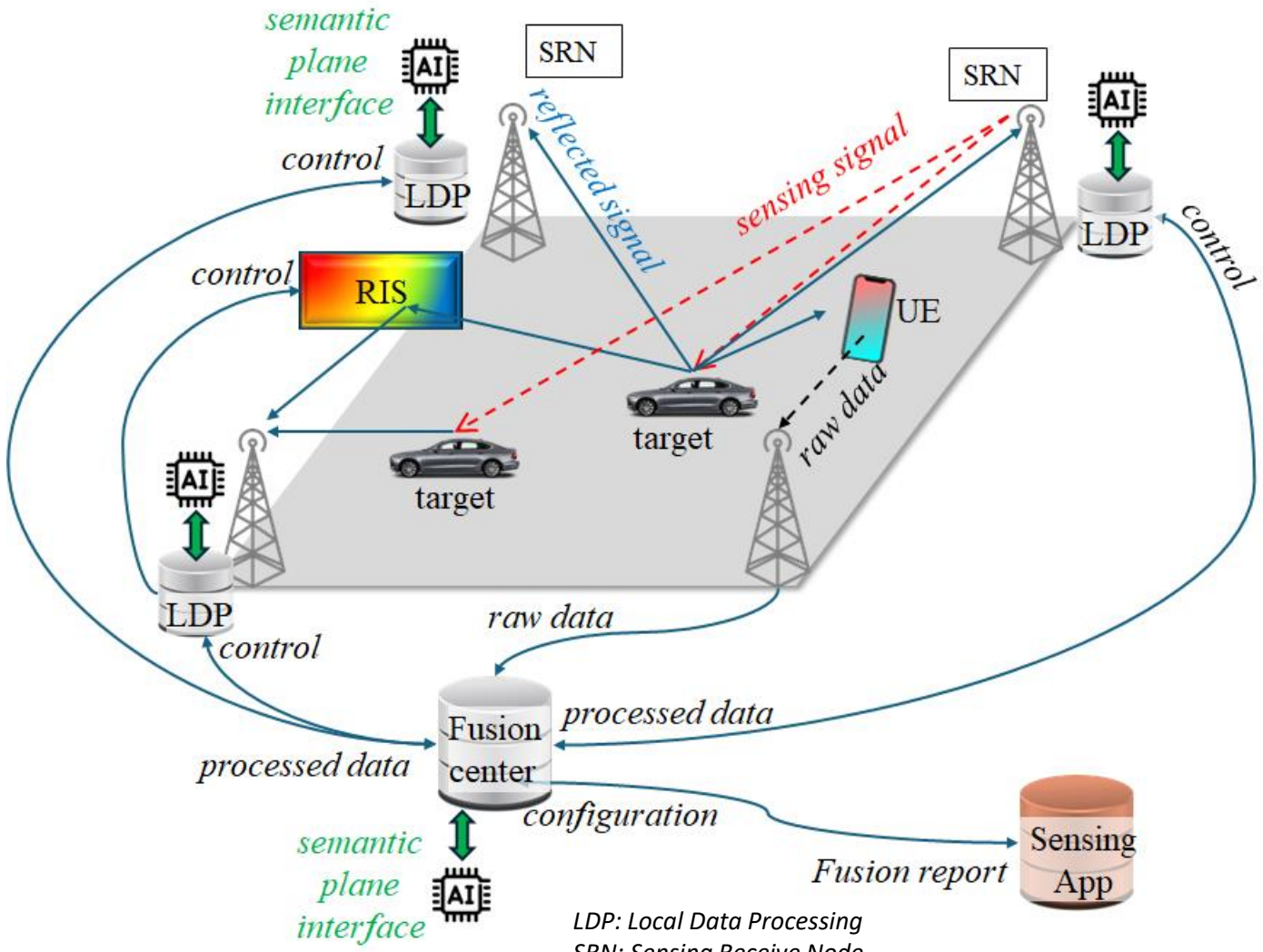




3 cornerstones

- The **distributed architecture**
- The **semantic / goal oriented framework**
- The **high-resolution signal processing**

DISAC ARCHITECTURE

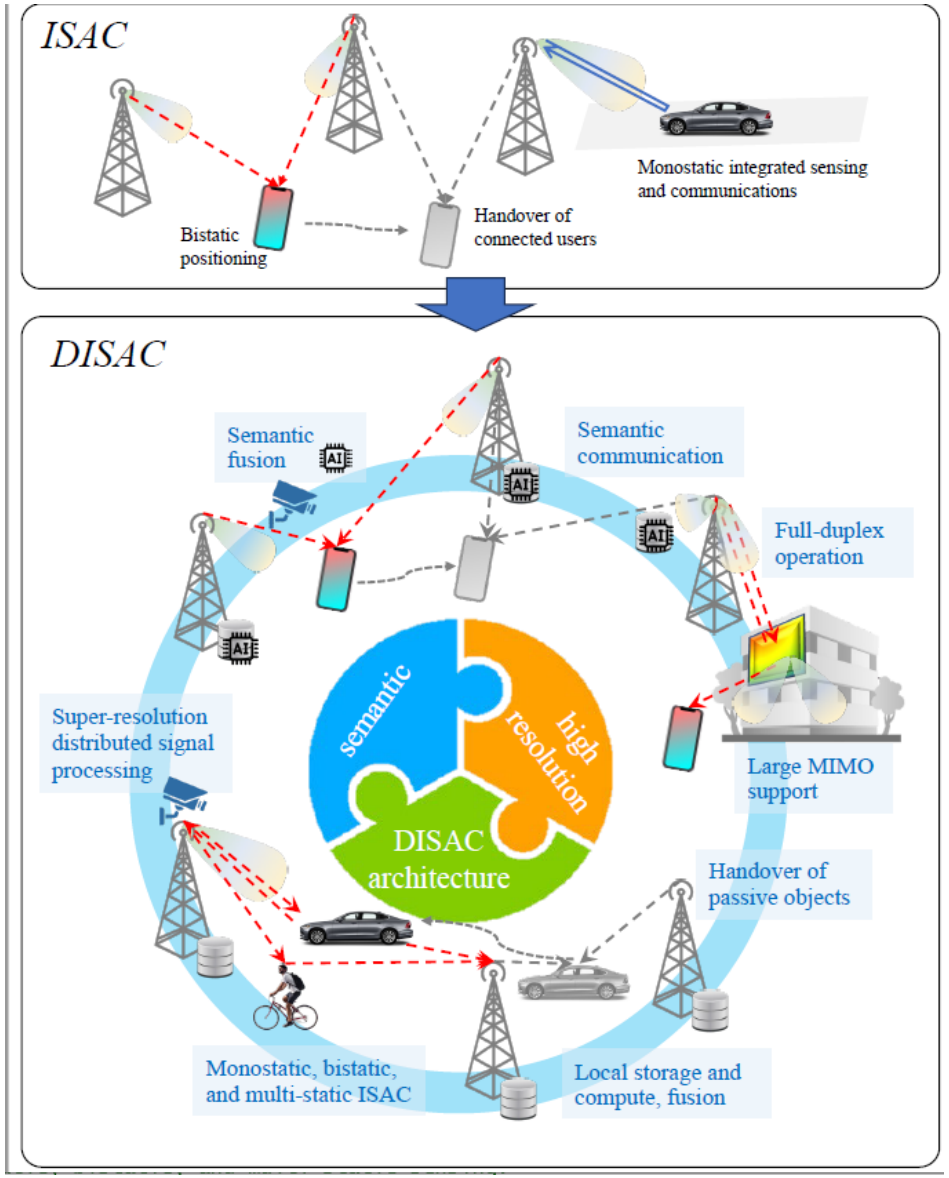


LDP: Local Data Processing
SRN: Sensing Receive Node
RIS: Reconfigurable Intelligent Surfaces

- **Intelligent distributed processing**
- Seamlessly **integrate heterogenous sensing** nodes with different capabilities
- **Support** for Large MIMO and RIS Sensing
- **Semantic layer** to facilitate sensing aided communication and communication aided sensing

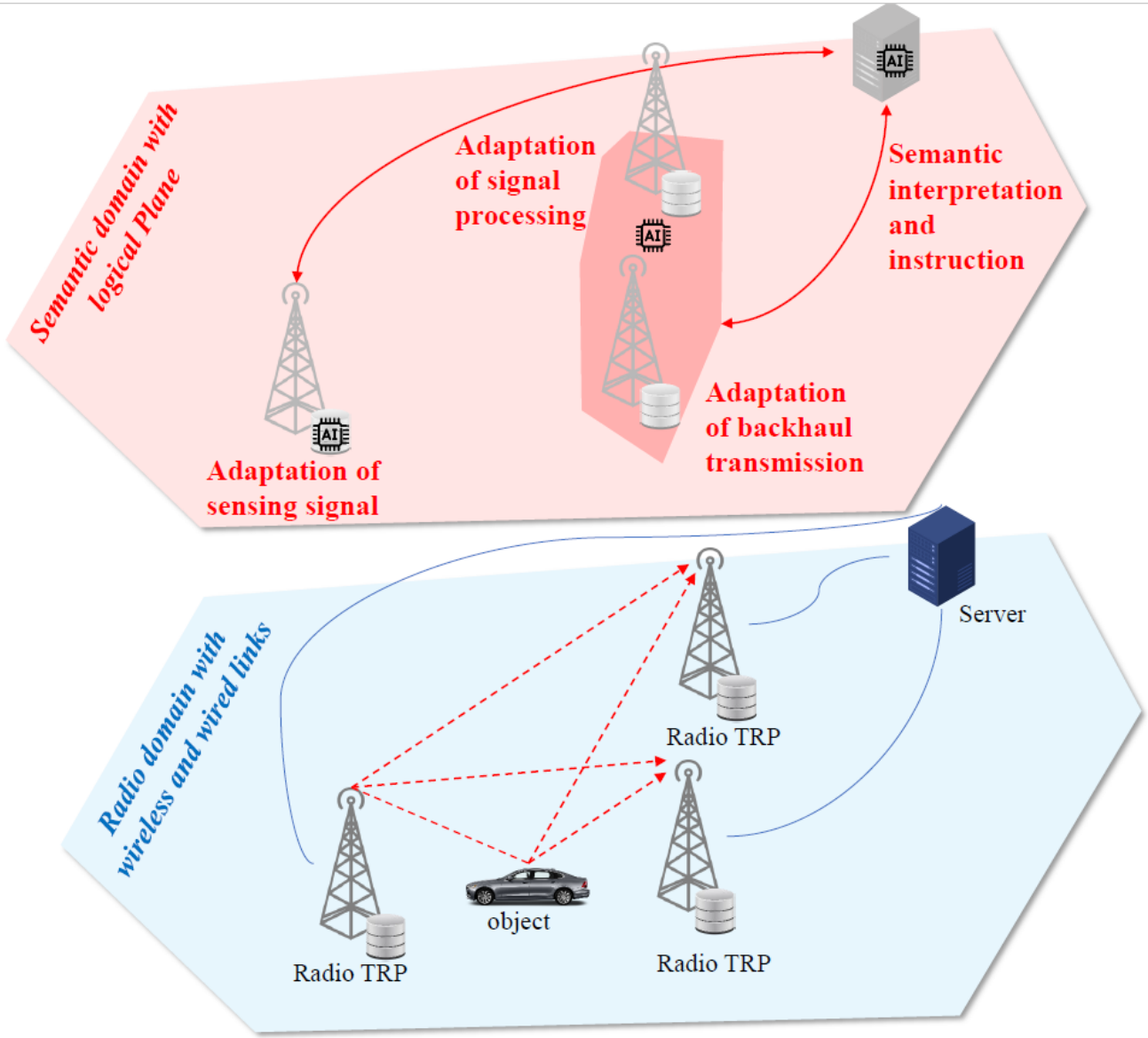
ISAC TO DISAC

Current status	Limitation	What is needed
Single transceiver solutions	Not scalable, do not harness large distributed aperture	Multi-BS, multi-UE ISAC framework, including clock distribution Distributed ISAC architecture
Single target solutions	Hides complexity of multi-target problems	ISAC methods that can detect, localize, and track many targets Scalable data association and distributed processing
Centralized processing	Fronthaul and backhaul bottlenecks	Balanced local processing, relevant information sharing, and fusion AI-based semantic processing to meet application requirement
Disconnected, incompatible approaches	Cannot integrate RIS, large MIMO, D-MIMO, mMIMO to provide coherent ISAC	Overarching framework that accounts for all sensing and communication platforms, improving both communication and sensing



SEMANTIC

- Leveraging semantic and goal-oriented communications for distributed integrated communication and sensing
- Transition from traditional data fusion to the composition of semantically selected information
- The semantic channel supports intelligent control on what should be transmitted
- Increasing performance over time (train while communicating): Over time, the AI is expected to learn a more parsimonious and efficient information representation



6G-DISAC TARGETS

	Latency	Energy efficiency	Positioning accuracy	Sensing performance	Spectral efficiency
State of the art	**10 - 100 ms** *Source: **5G** New Radio: Unveiling the Essentials of the Next Generation Wireless Access Technology* **For initial access**	**X** *Source: 3GPP TR 28.8113 (Management and orchestration; Study on new aspects of Energy Efficiency (EE) for **5G**)* **EE is unitless & depends on the load**	**0.2 - 1 m** *Source: 3GPP TR-38.857 (Study on NR positioning enhancements)*	**0.75 m resolution** **200 m range** *Source: 24 GHz Demorad Radar Solutions Enable New Contactless Sensors for Emerging Industrial Mass Market.*	**Y** **considering half-duplex transmission**
6G-DISAC targets	**10 ms – 1 ms**	**2X – 10X**	**0.01 - 0.1 m**	**0.1 - 1 m resolution, unlimited range**	**2Y**

6G-DISAC QUANTITATIVE TARGETS

KPI	Absolute or relative improvement	Current baseline value (state of the art)	Target value at the end of the project	Justification	3GPP Ref.
Spectral efficiency	relative	3GPP R18 MIMO	30% improvement in FR1 and FR2	Sensing-aided communication will improve the estimation of MIMO channel matrices and geometrical channel parameters	3GPP R1-2303007
User positioning accuracy	absolute	0.2-1m	0.01 m in FR2, 0.1 m in FR1	Combination of positioning and sensing, large bandwidths, large aperture	3GPP TR 38.859. R18
Energy efficiency	relative	3GPP TR 38.684	40% improvement in FR2	Sensing-aided communication will improve the estimation of geometrical channel parameters	TR 38.864
User orientation accuracy	absolute	1-5 degrees in FR2	<1 degree in FR2	Using arrays at the UE and many BSs.	Not addressed in 3GPP
Object positioning accuracy	absolute	1 m	< 1 m in FR1, and 0.1 m in FR2.	Large apertures at FR1, large bandwidth and large arrays at FR2, many transmitters and receivers at both FR1 and FR2	Not addressed in 3GPP
Object velocity estimation accuracy	absolute	1 m/s	< 1 m/s in FR1	Large integration times at FR1.	Not addressed in 3GPP
Object / gesture classification accuracy	absolute	20–30% misclassification rate	<5% misclassification rate	Target information is captured from different perspectives thanks to multi-static sensing	Not addressed in 3GPP

STANDARDIZATION

A key objective is to take the solutions developed in the project to standardization bodies

- Pre-standard research work in the ETSI ISG ISG (https://www.etsi.org/committee/2295-isac)
  - Good alignment with 6G-DISAC in terms of scope and timeline. Both activities will pave the way for standardization
  - We believe that the notion of widely distributed deployments and the need to track multiple targets over an extended space and time brings value to the work started in the ISG
  - Several members of the project are also participants to the ISG
- 3GPP standardization
  - Targets: Release 20 onwards to 6G
  - The consortium includes influent actors in 3GPP
- Other relevant bodies (industrial fora)

Get in touch

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Thank you!

Twitter @6G_DISAC

Take a look at our first consortium paper

On Arxiv :
http://arxiv.org/abs/2402.18271

Distributed Intelligent Integrated Sensing and Communications: The 6G-DISAC Approach

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