



# EMERGE E P-CAR

## RISULTATI E PROSPETTIVE IN ABRUZZO

ELENA CINQUE - Radiolabs



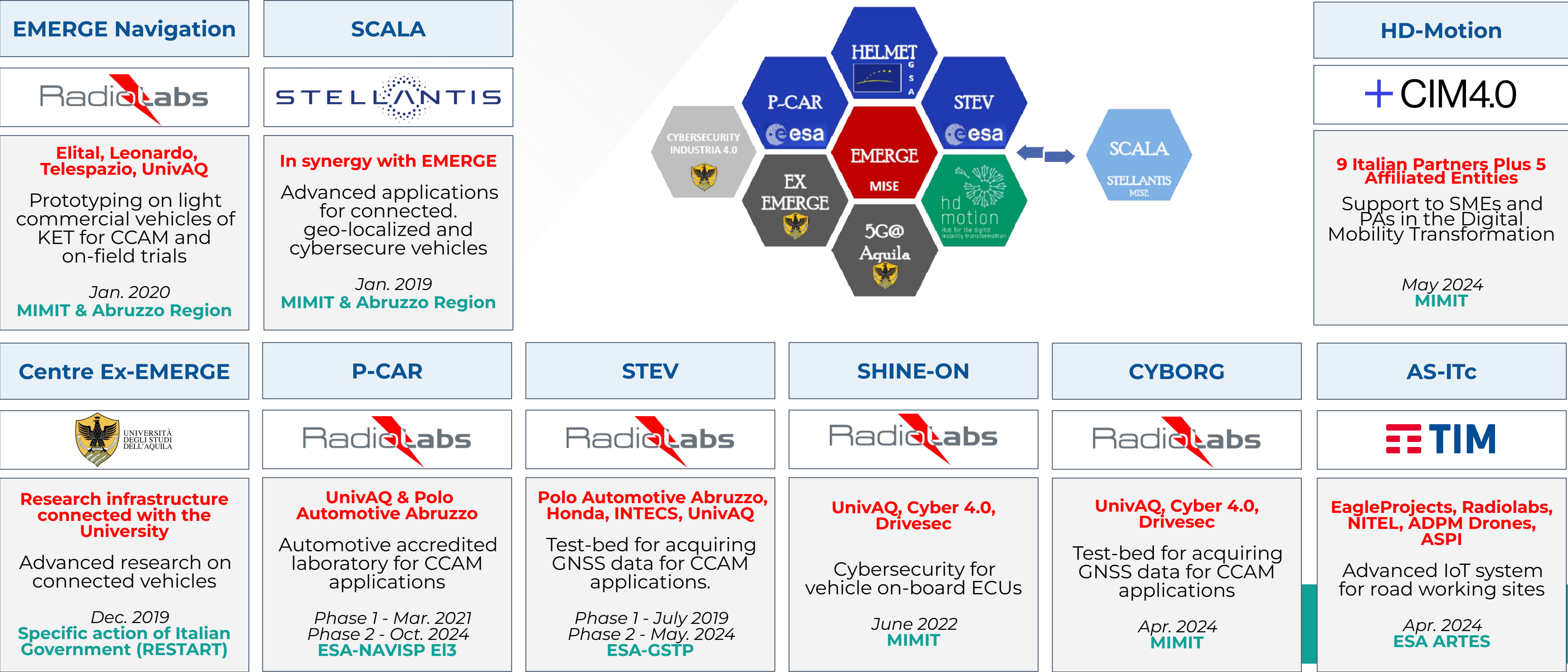
FRANCESCO VALENTINI - Radiolabs



FORTUNATO SANTUCCI - UnivAQ



IAF 2024



# IL PROGETTO EMERGE

**ELENA CINQUE**

*Ricercatrice Radiolabs*

# EMERGE-NAVIGAZIONE: THE FIRST INITIATIVE IN ABRUZZO

National project for the development and validation of advanced technologies for the connected vehicle.



UNIVERSITÀ  
DEGLI STUDI  
DELL'AQUILA

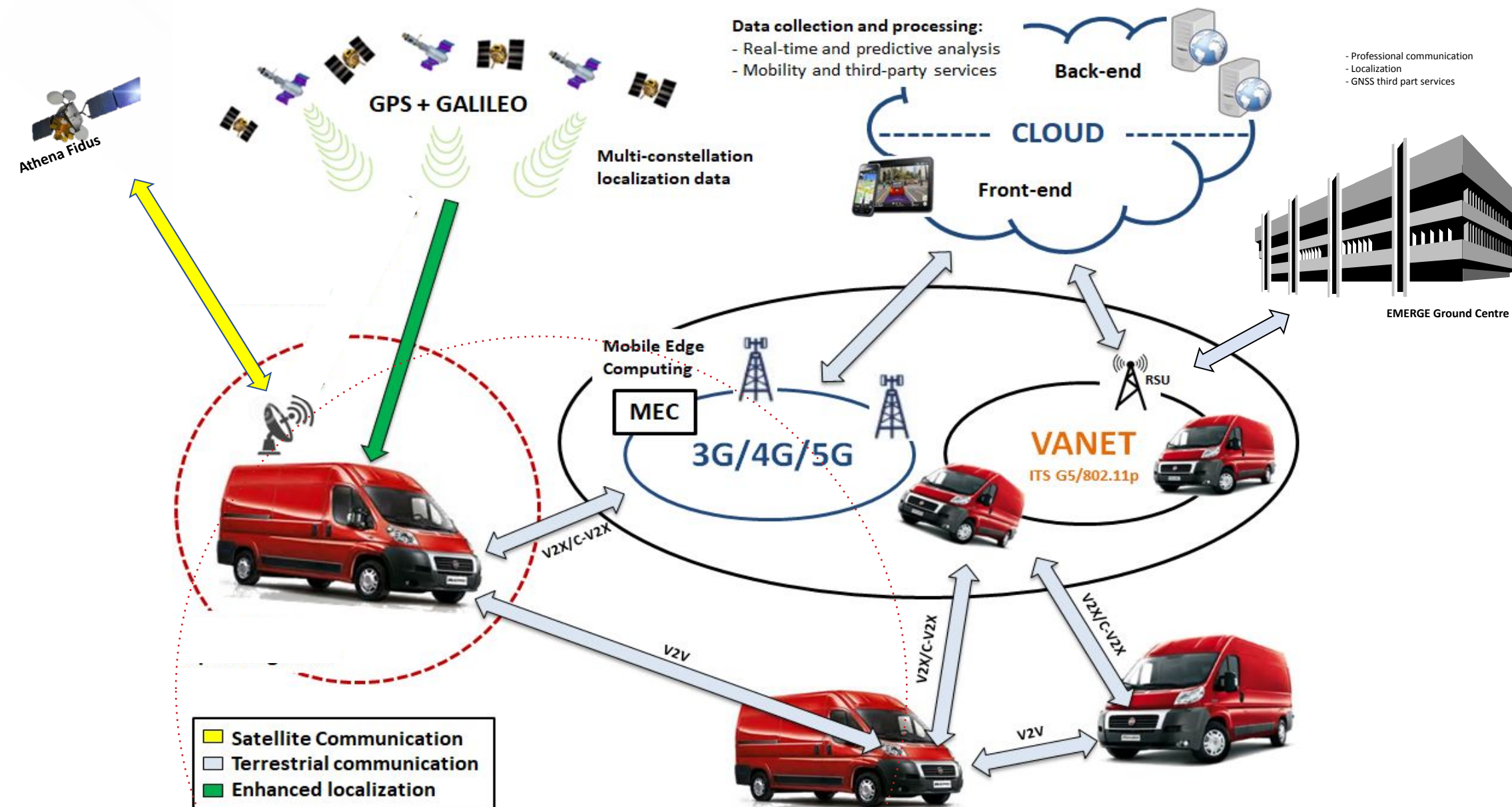


- **Pervasive connectivity** (V2X, 4G/5G and satellite communications)
- **High integrity positioning** (multi-constellation and multi-sensor with augmentation algorithms)
- **Cybersecurity**
- **Cloud/Edge computing** (ML/AI for optimization and identification of potential risks)

# EMERGE USE CASES

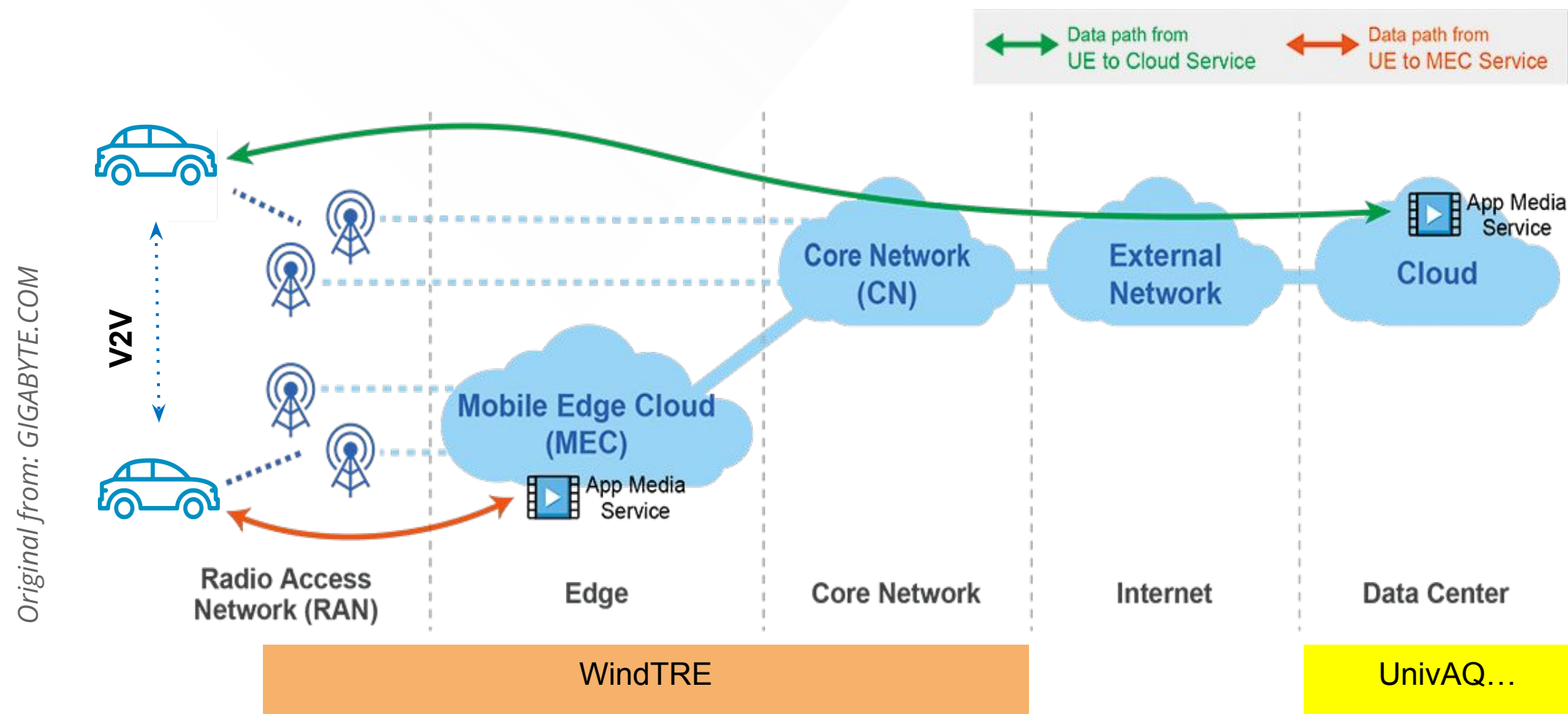
SCENARIO	CLASS	USE CASE
DAILY SCENARIO	COOPER. DRIVING AND PERCEPTION	UC_D1: Virtual electronic horizon
		UC_D2: AI techniques for efficient traffic management
EMERGENCY SCENARIO	COOPER. DRIVING AND PERCEPTION	UC_E1: Detection and monitoring of critical events
	COOPER. SAFETY	UC_E3: Emergency corridor

# EMERGE ARCHITECTURE



# MULTI-ACCESS EDGE COMPUTING

**KEY PRINCIPLE:** move resources and cloud computing functions to the "border" of the mobile network, bringing them closer to the end user.



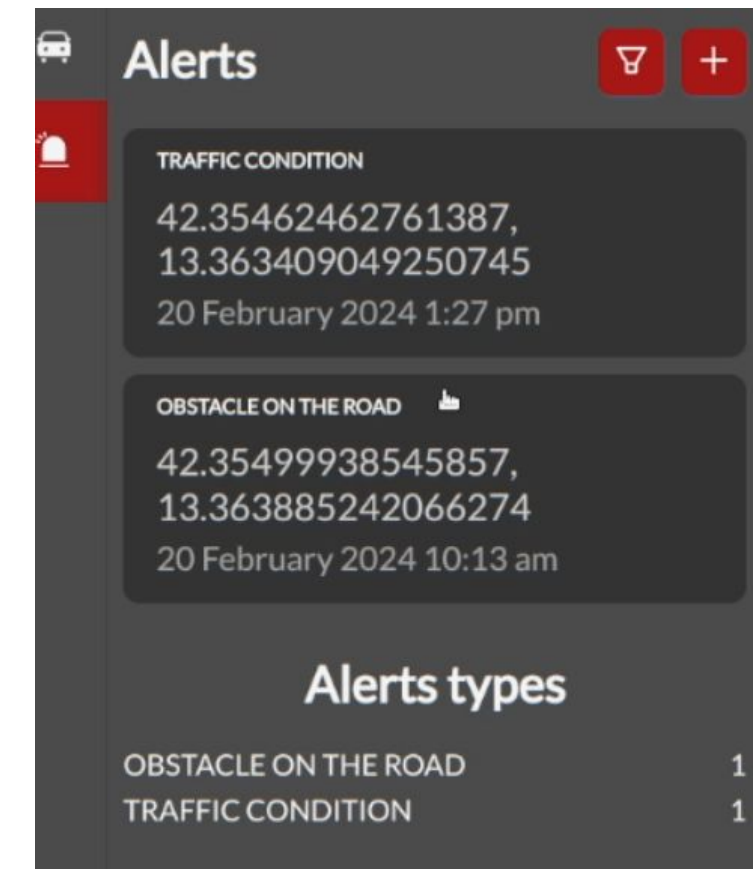
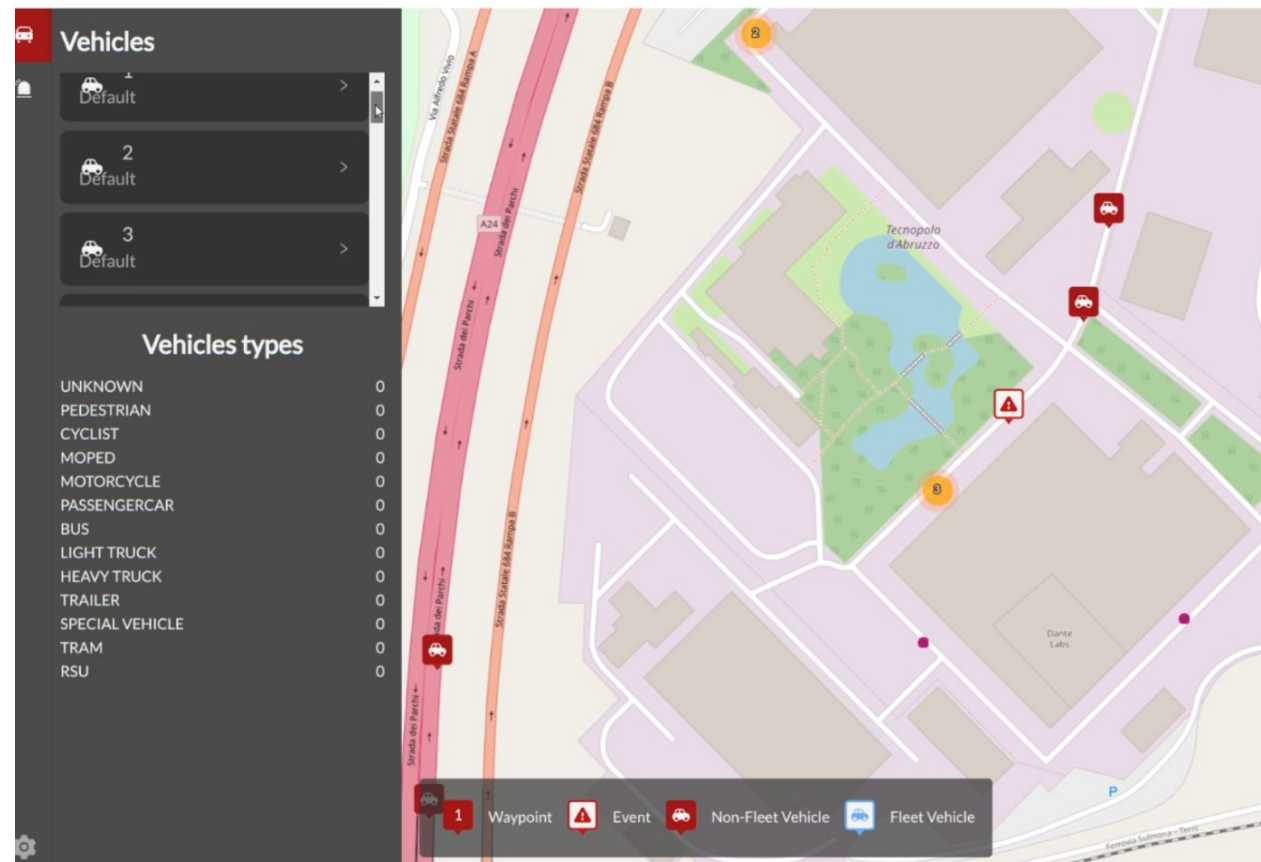
## BENEFITS:

- low-latency computing
- high-bandwidth
- better QoE/QoS
- mMTC/IoT

The EMERGE use cases implementation is enabled by a collaboration with WindTRE for a MEC node on the city of L'Aquila served with 5G connectivity and coordinated with the SCALA project of Stellantis.

# EXPERIMENTAL GUI GROUND SERVICE CENTER @UNIVAQ

Radiolabs



# DEDICATED MOBILE LABORATORIES

3 vehicles in 2 different configurations:

- **FULL** (1 vehicle) - GEO SATCOM on the move, SATNAV, IMU, 4G/5G/V2X Comms, IP cameras
- **MEDIUM** (2 vehicles) - SATNAV, IMU, 4G/5G/V2X Comms, IP cameras



# IL PROGETTO P-CAR

**FRANCESCO VALENTINI**

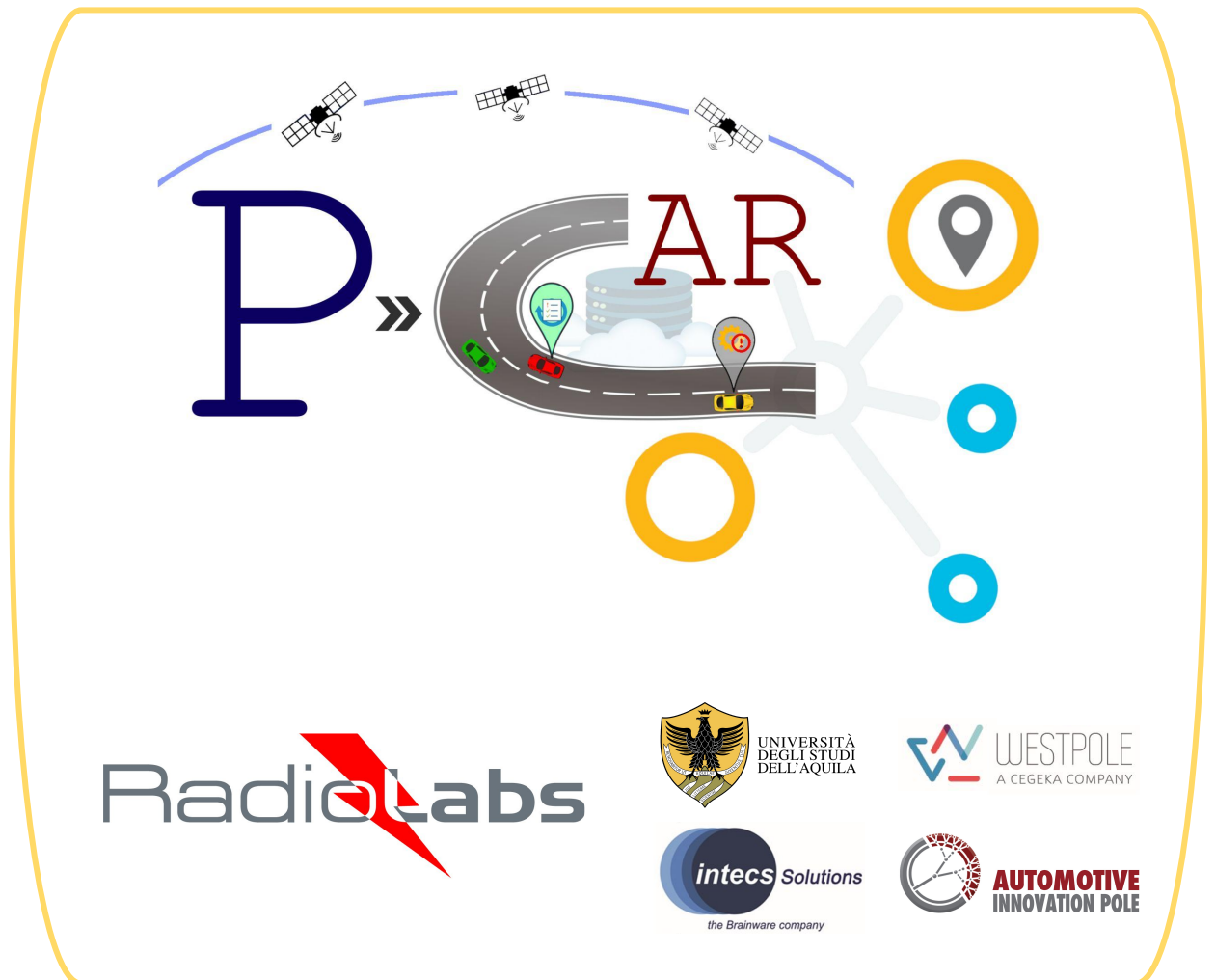
*Program Manager Radiolabs*

# P-CAR: AUTOMOTIVE ACCREDITED LABORATORY

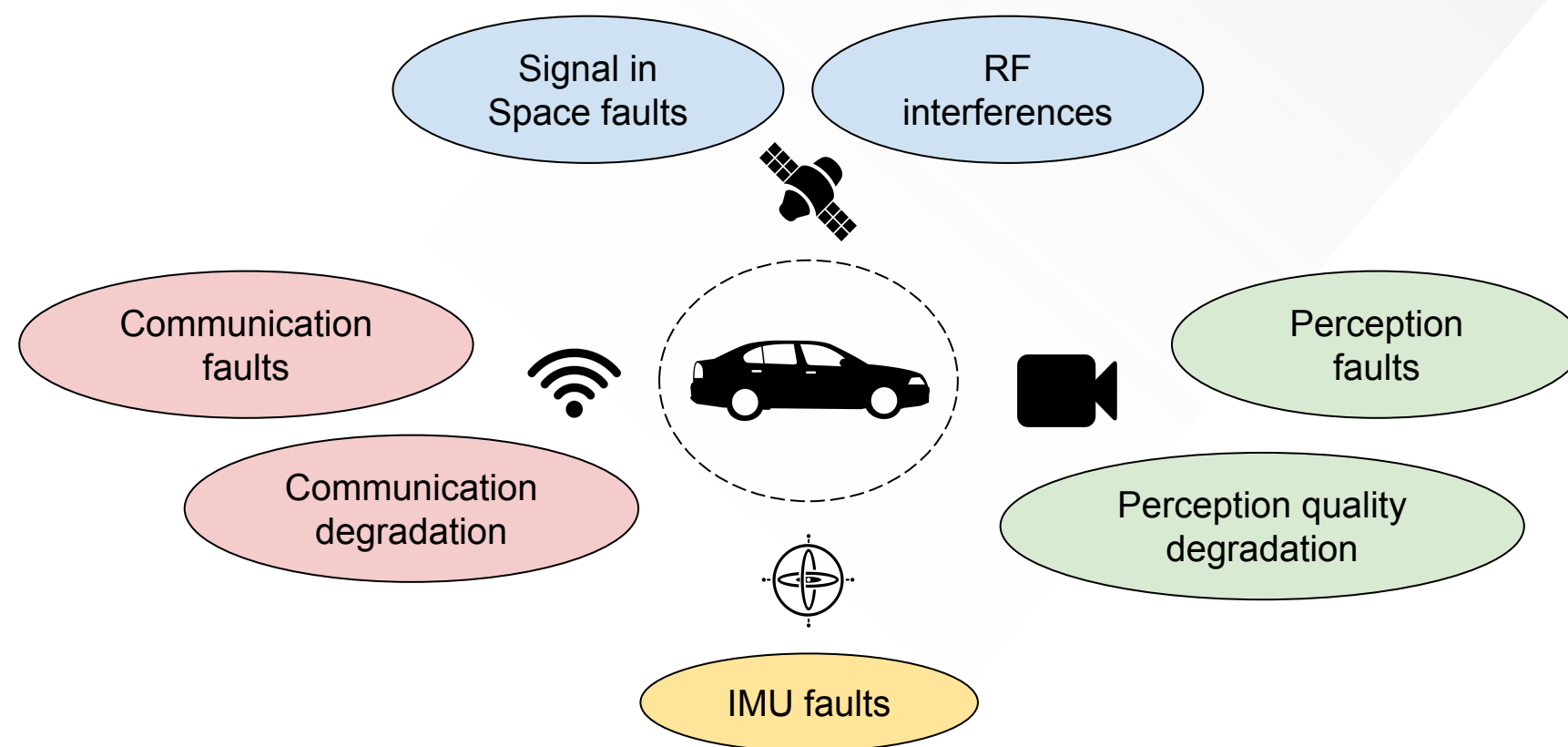
Realisation of a European accredited laboratory for certified assessment of advanced driver assistance systems that rely on positioning awareness in **cooperative, connected and automated mobility** (CCAM) applications.

## EXPECTED OUTCOMES

- **Economics:** the validation activities is worth the 30% - 60% value of the devices
- **Innovation:** know-how on safety-critical vehicles positioning
- **Synergies** with railway and maritime domains and with the *National Competence Centre on GNSS* of ASI



Funded under the **ESA NAVISP Element 3 program.**



## P-CAR ALLOWS TO

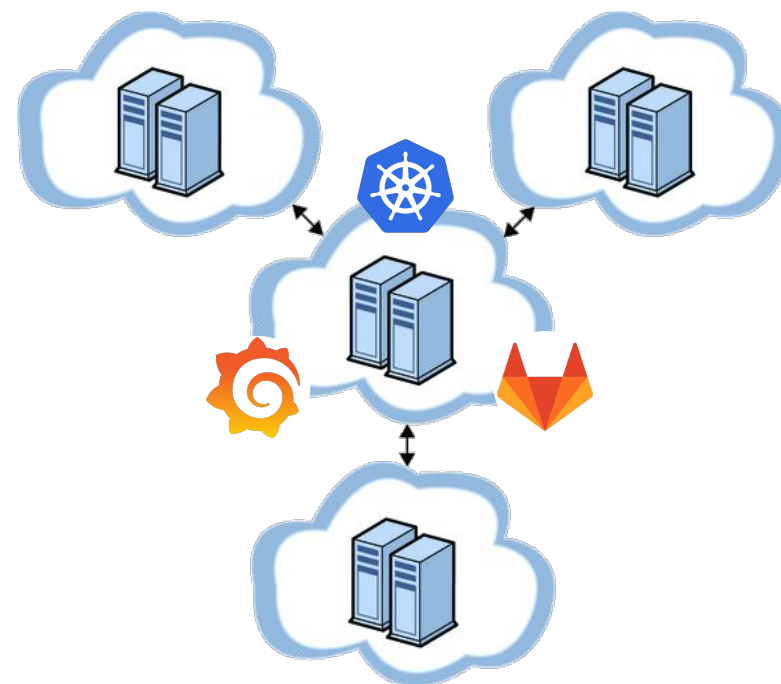
- ★ reproduce the **operational environment** where the system is to be tested
- ★ **inject faults** typical of the selected environment
- ★ analyse the **results**
- ★ integrate the customer **hazard and safety risk** analysis
- ★ collect the results into a **report**.

## SAFETY STANDARDS ADDRESSED

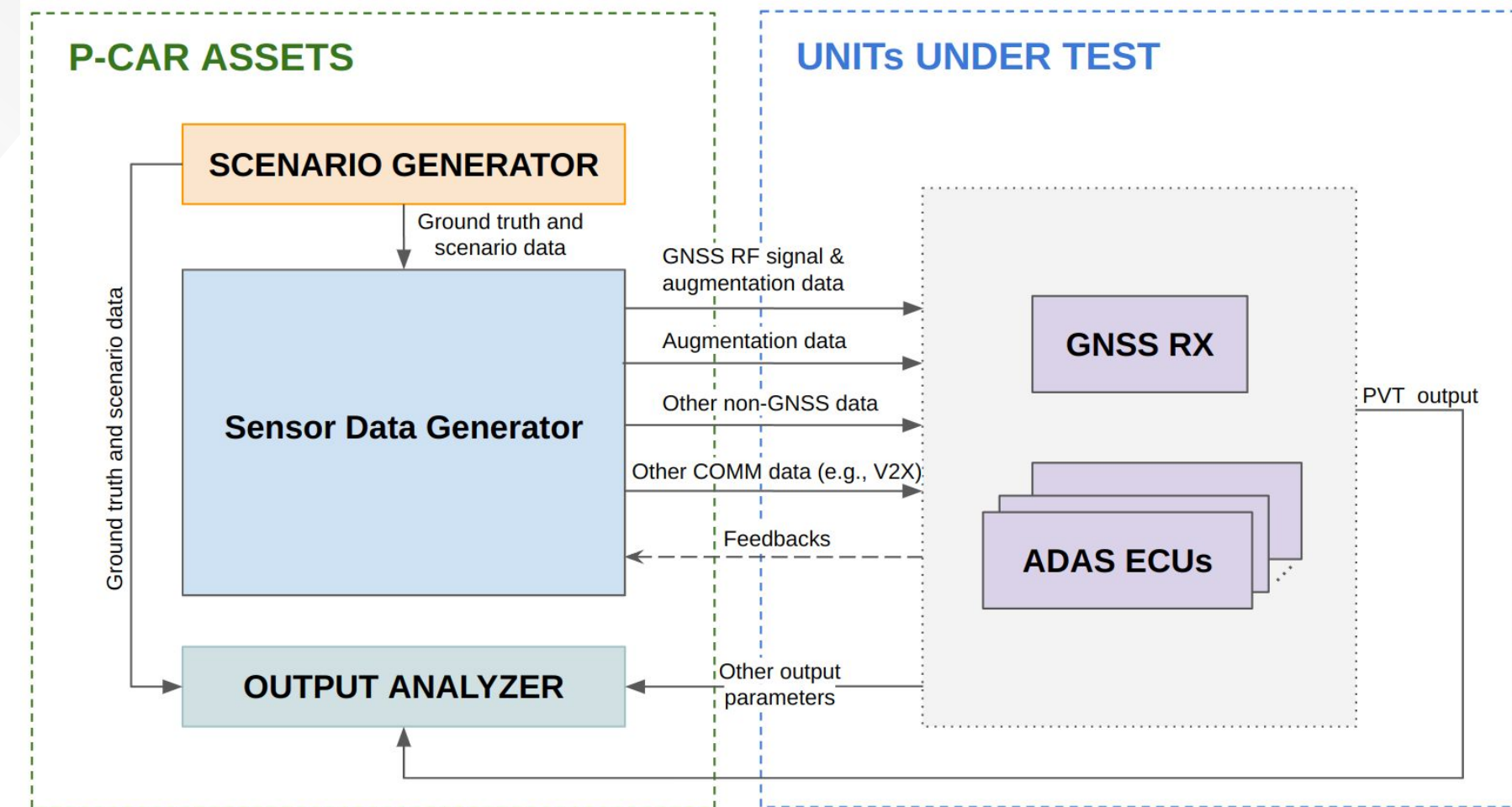
- Functional Safety (ISO 26262)
- SOTIF - Safety of the Intended Functionality (ISO 21448)
- General Safety regulations (EU 2019/2144, 2022/1426)
- UNECE regulation (e.g., R151, R152, R155, R157)

# HARDWARE-IN-THE-LOOP PLATFORM

- ★ virtualized scenarios
- ★ environment modeling
- ★ digital-twin approach
- ★ higher reproducibility
- ★ lower testing time
- ★ costs reduction



## GEO-DISTRIBUTED ARCHITECTURE

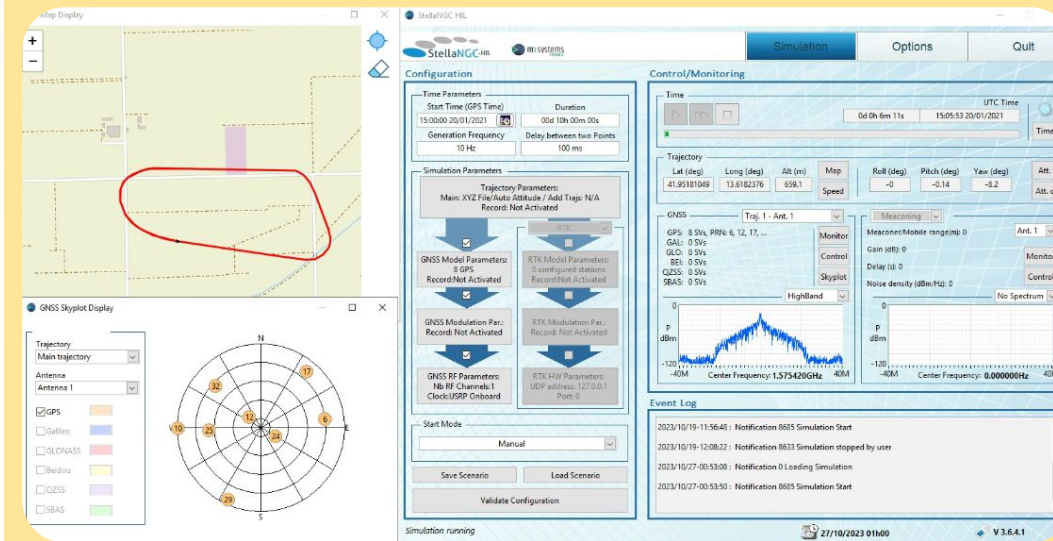


# P-CAR FEATURES

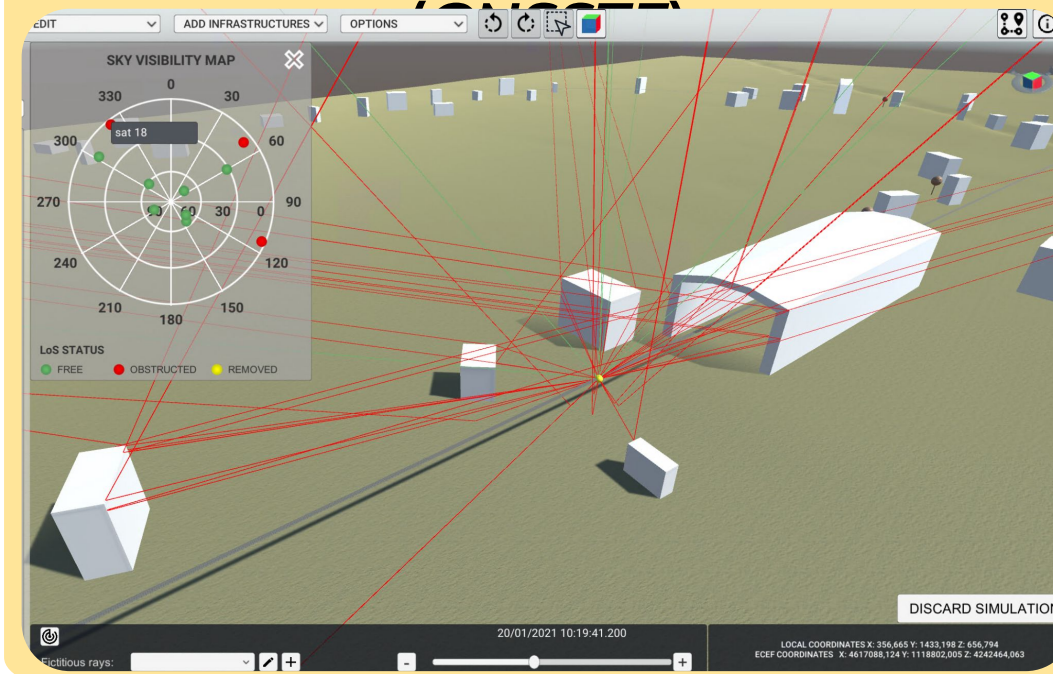
## Hardware-in-the-Loop setup for GNSS and ADAS testing



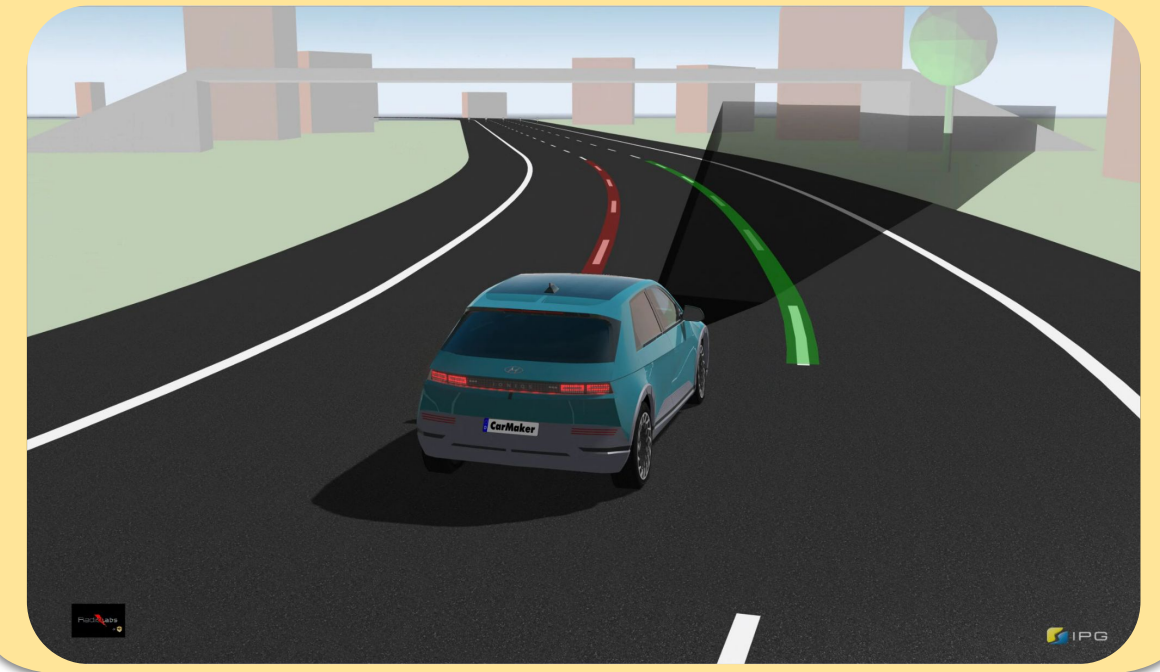
## GNSS constellation emulation with SBAS and multipath



## Environment-based GNSS deterministic multipath



## Environment and vehicle modelling including perception sensors (e.g., IPG CarMaker)



### Example of CCAM applications:

- Lane Departure Warning (LDW)
- Automated Lane Keeping (ALK)
- Automatic Emergency Braking (AEB)
- Intelligent Speed Adaptation (ISA)
- Adaptive Cruise Control (ACC)

### Example of supported sensors:

- GNSS and inertial sensors
- Camera, Radar, LIDAR

- ★ Baseline infrastructure for validation of a first set of Connected and Autonomous Driving (CAD) functions considering current regulations and recommendations.

- ★ CCAM services assisted by smart road/smart infrastructure
- ★ Resilience to cyber-attacks of positioning services
- ★ Geo-distributed laboratory platform
- ★ Prepare for the pilot exploitation

- ★ Partner with OEM and/or Tier Xs in order to have a concrete exploitation
- ★ Laboratory qualification and assessment in real environment

## PHASE 1 - LABORATORY BASELINE



## PHASE 2 - SMART ROAD USE CASES EVOLUTION



## PHASE 3 - PILOT EXPLOITATION

# IL CENTRO DI ECCELLENZA EX-EMERGE

**FORTUNATO SANTUCCI**

*Direttore del centro Ex-EMERGE,  
Professore Ordinario UnivAQ*

# An eco-system for innovation in connected and automated mobility

## Regional industrial settlement in Aerospace, ICT and Automotive



### Main industrial assets in ICT and aerospace

**Leonardo:** avionics, cybersecurity and professional communications

**Thales Alenia Space:** design and integration of sub-systems for space segments

**Telespazio:** Fucino space center with Galileo Control Center

**Reiss Romoli:** professional education and consultancy

**SMEs:** Elital, others

### Industrial assets in microelectronics and silicon

**Micron:** design center for solid state storage devices

**Lfoundry:** foundry services

**Research centers:** CNIT (FIBERS national lab), CINI, **Radiolabs**, **others**

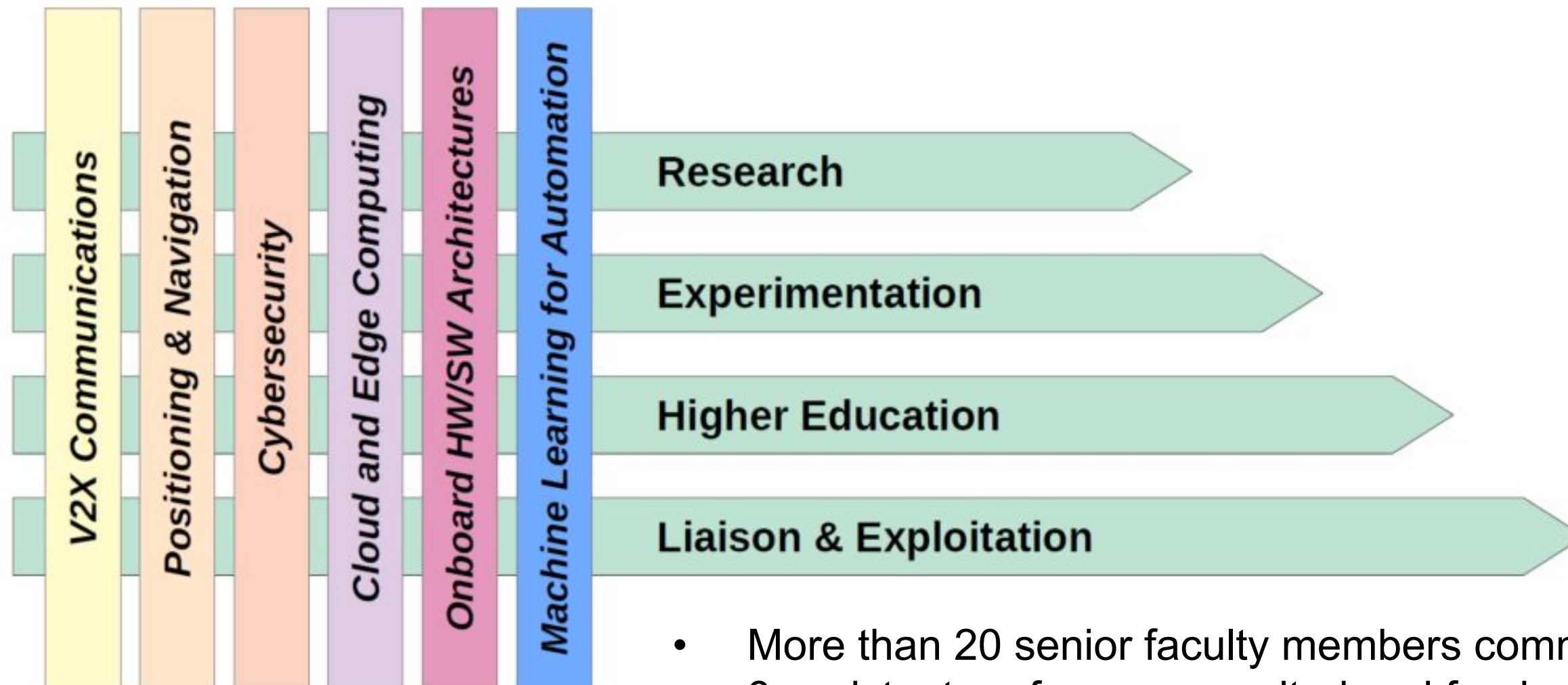
### **Other industrial domains:**

Automotive (**IAM**, **STELLANTIS Europe**, **HONDA**, etc.) and Chemical-Pharmaceutical (**SANOVI**, **DOMPE**)

**Further relevant institutions:** Gran Sasso national INFN labs, CNR and GSSI (Gran Sasso Science Institute)

# EMERGE ECOSYSTEM

Centre of EXcellence (EX) on Connected, Geolocalized and Cybersecure vehicles  
(EX-EMERGE)



- More than 20 senior faculty members committed in the Centre;
- 8 assistant professors recruited and funded by the Centre;
- 8 permanent research positions at Radiolabs Lab @ Univaq;
- More than 15 doctoral students educated by the Centre, with 7 doctoral fellowships directly funded (2 of those in National AI School and 1 in Int. Program)

## EX-EMERGE board

Vittorio Cortellessa	<a href="mailto:vittorio.cortellessa@univaq.it">vittorio.cortellessa@univaq.it</a>
Alessandro D’Innocenzo	<a href="mailto:alessandro.dinnocenzo@univaq.it">alessandro.dinnocenzo@univaq.it</a>
Gabriele Di Stefano	<a href="mailto:gabriele.distefano@univaq.it">gabriele.distefano@univaq.it</a>
Norberto Gavioli	<a href="mailto:norberto.gavioli@univaq.it">norberto.gavioli@univaq.it</a>
Costanzo Manes	<a href="mailto:costanzo.manes@univaq.it">costanzo.manes@univaq.it</a>
Patrizio Pelliccione	<a href="mailto:patrizio.pelliccione@univaq.it">patrizio.pelliccione@univaq.it</a>
Marco Pratesi	<a href="mailto:marco.pratesi@univaq.it">marco.pratesi@univaq.it</a>
Fortunato Santucci	<a href="mailto:fortunato.santucci@univaq.it">fortunato.santucci@univaq.it</a>

<http://exemerge.disim.univaq.it>

# A WIDER PERSPECTIVE

Integrated terrestrial-satellite networks for vehicular communications with “ubiquitous” connectivity and continuity of coverage: 5G (3GPP Rel 17) and 6G for improved reliability and lower latencies; continuity of coverage also in rural and remote areas through integrated terrestrial-satellite networks;

*High performance computing, AI and latest networking paradigms (O-RAN)*: edge computing and artificial intelligence for most advanced levels of automation;

Design and deployment of smart infrastructures for both road and rail: ‘smart roads’ is a prospective action of road operators and FRMCS is the state-of-the-art solution for connected and automated railways;

A few specific research items in wireless communications:

- Experimental validation of V2X and C-V2X technologies with available platforms;

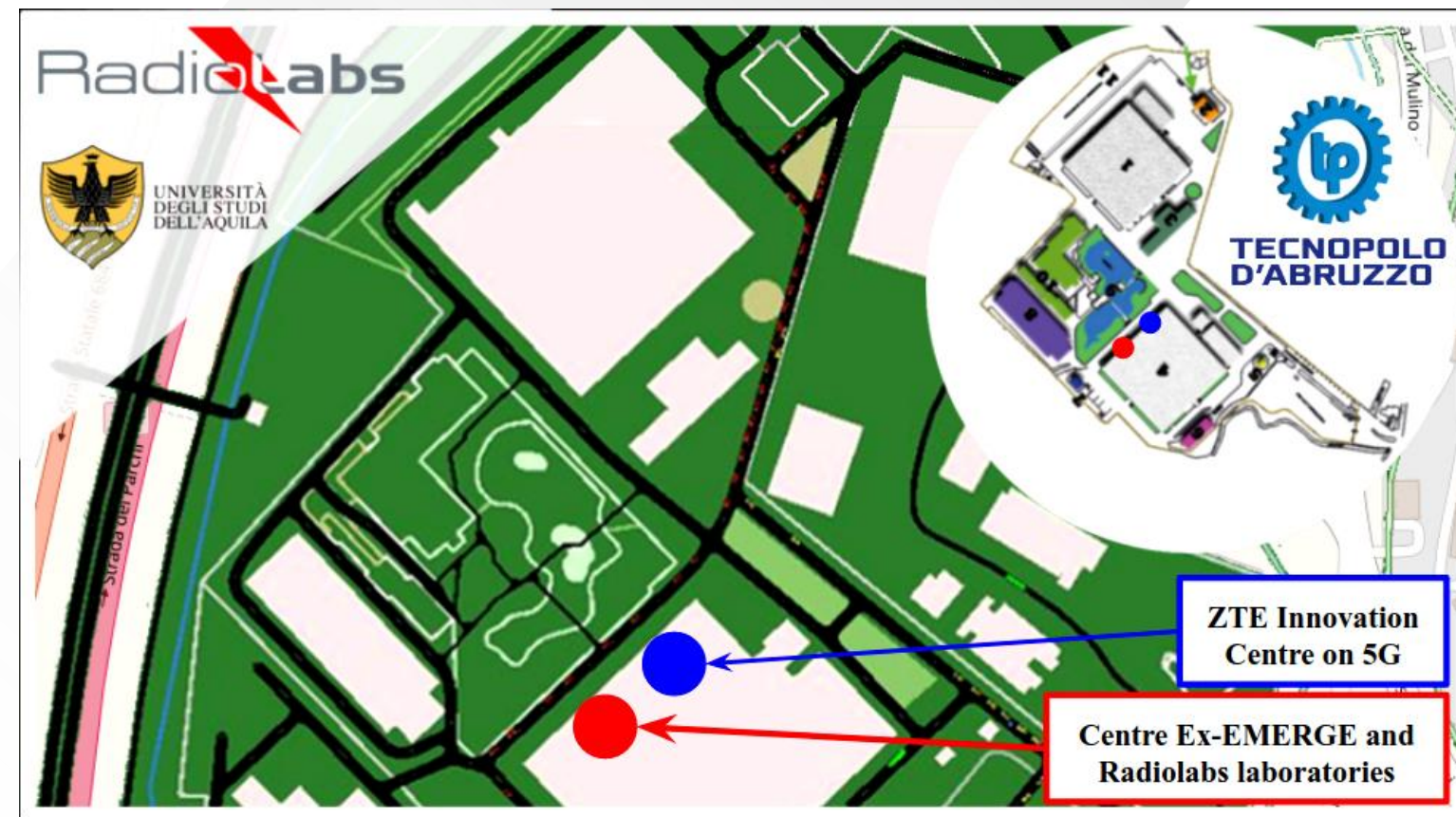
- Performance modelling of Sidelink communications based on LTE-V2X and NR-V2X;

- NOMA and smart metasurfaces for 6G.

# EMERGE 2.0 TOPICS

## Objective: improve EMERGE developments for Smart-Roads scenarios

- Innovation in mobile networks: 5G and 6G (3GPP Rel 17) - connected and autonomous vehicles
- FRMCS & V2X synergies: maximizing ground infrastructure reuse (ANAS-RFI)
- Smart road: multi-bearer technologies on public networks/LEO satcom and GNSS positioning
- Prevention of Critical Events: *Edge Computing* and advanced AI techniques
- Smart Road use-cases: increased vehicle safety, dynamic speed control
- Cybersecurity: increase the resilience of the TLC and GNSS technological infrastructure



# EX-EMERGE AND RADIOLABS LABORATORIES





UNIVERSITÀ  
DEGLI STUDI  
DELL'AQUILA

EXEMERGE  
CELLENCE

Radiolabs

# GRAZIE PER L'ATTENZIONE

## CONTATTI

Elena Cinque, [elena.cinque@radiolabs.it](mailto:elena.cinque@radiolabs.it)

Francesco Valentini, [francesco.valentini@radiolabs.it](mailto:francesco.valentini@radiolabs.it)

Fortunato Santucci, [fortunato.santucci@univaq.it](mailto:fortunato.santucci@univaq.it)