RadioLabs
A Research Consortium

Expertise & Profile

March 2016

RadioLabs

Ansaldo STS S.p.A. – Hitachi Systems CBT S.p.A.
University of Rome "Tor Vergata" – University of "L'Aquila" – Università of Rome "Roma Tre"

RadioLabs

standing for

"Consorzio Università Industria – Laboratori di Radiocomunicazioni"

Research Consortium

(home page: http://www.radiolabs.it)

UNIVERSITA' degli STUDI di ROMA TOR VERGATA

ROMA TRE UNIVERSITÀ DEGLI STUDI

Università degli Studi de l'Aquila

AnsaldoSTS

Hitachi Systems CBT S.p.A.

- *Consortium founded in 2001*
- *Headquarters located in Rome, Italy.*

Mission

+ 14 years experience in “Innovation, Collaborative Research, Knowledge Sharing on emerging ICT and GNSS technologies and relevant applications”

Research Areas

Communications

5G - Mobile Communications
NGN - Next Generation Networks
SDN- Software Defined Network

Navigation

Integrated systems & applications:
Railway
Automotive
Indoor

Multimedia

Multimedia platform & services
Collaborative platform & services
Next Generation Broadcasting

Security

Network security protocols
Security application
Security policies and strategies

Smart Environments

IoT – Internet of Things
Sensor networks,
Resource optimization
Open data Services

Partners


Ansaldo STS
UNIVERSITÀ DEGLI STUDI DI ROMA TOR VERGATA
ROMA TRE UNIVERSITÀ DEGLI STUDI
UNIVERSITÀ DEGLI STUDI DE L'AQUILA
DLR
LELAND STANFORD JUNIOR UNIVERSITY
Univerzita Pardubice
The University of Nottingham
UNITED KINGDOM - CHINA - MALAYSIA
sogei
RFI RETE FERROVIARIA ITALIANA
GRUPPO FERROVIE DELLO STATO ITALIANE
TRENITALIA
GRUPPO FERROVIE DELLO STATO
DB NETZE
THALES
ceit | IK4
Research Alliance
unife
THE EUROPEAN RAIL INDUSTRY
NSL
UNIVERSITÀ BOCCONI
vodafone
UNIVERSITÀ CATTOLICA del Sacro Cuore

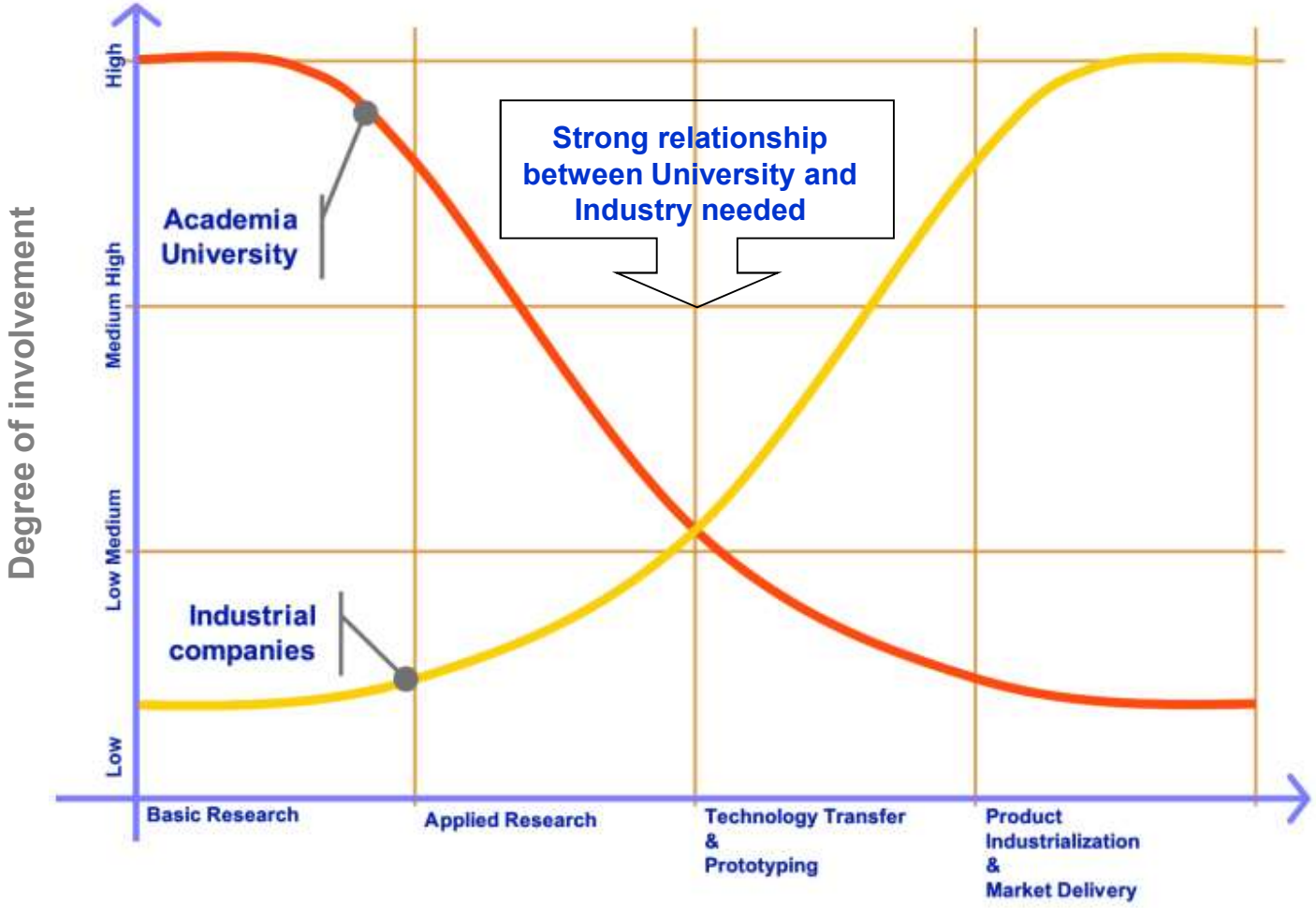
Main Financial Results 2015 (K€)

	2015	**2014**	delta %
▪ **Value of production (*)**	797	768	+ 3.7
▪ **Results after tax**	12	1.3	
▪ **Cash flow**	264	135	+ 95

Budget 2016: 937 K€ (*)
New Contracts: 400 – 600 K€

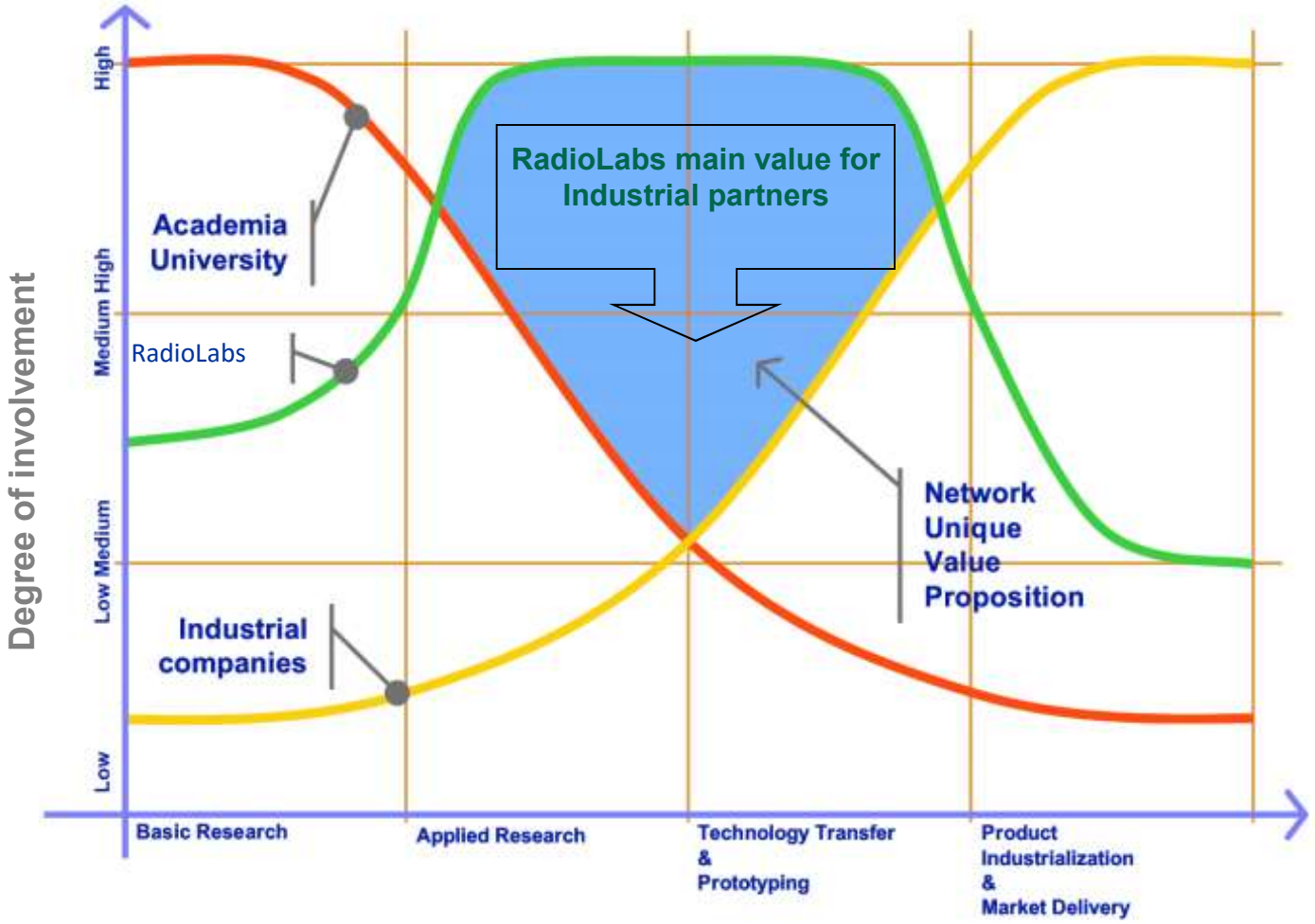
* Excluding *in-kind* contribution from University's laboratrories

Relationship between University and Industry



Evolution path from research to the market for products and services

RadioLabs positioning



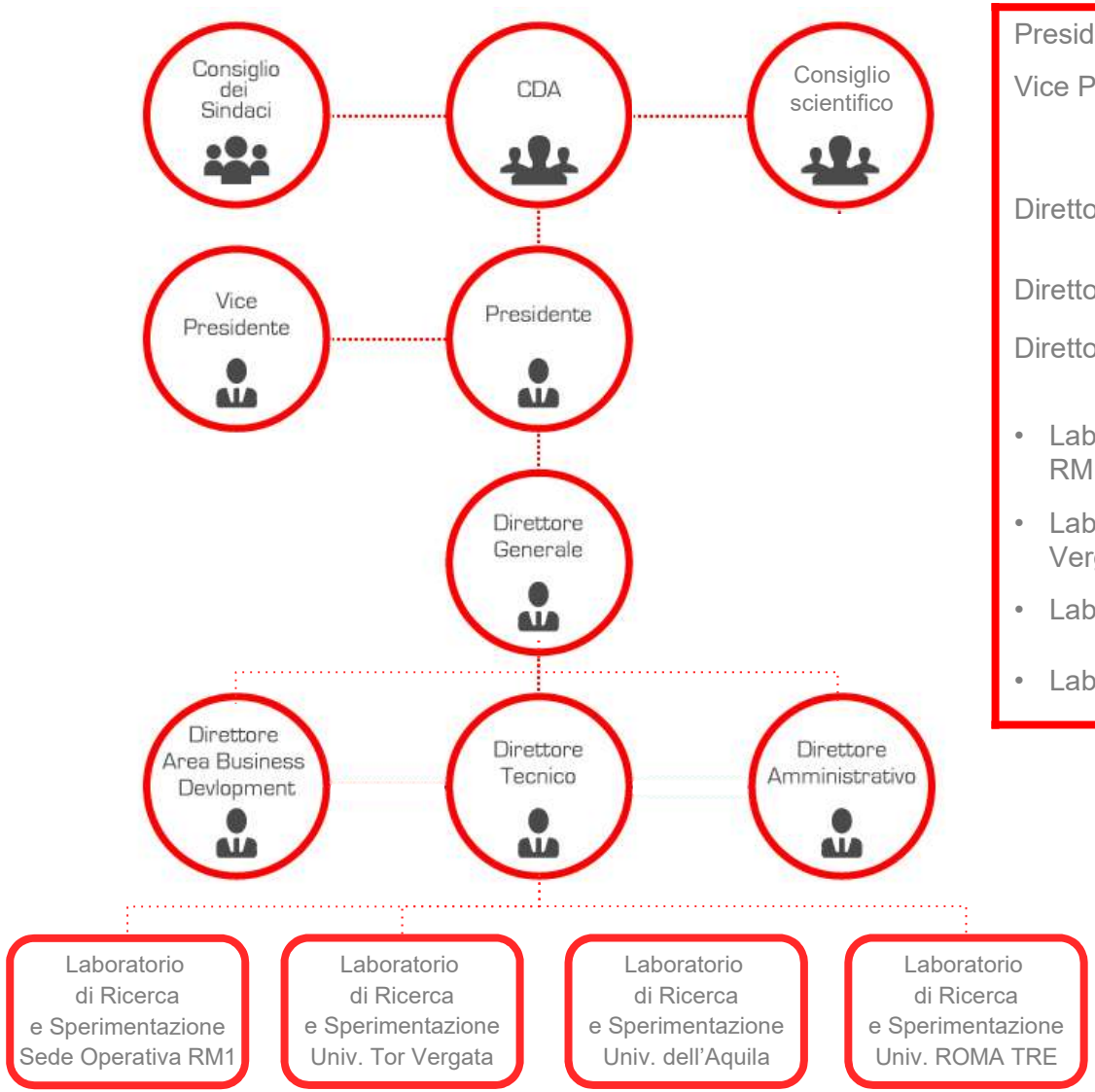
RadioLabs model

- **With its model of operation, *Radiolabs fills the gap of relationship between University and Industrial partners by:***
  - assisting industrial partners along the evolution path from conception, through basic and applied research stages, till industrialization of marketable products and services;
  - realizing a network of human resources belonging to Industries and Universities working together toward a common aim;
  - providing the industry with trained researchers (mostly Ph.D.) ready to be integrated into the company;
  - flexibly providing industrial partners with the skills how and when they are needed.

Scientific excellence

- **Radiolabs promotes research and innovation in the ICT sector by**
  - publishing Papers and Articles on the results of its research on major international conferences and Magazines
    - more than 25 papers by 2014
  - realizing an international network of Universities working together toward a common aim
    - University of Stanford
    - University of Nottingham
    - University of Pardubice
  - Financing Ph.D. with the Universities
    - Two PhD students with University Roma Tre
  - Providing Advisory support to RFI for the GNSS-Risk Analysis Technical Committee

Organization



Presidente	Prof. Alessandro Neri
Vice Presidente	Prof. Paola Inverardi
Direttore generale	Ing. Francesco Rispoli
Direttore amministrativo	Dott. Alfonso Falà
Direttore tecnico	Prof. Franco Mazzenga
• Laboratorio sede operativa RM1	Ph.D. V. Palma
• Laboratorio Univ. Tor Vergata	Prof. Giuliano Romeo
• Laboratorio Univ. De l'Aquila	Ph.D. Marco Pratesi
• Laboratorio Univ. Roma TRE	Ph.D. Marco Carli

Radiolabs Management Team

Alessandro Neri, Presidente
Professore ordinario in Telecomunicazioni all'Università "Roma Tre".

Paola Inverardi, Vice Presidente
Rettrice Università dell'Aquila,
Rappresentante nazionale nel Comitato del Programma Quadro Horizon 2020 – Information & Communication Technologies

Francesco Rispoli, Direttore Generale
Responsabile tecnologie satellitari Ansaldo STS,
Direttore del board Galileo Services

Radiolabs Technical Staff

Maurizio Salvitti
Degree Electronic Engineering
Program Manager

Agostino Ruggeri
Computer Engineering degree with specialization in Telematics Systems .
Project Manager

Alessandro Vizzarri, PhD
Telecom systems

Alessia Venarini
Master degree in ICT
GNSS - EGNOS applications

Andrea Coluccia
Bachelor degree in Telecommunication
GNSS simulation tools

Cosimo Stallo, PhD
MSc Degree in Advanced Communication and Navigation Satellite Systems
Senior Researcher

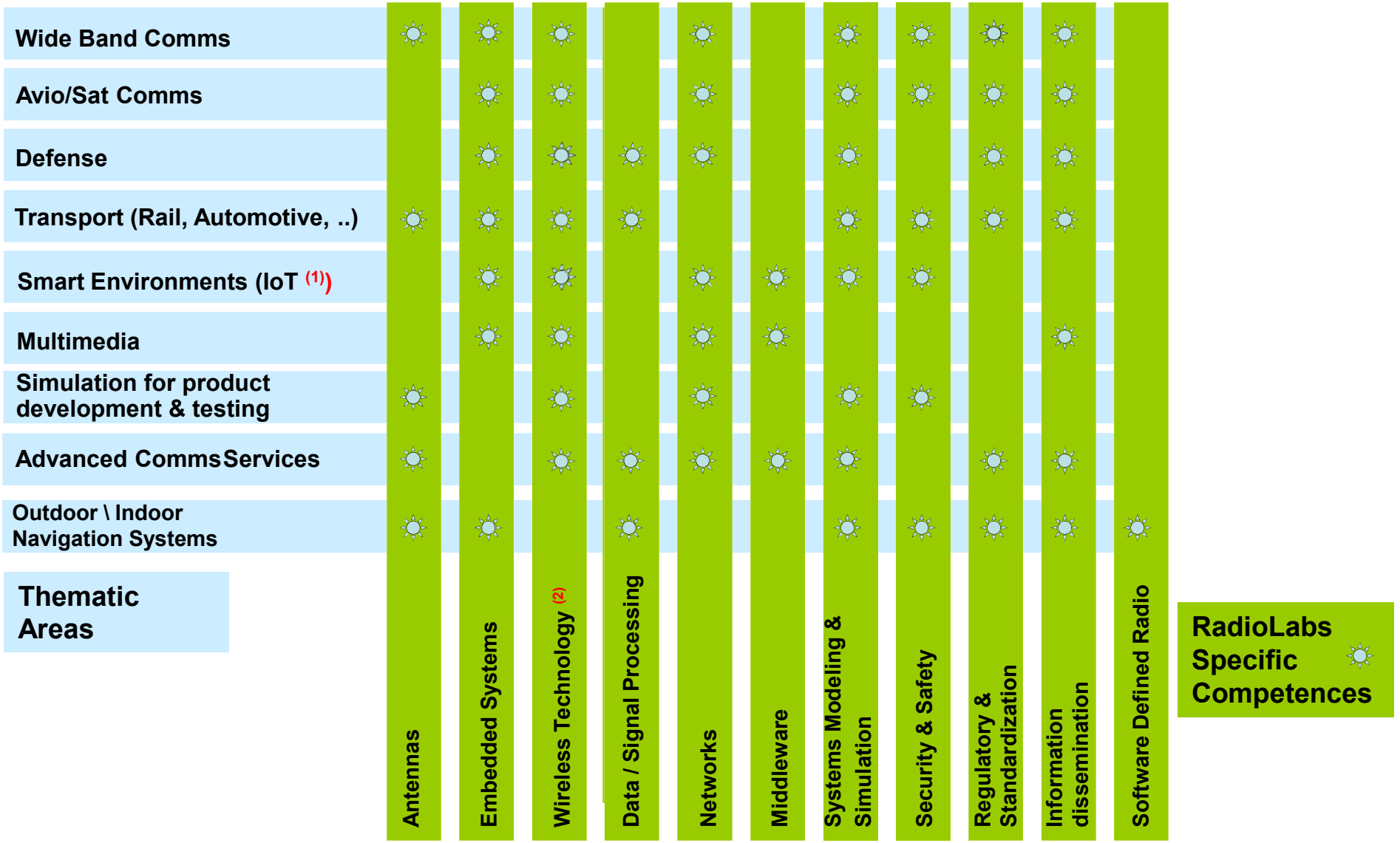
Veronica Palma, PhD
Master of Science) in Electronic Engineering
Project Manager ERSAT EAV

Radiolabs researchers at University laboratories

A team of about **20 reserachers** in the three associated laboratories:

Permanent staff + Researchers = + 30 resources

Competences & Skills



Competences & Skills

SOFTWARE COMPETENCES

❖ PROGRAMMING LANGUAGE

- Labview
- Matlab & Simulink
- C, C++
- Java , Python
- PHP, Javascript
- SQL
- VHDL

❖ TOOLS

NAVIGATION

- RTKLib
- GoGPS
- RxTools (Septentrio)
- uCenter (U-Blox)

CAD SYSTEMS

- AutoCAD
- Inventor
- Tinkercad

ELECTRONIC DESIGN & SIMULATION

- Spice, Splice
- Altera Quartur/Modelsim

❖ Operative system

- Android
- TinyOS

HARDWARE COMPETENCES

❖ ARCHITECTURES

- Microcontroller 8,16, 32 bit
- Microprocessor 16,32 bit
- FPGA
- Software Define Radio (SDR)

❖ HARDWARE PLATFORM

- Raspberry
- Arduino
- COHDA wirelles (MK5)
- USRP N210

❖ SENSORS

- CCD
- CIS
- Inertial Measurements Unit (IMU)

Communication and protocol design for pervasive and cognitive networks

RadioLabs

- ✓ **Cooperative wireless techniques for green communications:**
  signal design and physical layer techniques for novel communication paradigms, that include cooperative and cognitive wireless systems, network coding, distributed MIMO and spatial modulations;

- ✓ **Interference modelling and radio resource management in heterogeneous wireless networks:**
  characterization of interference as a prominent and limiting feature of many wireless environments, along with evaluation of achievable performance and development of novel paradigms for radio resource management;

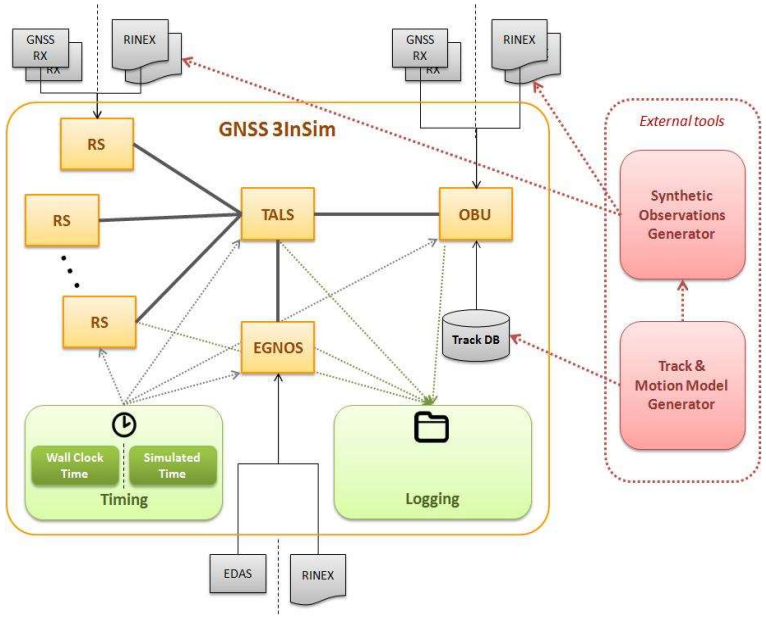
- ✓ **Cross-layer protocol design for distributed wireless networks:**
  analysis, modelling and specification of cross-layer protocol stacks that are able to meet specific application requirements in distributed wireless systems;

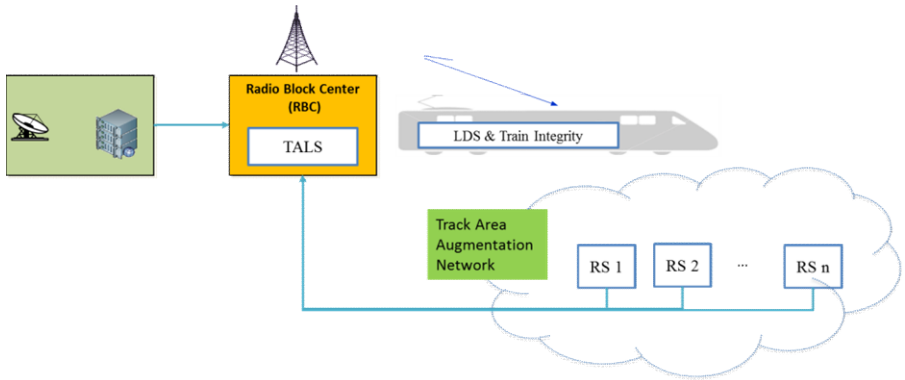
- ✓ **Network management & traffic modelling in broadband infrastructures for the future internet**

- ✓ **Algorithms and platforms for localization, sensing and security**

Simulation Tools for High Integrity GNSS localization: GNSS3InSim

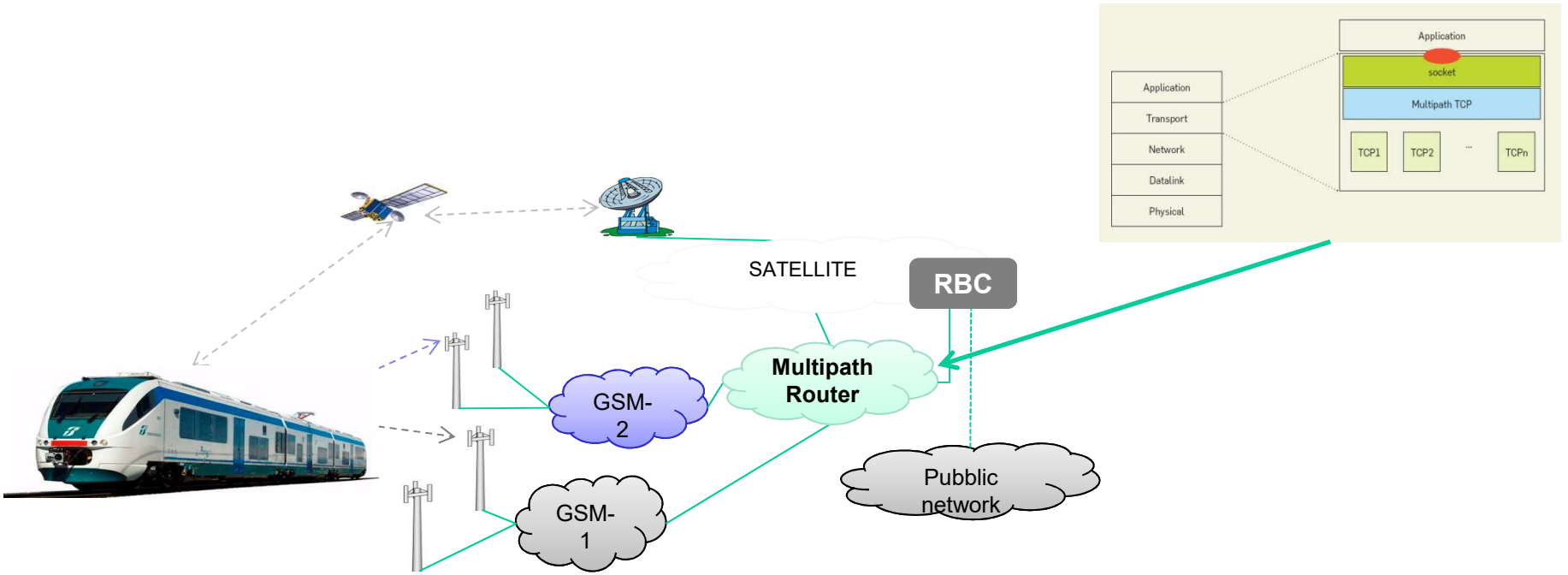
GNSS3InSim is a software simulator developed for high integrity GNSS location determination systems to build a configurable environment, where different choices for the algorithms and for the configuration parameters can be easily tried, evaluated and compared. 3InSim allows also to integrate system documentation with a non-ambiguous specification in the form of tested code and to evaluate the performances of the system.





Simulation Tools for multi-bearer telecom: 3InTLC

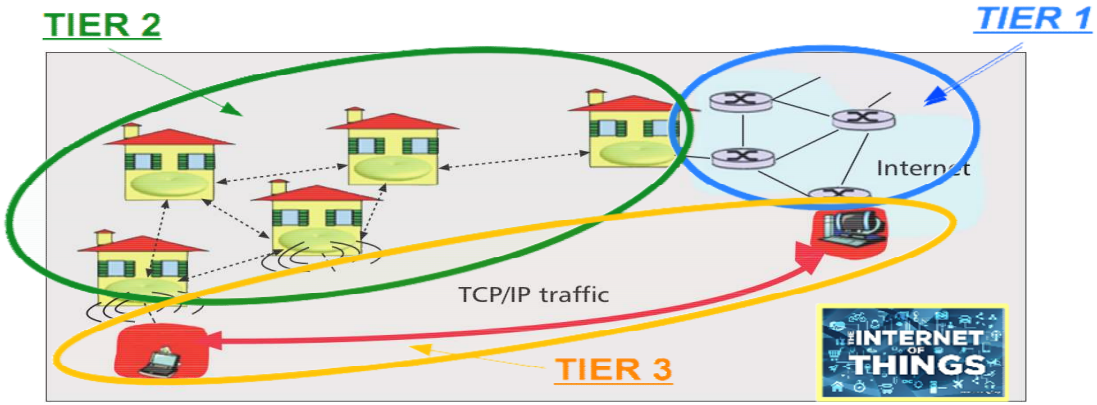
The 3InTLC emulator allows building and testing network-enabled applications, especially those mission-critical such as GNSS 3InSim, in a real-time/emulated railway environment. Most applications work well on broadband connections, but also should be tested on a dynamical low-speed or high latency communication links, as is the real target environment.

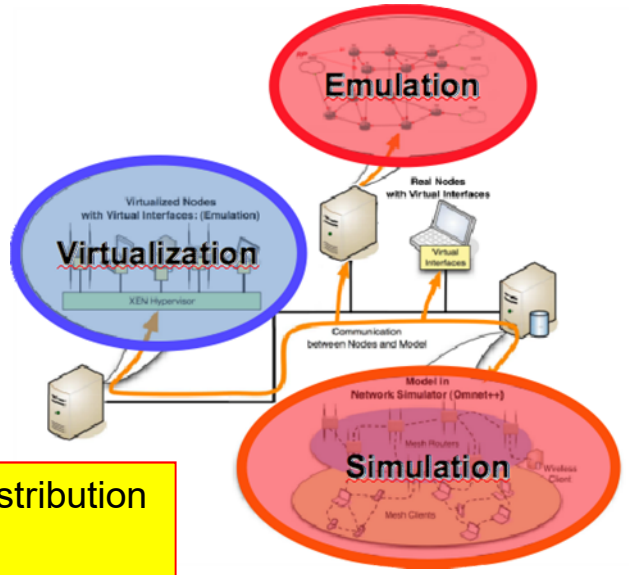


Heterogeneous networking

- Advanced IP networking in high capacity backbones
- Ad hoc mobile networks and integration with infrastructured networks
- Testbed based on open source platforms

M. Pratesi, F. Valentini, F. Santucci, "***An Android-based testbed for Hybrid Wireless Mesh Networks in the IoT Perspective***", submitted to IEEE Research and Technologies for Society and Industry", Torino, 2015.





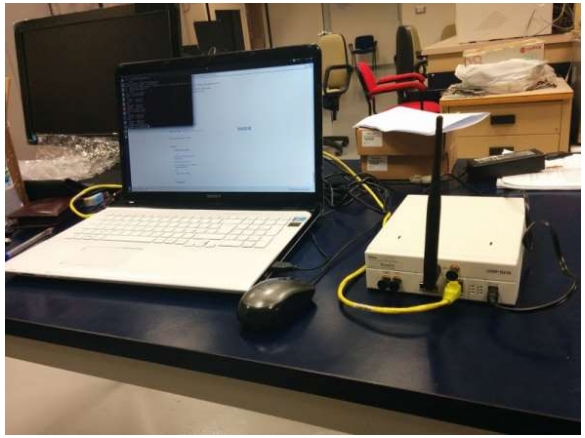
- Ad hoc mode available for **Android 4.2.2 - Cynogenmod 10.1** distribution
- **802.11.g MANET** based on Google Nexus 7 Tablet
- Inftastructured network: **Raspberry PI** and **CISCO routers**.

Vehicular networks

Vehicular Networks Analysis and Testing based on **IEEE 802.11p** technology

Test-bed realization: to test and analyze 802.11p features under high mobility conditions and to assess compatibility between SDR solution and **COHDA devices**.

Cohda Wireless MK5



USRP N210

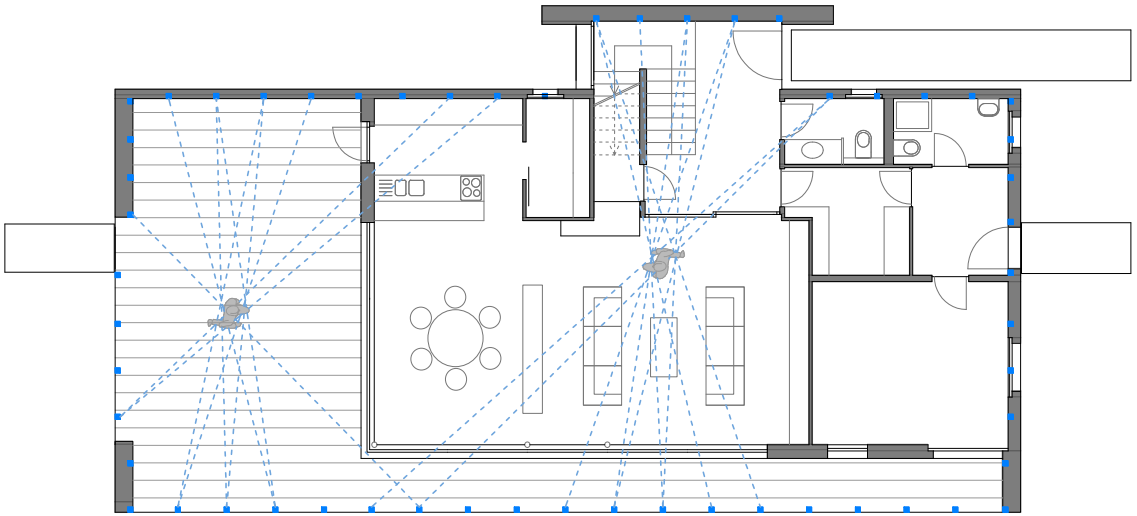
Software: **GNU RADIO** (open source), **Choda**
Programming Languages: **Python**, **C/C++**

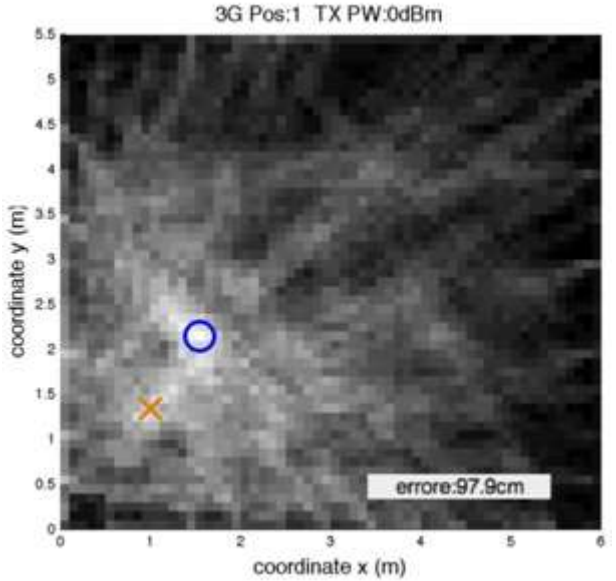
Tracking of people and goods

Development of devices with integration of RFID and radio connectivity for the localization of people and objects in complex environments.

- Without device
  - *Radio Tomography Image*
    - Faraone, M.; Alesii, R. ; Tennina, S. ; Graziosi, F., ***Device Free Patients Localization in Controlled Indoor Environments,*** IEEE CAMAD2014, December 1-3, 2014, Athens

Software: **Matlab**
Programming Languages: **C/C++, TinyOS**





NAVIGATION-Communications for Train Control Systems

RadioLabs

- Strategic partners

AnsaldoSTS · sogei · RFI Rete Ferroviaria Italiana – Gruppo Ferrovie dello Stato Italiane · Telespazio A Finmeccanica/Thales Company · ESSP

2012	2013	2014	2015	2016	2017	2018

esa **3InSat**

ARTES 20 TRAIN INTEGRATED SAFETY SATELLITE SYSTEM

Horizon 2020 – GSA - ERSAT THE ERTMS OVER SATELLITE PLATFORM

ERSAT EAV
ERTMS-ETCS Test Site

ARTES 20 SPACE BASED SERVICES FOR RAILWAY SIGNALLING

esa **SBS**
RAILS- FS

ASI – PMI- Railway Augmented Multisensor Positioning System

asi agenzia spaziale italiana **RAMPS**

Horizon 2020 - GSA- Railway High Integrity Navigation Overlay System

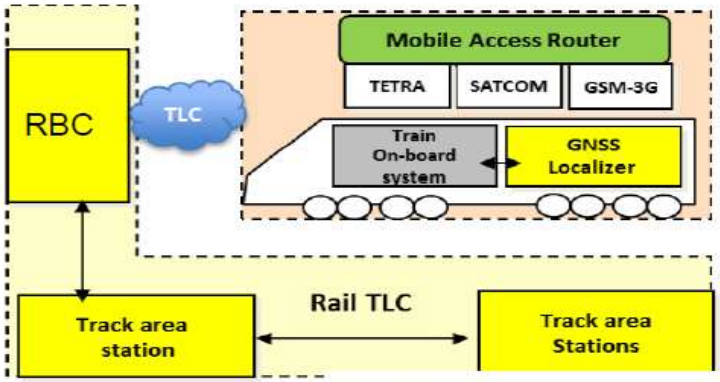
RHINOS

Horizon 2020 – GSA- Satellite Technology for Advanced Railway Signalling

STARS

• Main Projects

3InSat Project



Source of financing:

ESA ARTES 20

Duration:

March 2013 – July 2015

The project

3InSat is a project aimed at developing and validating a new satellite platform to be integrated in the SIL4 Train Control System and its Management System. This project is based on the platform ERTMS-ETCS and aims to address specific developments of the satellite location and satellite communications to meet services demand for low-traffic, in rural areas, for freight transport (particularly in mining) and regional transport through the development of solutions appropriate to International, European and National markets. In the project an experimental test and assessment campaign is foreseen to be performed in Sardinia along a railway line of 50 km.

More details can be retrieved from the project page on the portal ESA: http://artes-apps.esa.int/projects/3insat.

Partner

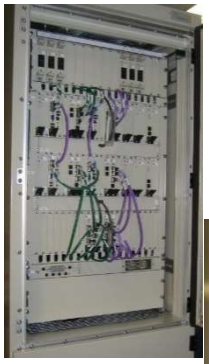
Partners AnsaldoSTS DB NETZE RFI PRAHA TRIAGNOSYS RadioLabs DLR

3InSat Test Bed

50 km

Reference Station

RBC

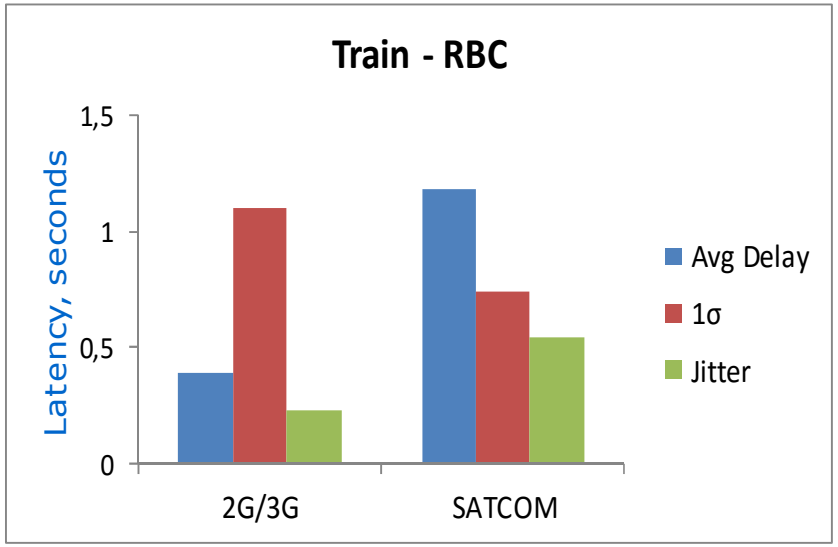


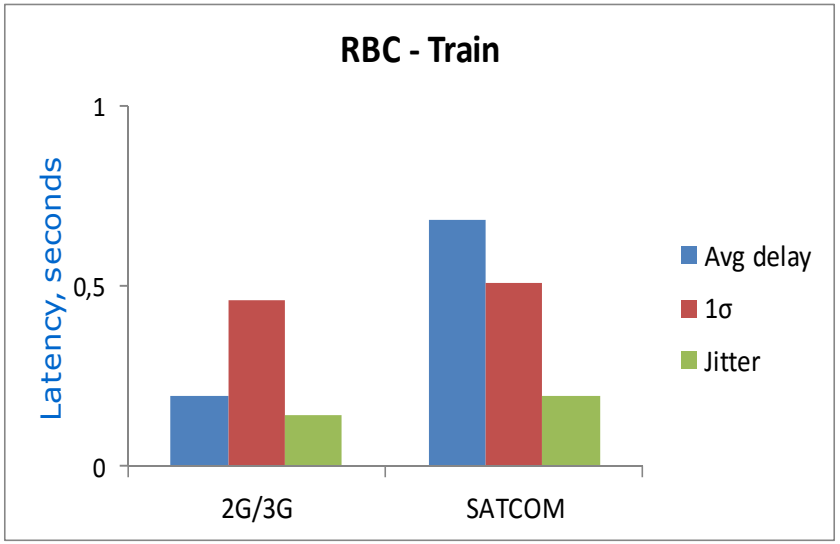
TALS

RBC Building

Train antennas

Multi-bearer telecom validation campaign





Reference latency < 2 s @ 300 km/h

Antennas

- **Line Lenght: 300 Km**
- **Duration: 23 days**
- **Total distance: 13.800 Km**

ESA 3InSat project

ERSAT EAV

Galileo-1 H2020

Ansaldo STS A Hitachi Group Company

RFI RETE FERROVIARIA ITALIANA GRUPPO FERROVIE DELLO STATO ITALIANE

DB NETZE

TRENITALIA GRUPPO FERROVIE DELLO STATO ITALIANE

ASSTRA ASSOCIAZIONE TRASPORTI

ceit ik4 research alliance

sogei

ESSP

UNIVERSITÀ BOCCONI

DLR

TELESPAZIO A Finmeccanica / Alcatel Company

RadioLabs

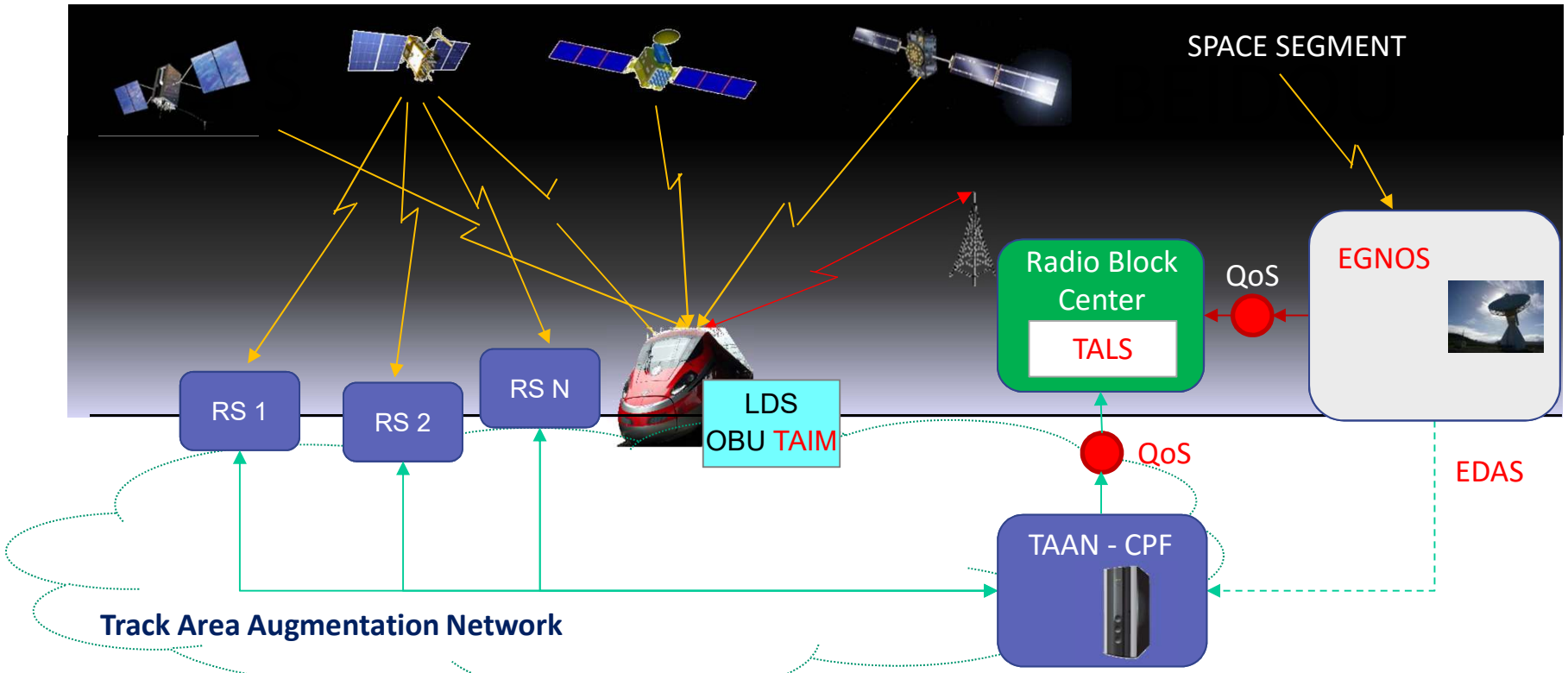
Supporting partner

ANSF Agenzia Nazionale per la Sicurezza delle Ferrovie

ERSAT EAV Mission

- To improve the **sustainability and growth of the regional and local railway lines**, **guaranteeing the safety:**
  - minimizing the costs for railway signalling infrastructure, without sacrificing the safety;
  - safeguarding the European efforts for standardization of signalling systems (ERTMS);
  - promoting the adoption of the GNSS technology into the ERTMS for improving the competitiveness of European railway industry.
  -
- The **utilization of EGNOS and Galileo Services,** as foreseen in the ERTMS MoU signed in 2012 by the railways stake-holders:
  - Exploiting and adapting the enabling GNSS key technologies;
  - Complementing the existing GNSS technology and operational services for railways application, fulfilling user requirements (SIL-4).

ERSAT EAV: High Integrity Augmentation Architecture

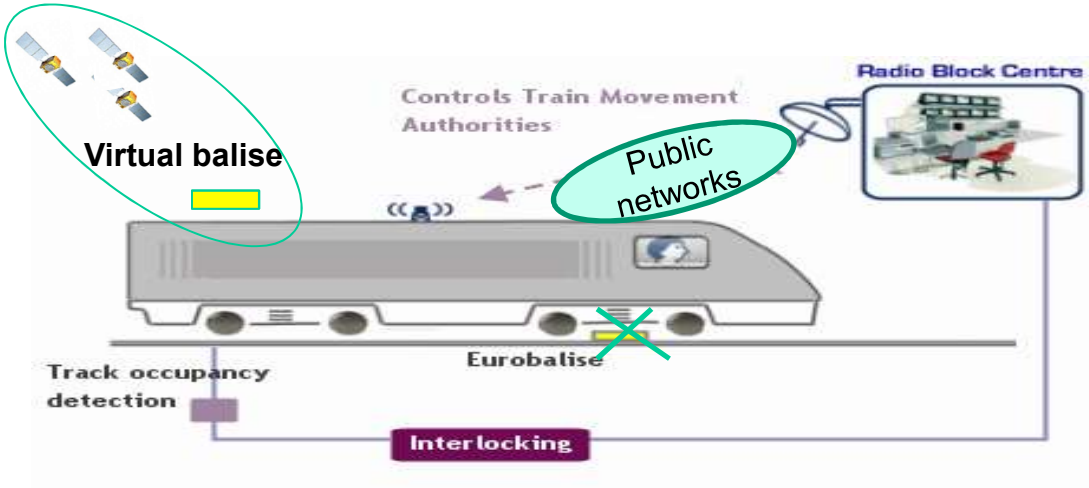


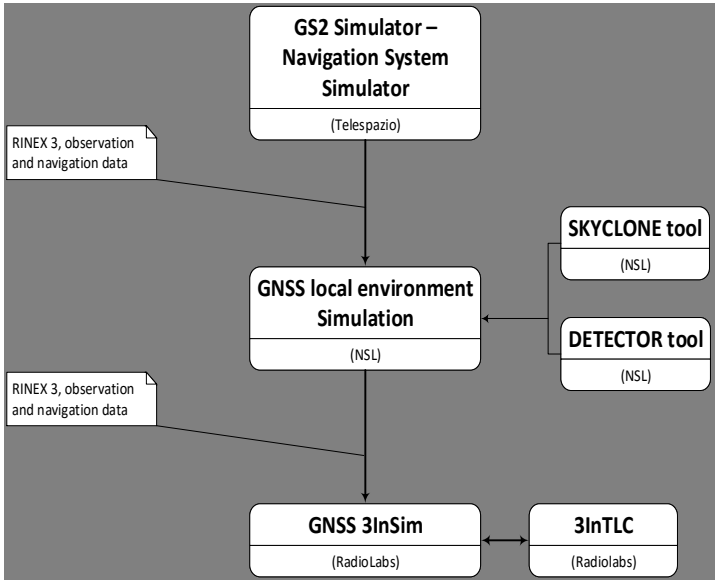
CPF	Central Processing Facilities
TALS	Track Area LDS Server
RS	Reference Station
EDAS	EGNOS Data Access Service
LDS OBU	Location Determination System On Board Unit

SBS Rails Project (ESA)

The SBS Study target is a technical and economical feasibility analysis for introducing the satellite assets (navigation and telecommunications) into the ERTMS train control system platform

Radiolabs contribution: Proof of Concept, analyses and performance validation





RAMPS Project

RadioLabs

RAMPS

Railways Augmented Multisensor Positioning System

Source of financing

ASI (Italian Space Agency)

Duration

18 months

The project

RAMPS (Railway Augmented Multisensor Positioning System) is a research project that will demonstrate how satellite navigation could be used as part of the management and control system of the high-speed railway traffic, improving the level of safety and efficiency of such rail service in the "Start of Mission" operational phase.
To accomplish this RAMPS determines the position of the train without exploiting the physical balises and at the same time is designed to be compatible with existing elements of ERTMS / ETCS system.
To achieve these objectives, RAMPS plan to synergistically use some innovative technologies (both of processing and of sensors) and the European infrastructure of the Satellite Navigation, minimizing both the infrastructure to be developed from scratch and the impact on the pre-existing one and thus ensuring backward compatibility with what is already operational.
RAMPS foresees two different modes of operation, defined according to real scenarios in which it will be used:

- Scenario "in station";
- Scenario "along the route."

Partners

Tecnologie nelle Reti e nei sistemi T.R.S. SpA

dune

ROMA TRE UNIVERSITÀ DEGLI STUDI

RadioLabs

RHINOS Project (Radiolabs coordinator)

Railway High Integrity Navigation Overlay System

Source of financing
EU H2020
Galileo-2
Duration
18 months

The RHINOS will develop candidate concepts for the provision of the high integrity needed to protect the detected position of the train:

- **EGNSS (GPS and GALILEO**) plus the SBAS constitute the reference infrastructure that is available worldwide. In addition to that, local augmentation elements, ARAIM techniques and other sensors on the train are the add-on specific assets for mitigating the hazards due to the environmental effects which dominates the rail application.
- **International cooperation with the Stanford University** researchers that have been involved in the aviation application since the birth of the GPS. They have indisputable knowledge of the GNSS performance and high-integrity applications.
- Ambition is a **global solution** a step beyond regional GNSS platforms,

STARS Project

Satellite Technology for Advanced Railway Signalling (UNIFE)

Source of financing
EU H2020
Galileo-2
Duration
24 months

Radiolabs is partner of the first European Consortium bringing together Rail and Satellite stake-holders

- The way for the future EGNSS deployment in safety relevant railway applications.
- Implementation of the satellite positioning functionality of the future railway signalling systems, especially for lines with lower traffic density.
- The project deals with three main topics:
  1) The elaboration of reference data and characterisation of the railway environment through a measurement campaign;
  2) The assessment of the EGNSS performances achievable in the railway environment
  3) Quantification of the economic benefits and specifying the possible implementation roadmap

- Linked with other initiatives in order to feed directly into the standardization work of ERTMS,
  - with NGTC (EU funded FP7)
  - the results will be directly implemented by SHIFT2RAIL,
  - taking profit of the strong know-how inherited from civil aviation, making this project as completely integrated and consistent in overall activities in Europe and worldwide, leading to the effective deployment of the satellite technologies in advanced railway signalling systems.

VIRGILIO Project for geo-localization services

Source of financing

LAZIO INNOVA ex L.R. 13/2008

Duration

24 mesi

The project

The aim of the VIRGILIO project (Virtual InstRuments for GNSS Augmentation and LocalizatIOn) is the is implementation of the a platform to support the design activities that can be configured in modular way by users and can be offered with the same paradigms SaaS (Software as a Service) typical of the software tools usable in Cloud.

The project derives its origin from the expertise that RadioLabs has developed in recent years in the study and simulation of GNSS system for geo-localization services.

The platform will aim to provide a tool can be used both by Research Institutes and Small and Medium Enterprises (SMEs) to verify the feasibility, dimensioning, planning and optimization of innovative LBS (Localization Base Services) services. The analysis of the platform requirements will be carried out on the basis of in-depth market research and subsequently plausible usage scenarios will be hypothesized.

Partner

D-BOX (1/3) – Main Objectives

Source of financing
EU FP7
Duration
24 months

Demining toolbox for humanitarian clearing of large scale area from anti-personal landmines and cluster munitions

Project Leader

WP Leaders

D-BOX (2/3) - The GAUGE tool

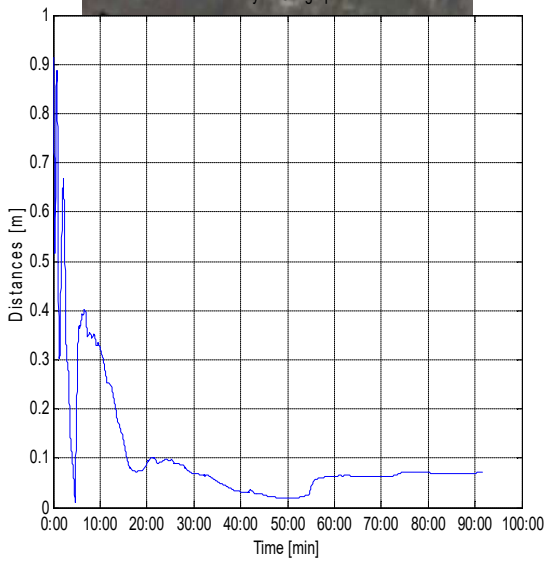
- **GAUGE** = **G**NSS-based **A**ccurate **U**nexpensive **G**eoreference **E**stimator
- The problem: is it possible to have accurate positions at low cost?

- Trade-off between accuracy and inexpensiveness
- **GAUGE** is a tool to provide **accurate georeferentiation with low-cost equipment**.

D-BOX (3/3) - What offers GAUGE?

- **10 cm** accuracy in **20 min** (max) at less than **300 €**

Accuracy of Gauge position



FINMECCANICA

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COMUNICATO STAMPA

Finmeccanica: tecnologia al servizio delle operazioni di sminamento

- **Presentato a Napoli D-BOX, un insieme di servizi, sistemi e sensori per proteggere gli operatori impegnati in operazioni di sminamento**
- **Finmeccanica è leader della componente di innovazione tecnologica della soluzione, sviluppata nell'ambito di un progetto della Commissione Europea**
- **Il progetto è un esempio di tecnologia militare applicata in ambito civile a scopi umanitari**

Giugliano, 3 marzo 2016 – Si è svolta oggi, presso il sito Finmeccanica di Giugliano (Napoli), la dimostrazione finale di D-BOX (Demining tool-BOX), progetto di ricerca per lo sviluppo di una soluzione completa per aumentare la sicurezza delle operazioni di sminamento, finanziato dalla Commissione Europea. Finmeccanica, attraverso la divisione Elettronica per la Difesa Terrestre e Navale, è leader della parte di innovazione tecnologica e responsabile della dimostrazione finale del progetto, a cui partecipano anche altre aziende, università e centri di ricerca.

Un esempio di come tecnologie e competenze sviluppate nel settore difesa possano essere utilizzate per attività civili e di sicurezza, D-BOX è in grado di integrare informazioni e dati ricevuti da diversi strumenti e sensori, consentendo all'operatore di concentrarsi esclusivamente sulle attività che sta conducendo sul terreno.
D-BOX consente di minimizzare i rischi per l'uomo, aumentare l'efficienza delle operazioni e contenere i costi delle campagne di sminamento. Un professionista del settore, infatti, impiega oggi circa 8 ore di lavoro per bonificare 5m² di terreno, con risultati non sempre affidabili e precisi. Grazie a D-BOX sarà possibile disporre di informazioni di dettaglio provenienti da diverse fonti - satelliti, droni, telecamere termiche, sensori di prossimità di concezione innovativa, antenne e altri strumenti sul campo – confrontarle con dati statistici e quindi intervenire con maggiore sicurezza sull'area di lavoro.

Nel corso della dimostrazione sono stati ricreati diversi scenari applicativi - dal deserto al terreno umido, da aree con folta vegetazione a zone colpite da esplosioni – per riprodurre le condizioni e gli ambienti su cui oggi si concentrano maggiormente le operazioni di sminamento, con particolare riferimento alla Croazia e al Sudan.

SAFEDEM Project

RadioLabs

Source of financing
ESA ARTES 20 IAP
Duration
18 months

SAFEDEM aims at providing a service platform addressing the needs of the Mine Action community to improve and optimize planning and preparation, and to reduce the impact of demining activities.

SAFEDEM service platform integrates data from Earth Observation satellites with high-resolution data acquired through Remotely Piloted Aircraft Systems (RPAS) to offer a comprehensive set of products and services in support to land release process in mine action at its various levels.

The key objectives of SAFEDEM are:
•to bring satellite technologies in the Mine Action context, where up to now they are only partially exploited;
• to consolidate a methodology for integration and fusion of Satellite, RPAS and land based data aimed at providing support for Land Release activity;
• to demonstrate and deliver to the Mine Action users some well-established data processing techniques;
• to set-up a set of innovative services in a coherent framework, in order to help Mine Action practitioners in their activities.

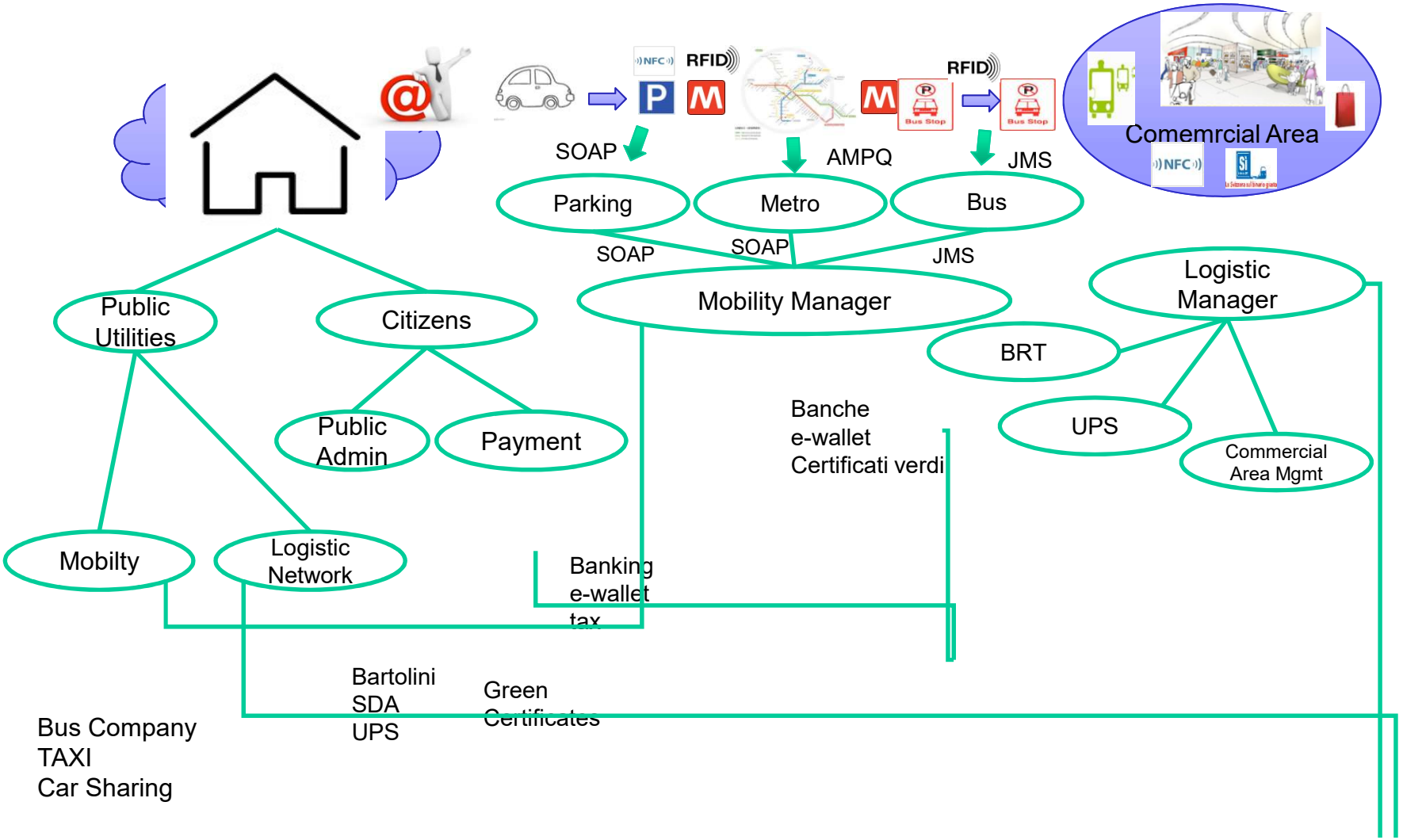
e-geos AN ASI/TELESPAZIO COMPANY · SAPIENZA UNIVERSITÀ DI ROMA · MEEO · OBEN · Edel Aerospace · Vrije Universiteit Brussel · FSD · AUREA IMAGING

LogON:Logistics Open Network

Source of co-financing
Ministero Sviluppo Economico

RadioLabs

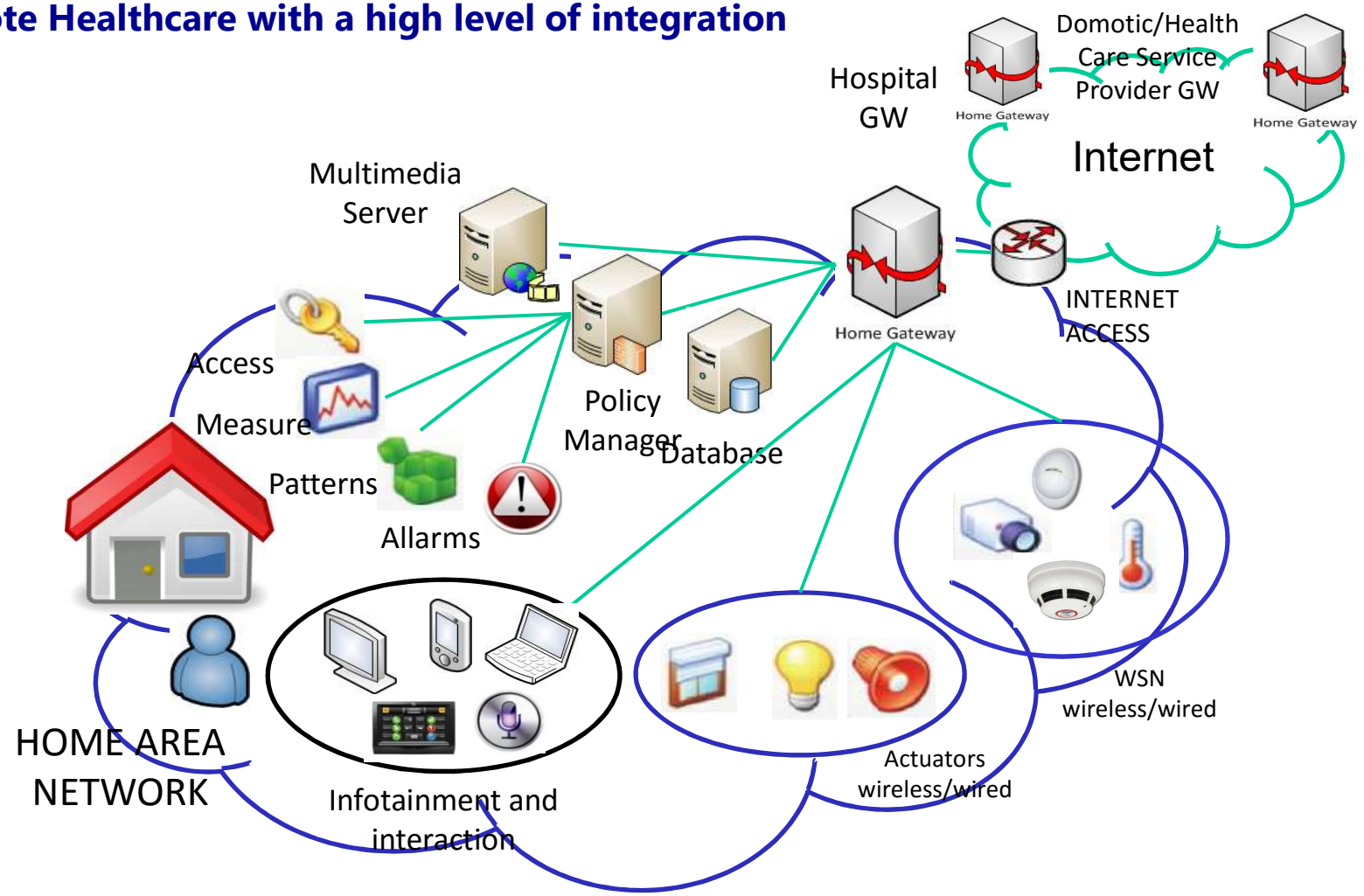
innovative platform of logistic services and components in urban scenario



DAHMS:Distributed Architecture Home Modular Multifunctional Systems

Source of financing
Ministero Sviluppo Economico

modular and multi-functional systems for Domotics and Remote Healthcare with a high level of integration



MOTUS: MOBILITY AND TOURISM IN URBAN SCENARIOS

Scenario

The mobility in the urban environments is an important problem for both public administration and people that moves in it.

GOAL

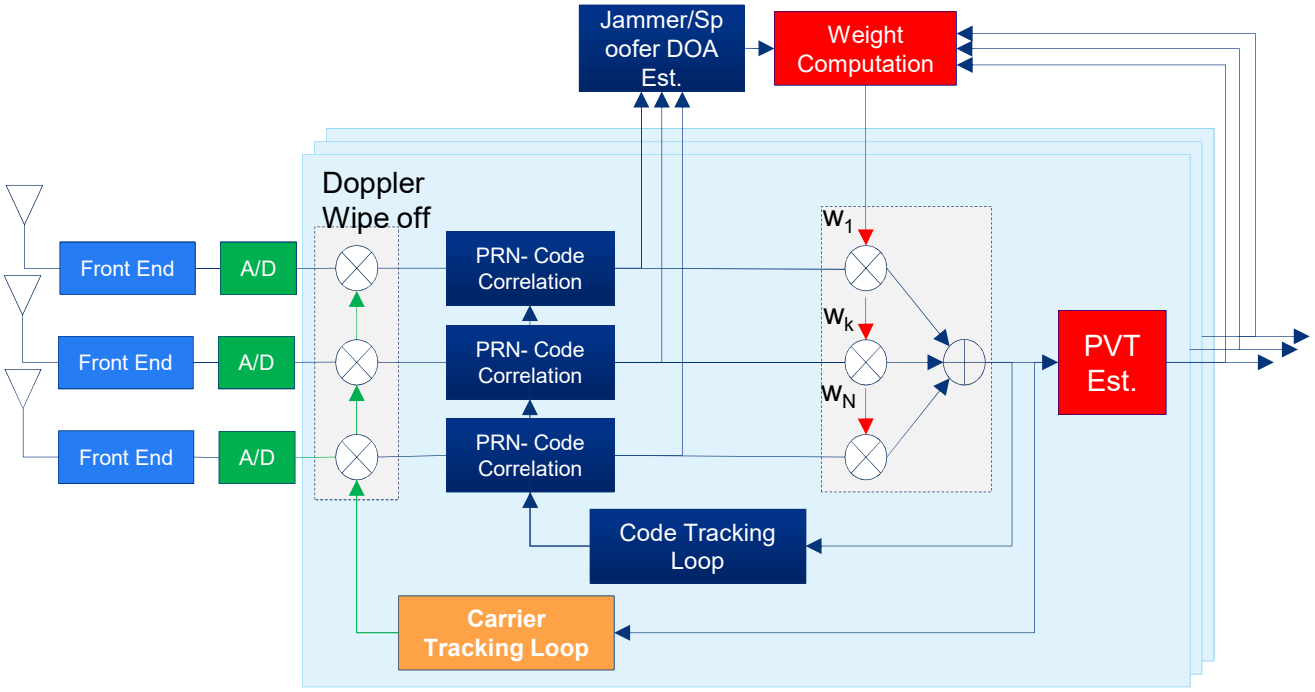
The objective of MOTUS is to offer to mobility management, turist and citizens a system for monitor and understand the urban mobility, pedestrian and vehicular, with the final goal to improve the life quality.

Technology

The MOTUS infrastructure includes a system to collect and integrate data (GPS, GSM/UMTS, etc.) provided by heterogeneous infoprovider through which urban mobility is described.

New Project: Time-Space Beamforming

"Digital Beamforming and advanced GNSS signal processing techniques for High GNSS anti-jamming, anti-spoofing and anti-meaconing Capabilities for Rail Applications"



Potential threat affecting the received GNSS signals are intentional interferences (e.g. jammers), and smarter attacks (e.g. spoofing, meaconing).
Even if spoofing or meaconing are detected, the related signals are hard to filter out in the time domain, alone.
Mitigation of such a kind of hazards has been primarily investigated for military applications. Thus, very few commercial solutions exist for civilian applications, essentially limited to anti-jamming, and none of them has been designed for the railway context.

GOAL

The most effective means to detect and mitigate spoofing and meaconing are constituted by the verification of the spatial coherence of the received SISs with respect to the position of the receiver.
The objective of project is to implement this concept by using the Digital Beamforming and advanced GNSS signal processing techniques for the railway context.

University of Nottingham