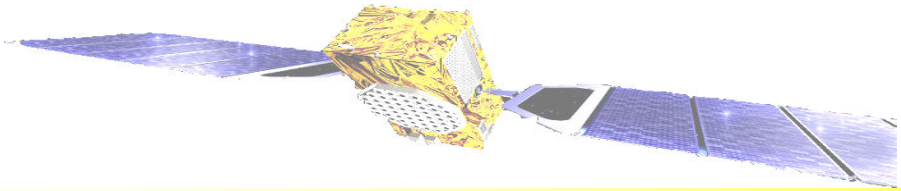

Galileo
an engine of innovative Applications and Services

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GALILEO e le Infrastrutture Critiche
CAMPUS BIO-MEDICO di ROMA
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GALILEO, an engine of innovative Applications and Services

MAIN TOPICS

Galileo is a dual use GNSS system fostering applications in different sectors: commercial, safety and security of territory and the citizen.

Galileo a GNSS system enabler of technologies integration: merging telecom (terrestrial and satellite), earth imaging and mapping (aero or space based) and IT (Information technologies)

An extensive and comprehensive European action plan on GNSS is paving the way for Galileo application and services, also launching measures to favour penetration (including legislation)

Galileo is part of a new industrial policy strategy for Space activities.

European Policy

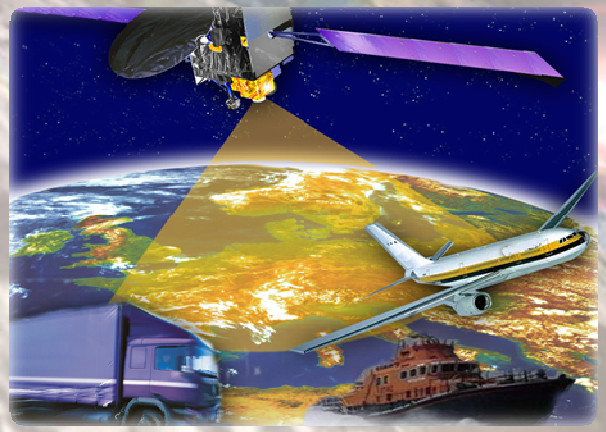
To implement its own Navigation Satellite Systems in two steps:

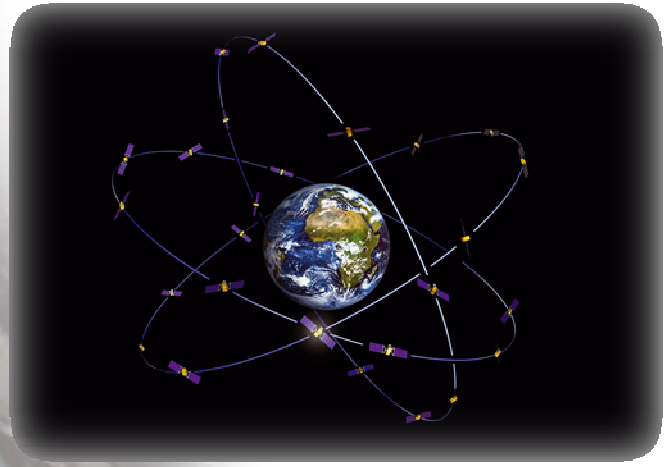
EGNOS

Augmentation system based on 3 geostationary satellite and a network of ground stations certifying and enhancing the existing navigation signal allowing the use in safety critical applications

Galileo

Autonomous Navigation system based on 30 satellites in MEO orbit, 27 actives 3 spare, placed in 3 orbital planes





Galileo and Dual Use

Galileo is a Civil system under Civil control, however:

- **Large satellites systems (Communications, Earth Observation) are generally** Dual-Use **systems,**
- **In principle, the Galileo system is conceived in such a way to fit the** needs of the military users **too,**
- **Applications such as crisis management, law enforcement, tracking of dangerous goods are often involving** military corps
- **The same applies to missions for peace-keeping or defense,**
- **Dual use of Galileo de-facto** is a reality**.**

Galileo PRS potential Users

Law Enforcement, Internal Security & Customs
Police, Coast Guards., Special Units etc.

Emergency Services
Fire Brigades, Civil Protection, etc.

Critical Energy, Critical Telecom
Network operators, Energy Suppliers

Critical Transport
Mass, high-value & hazardous goods transporters

Strategic, Economic ,& Commercial activties
Banks, Commercial ports, Space Agencies etc.

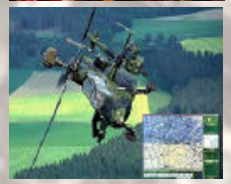
Defence
Army, Navy, Air Force, Joint forces

GNSS support in Governmental Activities

Application domains

- **Law Enforcement**
  - Police
  - Special Ops
  - Customs

- **Emergency Services**
  - Fire Brigades
  - Civil Protection



- **Defence**
  - Army
  - Marine
  - Air Force

Main operational scenarios and applications

- Day to day patrolling coordinated by a control centre
  Navigation/Positioning for Land vehicles & Handsets
- Particular security measures enforcement
  During particular events (Olympics, G8 Summit…)
  - Involving various kind of platforms
  - Tracking of suspects' profiles, dangerous goods

- Coordination of land vehicles
  - Automatic Vehicle Location (AVL)
  - poss. Navigation
- Location of emergency personnel
  - Navigation information for the unit
  - Reporting of position & status for the control centre

- Various types of applications & platforms
  - As a backup: Navy vessels, some aircraft…
  - As a Sole Mean: Infantryman equipment, some synchronisation applications…
  - As a setting mean for other PNT systems: Helicopters…

GNSS support in critical infrastructures

Application domains	*Main operational scenarios and applications*
 • **Critical Telecom** Network operators	**Network synchronisation and timing** - **GNSS as primary** reference **clock** (backed with atomic clocks) - Frequency calibration of radio signals (**GSM** base stations)
 • **Critical Energy** Energy suppliers	**Network monitoring and control** - Internal oscillator management - **Time** stamping **of incident** - Synchronised mesuraments
 • **Critical Transport** Civil aviation	**Next generation global ATM**
 • **Strategic Activities** Commercial ports	**Vessel Traffic Management** **Container tracking & tracing**

GNSS support to professional communication

Professional Mobile Radio (PMR) systems

Secure communications for law enforcement and emergency services

Key management for groups of users
Accountability and tracking of secure assets

GNSS and PMR

- Clock synchronisation in the network infrastructure
- Used for radio base stations when operating in Simulcast mode
- Location application for end-users
- Vehicle & pedestria location
- Common operational picture
- Force/asset tracking

Public Related Service (PRS)

PRS is not designed for Safety needs but for Robustness

PRS is of interest for Governmental bodies or Entities devoted to the security of the territory:

- robust and access-controlled service for government applications (protected against jamming and spoofing)
- operational at all times and in all circumstances, notably during periods of crisis ("continuity of service")
- separated from other services that can be denied without affecting PRS operations

PRS response to open GNSS vulnerability

- **Robust against interference/jamming**

▲ JAMMER
for GPS, GSM (900MHz), DCS (1800MHz), and 3G mobile bands

  - **PRS signal structure has been specifically designed to resist to interference and medium/low power jammer**
  - Jamming of PRS will necessitate more expensive higher power jammers: easier to localise

- **Robust against meaconing/spoofing attacks**
  - **Robust encryption mechanisms in PRS signals and data message provide protection against meaconing and spoofing**

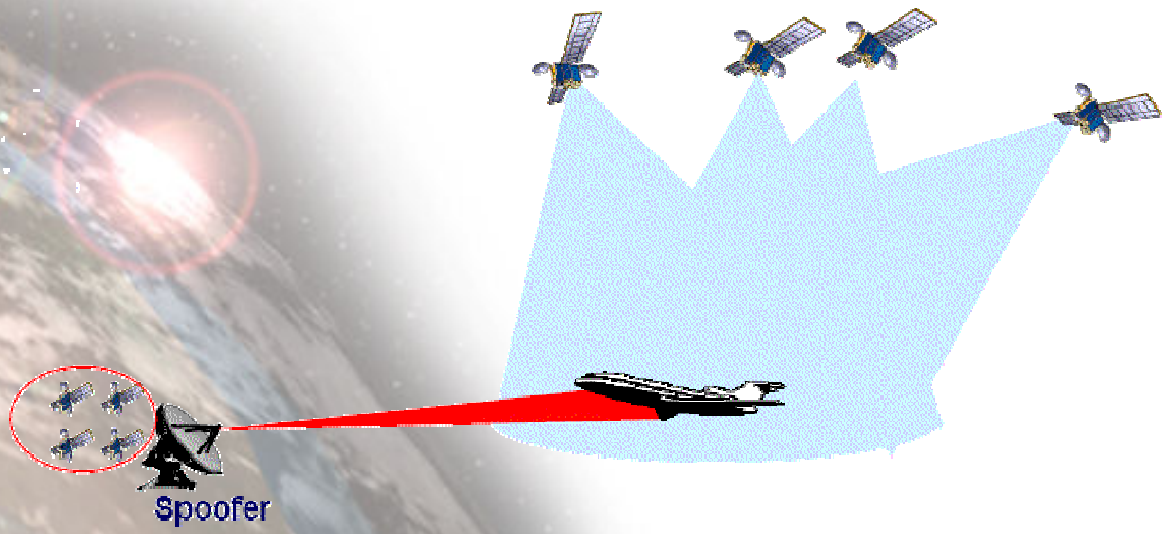
- **Designed to have:**
  - **Separation of PRS Signals from open service signals**
  - **Robust access control to PRS signals**

  Open GNSS can be disrupted while maintaining continuity of service to PRS Users

GNSS open service signal: Vulnerability to spoofing and Meaconing

Meaconing: consists in rebroadcasting GNSS signals on the same frequency to confuse navigation

Spoofing: consists in broadcasting GNSS signals that emulate a fake constellation to mislead navigation



Galileo PRS Service features

PRS offers:

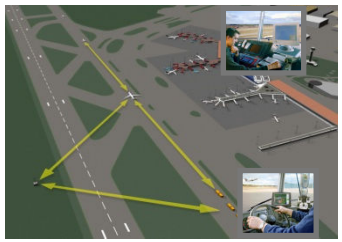
- PNT services in a robust way
- Controlled Access via Key management for authorised users
- Denial capability
  - **service**
  - **single user**
  - **group of users**
  - **geographical**
- Navigation message protection
- PRS receivers control & management
- OTAR capability for remote users

SENECA: Civil Aviation Programme

ASI and ENAV (the Italian Company responsible for Air Traffic Control) have defined a joint national Programme aimed to introduce gradually the satellite navigation, starting from EGNOS programme, into the Civil Aviation cotrol procedures, for a 5 years duration.

Objectives:

- Ensure a wide and prompt use of EGNOS for Civil Aviation in Italy.
- Prepare Civil Aviation for transition from EGNOS to GALILEO
- Promote innovation and Research in Satellite Navigation field

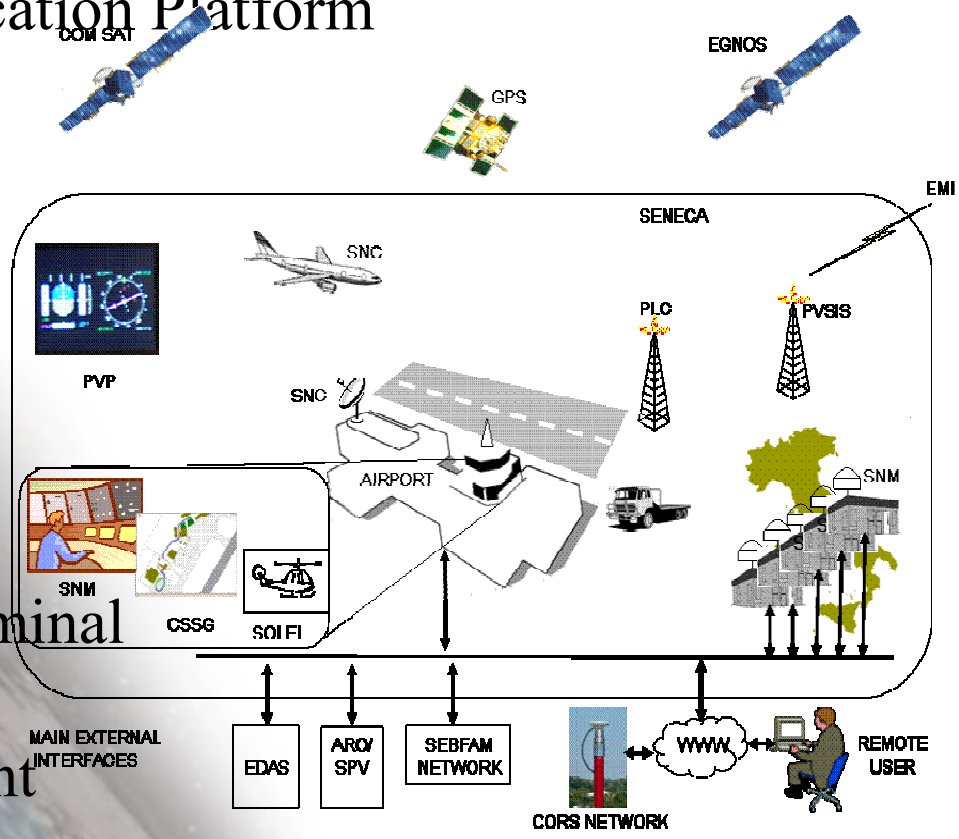


Activities:

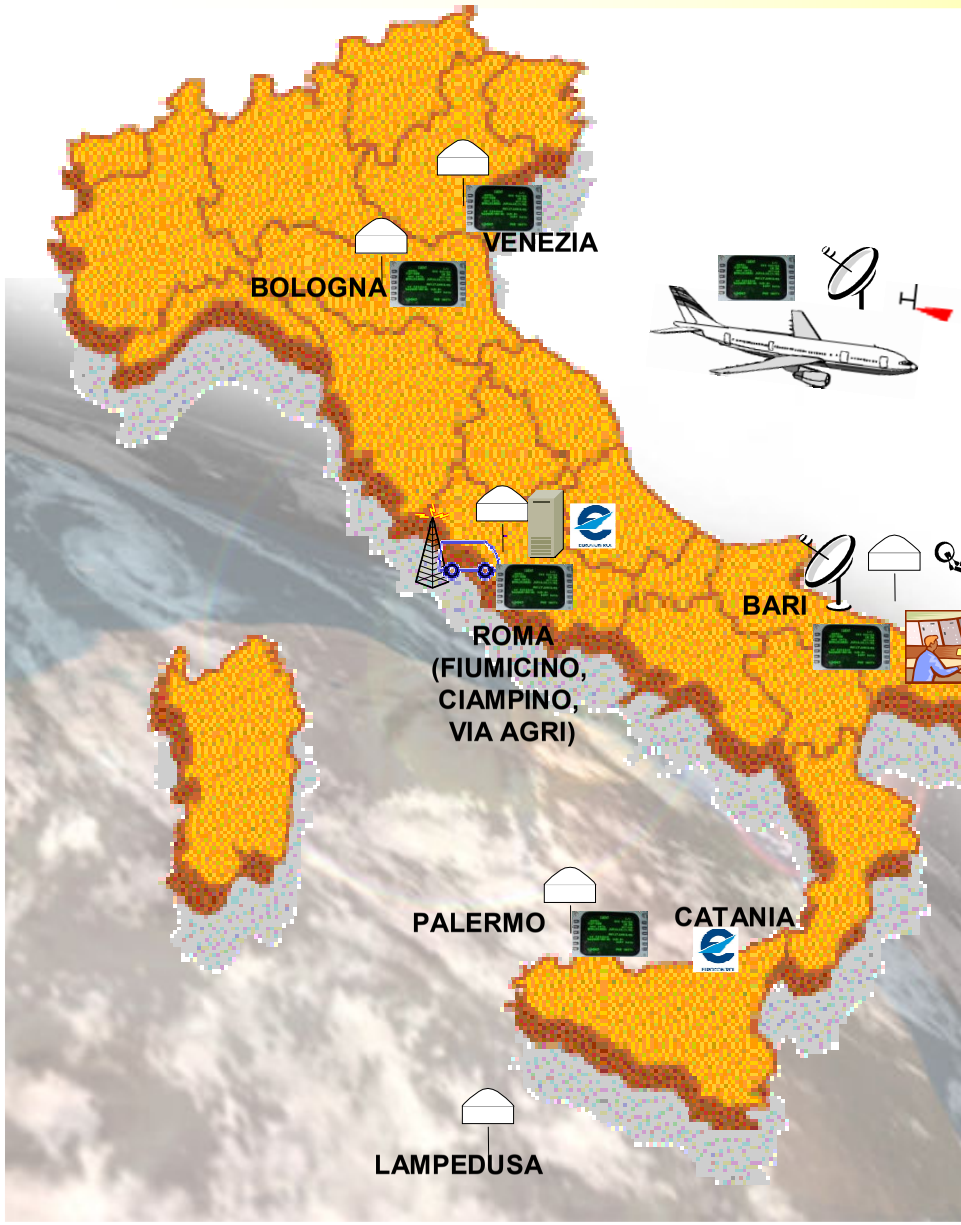
- Support to Certification of EGNOS system
- Verification of EGNOS performances in operational conditions within the national air space
- Introduction of satellite navigation in Civil Aviation procedures and systems
- Development of Innovative Services and Applications based on GALILEO

SENECA: Civil Aviation Programme

- National Signal Monitoring System
- Civil Aviation procedures verification Platform
- Services Experimental Centre
  - GNSS Simulator
  - Data Analysis
- Local Elements
- Multifunctional NAV/COM terminal
- General Aviation and UAV flight



SENECA Architecture Deployment



SNC: Navigation & Communication

PVSIS: Platform for
Signal in Space Verification

PVP: Platform for Procedures Verification

CSSG: Centre for Experiment
GNSS Services

CSSG Front End Proxy

EDCN: Egnos Data Collection Network

PCL: Lcoal Component Platform

SOLEL: Elicopter Simulator System

SNM: National Monitoring System

SLM: Local Monitoring Stations

Validation & Demonstration Activities

Ground Validation

- Cockpit simulator (flyability and preliminary obstacle assessment)
- Simulation of 4 aircraft categories (A, B, C, D)

- Data quality assurance
- Regulations compliancy (ICAO 8168, 9906, ARINC 424)

Integrated solution

Flight Procedure loading

- Certified Data-packer
- Aircraft: PIAGGIO P-180 Avanti II (Flight Inspection department fleet)

Demo Activities

- Flight Trials
- Involvement of local ATC personnel

Operational feedback

- Pilot and ATCOs feedback required
- APV/SBAS benefit evaluation

ASI sustains new challenges on train control systems

ERTMS (new MoU)

- extending specifications to meet global requirements by introducing:
  - Network independent TLC
  - Satellite positioning

Increase market

Making investments more attractive

Ensure ERTMS compatibility

Exploit new technologies

New markets

- private freight/mining lines
- Low traffic-regional lines

GNSS

- GPS, GLONASS fully operative
- GALILEO under development to provide Europe independence and greater robustness

3INSAT - Train Integrated Safety Satellite System

- A Project financed by ASI within the ESA ARTES Telecommunication Programme
- Development and validation of a satellite-based platform compatible with the ERTMS-ETCS
  - ✓ Exploitation of new satellite TLC technologies
  - ✓ Adoption of GNSS and augmentation networks for meeting SIL-4 requirements
- Managed by ESA
- Roadmap up to the validation and certification phase

Benefits:

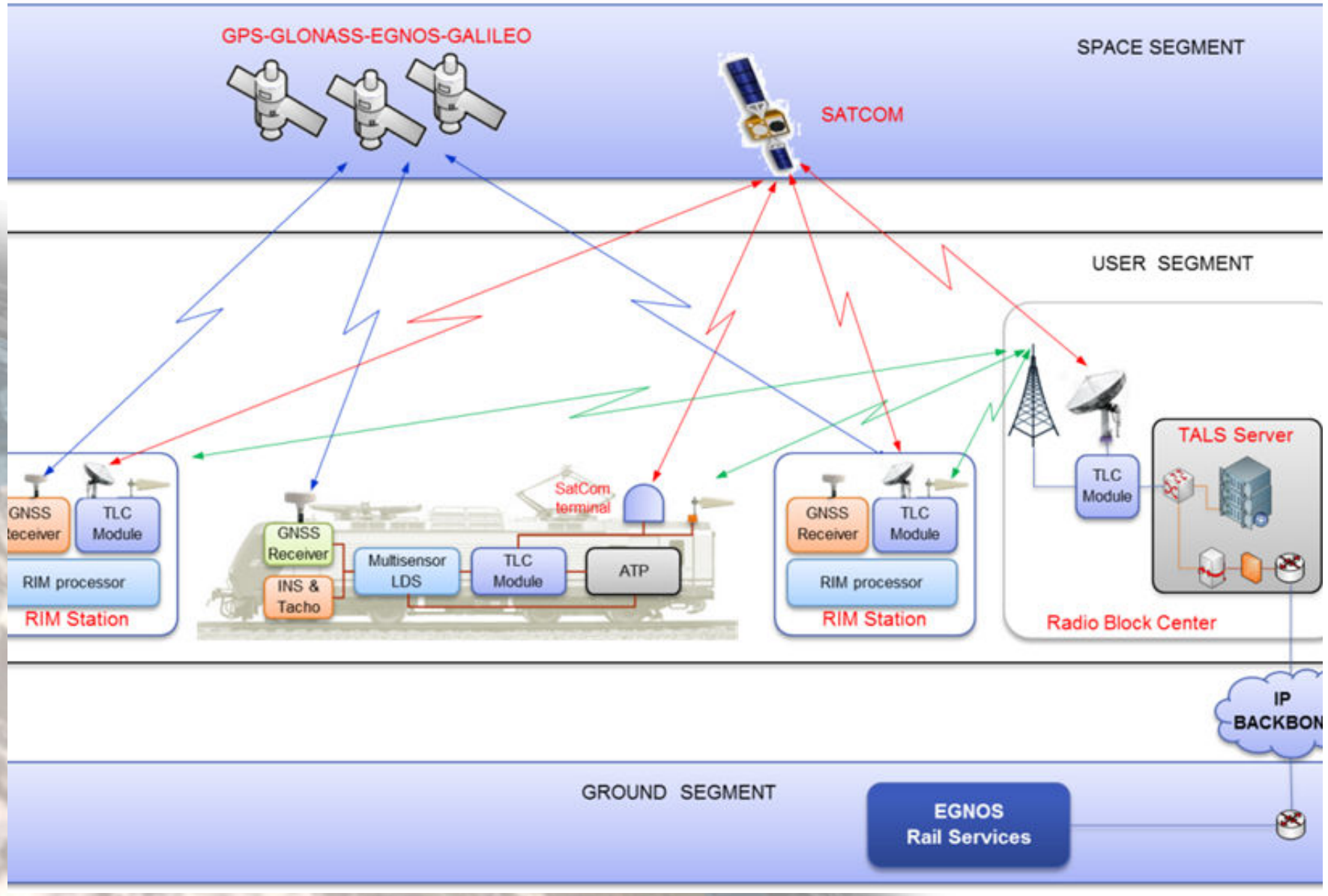
✓ Increased network capacity/efficiency

✓ Lower capex & operational costs

Prioritary applications

Local lines, low-traffic ,Regional lines, new freight lines on a world-wide level

3INSAT - Train Integrated Safety Satellite System



3INSAT - Train Integrated Safety Satellite System

The function of train localization is distributed among the following elements:

1. Space segment (GPS, GALILEO, GLONASS constellations + EGNOS + SATCOM)
2. Augmentation and Integrity Monitoring network
3. on board unit (multiconstellation GNSS receiver+Multisensor Localization Determination System (LDS))

The primary task of the space segment is to provide the reference satellite signals needed for train position computation as well as to distribute real time corrections related to satellite ephemerides, clock offsets, propagation delays, and Signal In Space (SIS) integrity.

The (Track Area) Augmentation and Integrity Monitoring Network plays a role similar to the EGNOS Range and Integrity Monitoring subsystem and, in fact, it will be deployed only on those areas out of EGNOS footprint.

The Localization Determination System (LDS) unit computes the train position by using the GNSS signal, the augmentation information for integrity monitoring and the data from other sensors as Inertial Navigation Systems (INS) and tachometers.

3InSat - The Test Site – Olbia-Cagliari railway line

3InSat features for satellite assets validation on the test site:

- Total length: approximately 50 km
- Double track: to test train localization on parallel tracks
- Satellite localization system at SIL-4 level
- Multi-bearer TLC network
- Augmentation network validation
- Test Procedures validation
- Independent assessment by a NoBo (Italcertifer)

Possible future evolutions of 3InSat, including tests on ERTMS using satellite based localization, are under discussion

The EU's GNSS action plan

- **The Goal:**
  - Accelerate the development of GNSS applications and the adoption of EGNOS (and GALILEO)
  - Increase the European share of the GNSS application market

- **Proposals for EU's actions came from** :
  - 2006 Green paper on the applications of satellite navigation
  - Several market studies and CBA
  - Analysis of results of call for ideas for the European Satellite Navigation Competition, or calls for research proposals (FP6 and FP7)

⇒ **The number of domains of action is huge !**

The GNSS actions

- **24** actions to be implemented by the Commission with the assistance of the GSA:
  - A series of “horizontal” actions, by nature cross-cutting, to foster GNSSs pervasiveness
  - A series of actions in priority domains

- Type of actions :
  - Certification, standardization, and coordination activities
    - **Actions 1 to 6**
  - Information dissemination, information exchange, and awareness-raising campaigns
    - **Actions 7 to 11**
  - Regulatory measures (mainly for road transport)
    - **Actions 12 to 15**
  - Fund-raising for GALILEO or EGNOS-based innovation to develop applications
    - **Actions 16 to 24**

Six priority domains

1: LBS

2: Road transport

3: Aviation

4: Maritime transport

5: Environment and agriculture

6: Civil protection and surveillance

Galileo the new European strategy to exploit space potentials

Space activities and explorations generate a consistent fallout on our society, affecting our daily life and promoting scientific research and technological innovation, the two major driving forces in the more advanced economies.

European authorities endorse space activities within a competitive, sustainable industrial framework (COM(2010) 614).

Space action is embodied in one of the seven Flagship Initiatives, namely 'An Industrial Policy for the Globalization Era' within Europa 2020 strategy, asking the Member States to promote innovation and devise new supporting programs, numbering the realization of Galileo and GMES projects among the most relevant international challenges.

Galileo the new European strategy to exploit space potentials

In this respect Galileo embodies the whole concept of European space policy.

Under a shared governance it is invaluable in consolidating technological research and cooperation among Member States and between EU and its Space Agency ESA.

In January 2011, the European Commission completed an intermediate revision of the SATNAV European plans. Geolocation applications market – the Commission stated – is rapidly expanding and by 2020 its estimated global value should reach the 240B euro.

As far as Galileo and GMES are concerned, due to their higher qualifications, in the next 20 years they should generate an economic direct and socially indirect revenue in the region of 60-90B euro.


Thanks
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