Galileo
an engine of innovative
Applications and Services

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GALILEO e le Infrastrutture Critiche
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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 activities
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**

- **Critical Telecom**  
  Network operators

- **Critical Energy**  
  Energy suppliers

- **Critical Transport**  
  Civil aviation

- **Strategic Activities**  
  Commercial ports

**Main operational scenarios and applications**

- Network synchronisation and timing
  - **GNSS as primary** reference clock (backed with atomic clocks)
  - Frequency calibration of radio signals (GSM base stations)

- Network monitoring and control
  - Internal oscillator management
  - Time stamping of incident
  - Synchronised measurements

- Next generation global ATM

- Vessel Traffic Management
  - Container tracking & tracing
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 & pedestrian 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
• Robust against interference/jamming
  - 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**

**Mecaoning:** 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
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 control 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
Validation & Demonstration Activities

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

Integrated solution

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

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

- **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

- **Increase market**

- **Making investments more attractive**

- **Exploit new technologies**

- **Ensure ERTMS compatibility**
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
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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 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.
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