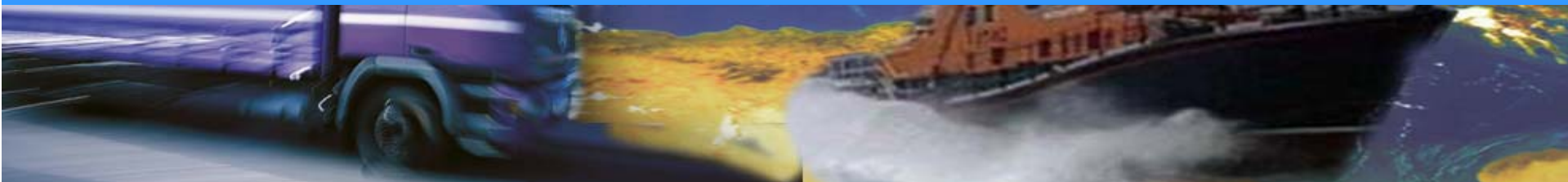


**Promote the use of
Satellite Navigation
through Applications:
Italian Initiatives**

Ing. Mario Caporale

Satellite Navigation Applications Head
Italian Space Agency





Satellite Navigation: as Application enabler

Satellite Navigation provides positioning and timing information for a great number of human applications (transport, agriculture, geodesy, environmental control, civil engineering, etc.)

Satellite Navigation acts as application “**enabler**”, involving a number of other technologies finalised to the success of the application itself.

Italy recognised since long time the potentiality of this technology in fostering many applications and have undertaken initiatives to develop pre-operational projects to pave the way to an extensive use of it.



ASI role in Satellite Navigation



The Italian Space Agency:

- Fund EGNOS and GALILEO projects (one of the four Major funders)
- Take part in the GALILEO & EGNOS European Management Boards and Technical Control Bodies
- Promote and develop National Application Projects aimed to foster the use of satellite navigation, armonizing them with Europea Projects



ASI Navigation Projects



The **national projects** answer to a specific public demand:

**Increase the Safety in the Transport Sectors
and in general improve territory safety and
security**

Satellite navigation helps to increase this safety but at the same time its use has to be suitably “protected”



The National Projects

Maritime Transport

Dangerous Goods Transport

Civil Aviation

Safety of Transport

Infomobility for Disabled People

Road Traffic and Infomobility

Safety and Security of Territory

**Infomobility
and citizen
safety and security**

SW Radio satellite navigation receivers

Applications Enablers

GALILEO TEST RANGE

Support Infrastructure



Maritime Transport Project



Context:

- Commercial transport is more and more congested on the road, causing:
 - Increase of costs
 - Increase of environmental risks



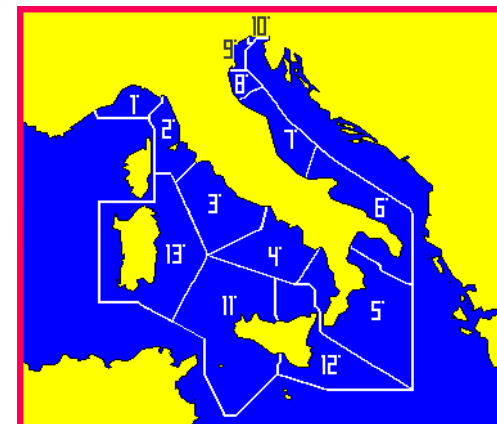
- A solution is to foster the use of maritime transport via the so called “sea highways”. The efficiency of the system, then, is strongly depending on the efficiency of ports.
- 92% of sea rescue services done by CoastGuard are related to sea personal navigation.
 - Adverse Meteorological conditions
 - Lack of sufficient information when requesting the rescue





Maritime Project: Sea Highways

- Improve the efficiency in approaching the ports and doing manouvres, respecting safety:
 - Automatization based on satellite navigation services
 - Service Guarantee on position data and service continuity via use of local augmentation systems
- Application products supporting the port manouvres (in and out):
 - Allow to experiment automation procedures through the use of satellite navigation
- Integration of more functions in a single terminal:
 - Multi-system satellite navigation (GPS and Galileo)
 - Augmentation of satellite navigation and integrity monitoring
 - Communications
 - A Service Center provides information, supervision and planning services.





Maritime Project: Personal Navigation



These applications are centered around:

- **Normal conditions: information system**
 - Virtual Radar
 - Reception of information via VHF coastal stations
 - VTS-AIS data decoding activated only for user surrounding area (authentication based on satellite navigation signals)
 - Dedicated Meteo forecast and maritime mapping info
- **Active Control Function**
 - CoastGuard tracing
 - Pre-alarm emission in case of anomalies
 - Provision of alternative routing in case of adverse meteo conditions
- **Emergency Situations**
 - Launch of rescue requests (VHF)
 - Indication of positioning and ship category in case of trouble



Hazmat Transportation Risk

The **Management of Dangerous Goods (HAZMAT) Transportation** is a challenging aspect, which can significantly benefit of the use of **new technologies**, among which satellite navigation and communication.

Management Phases

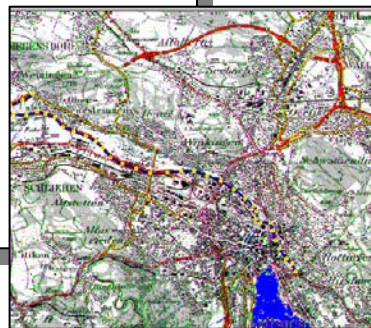
Knowledge & prevention

Analysis:

- Vulnerability
- Hazard

Decision:

- Prevention
- Mitigation



Emergency

Analysis:

- Damage (type, size)
- Emergency Response (potential)

Decision:

- Response
- Recovery



Sustainable D.G. Transportation System

A WIDE AREA SYSTEM for Monitoring, Management and Control of Hazardous Goods Transportation

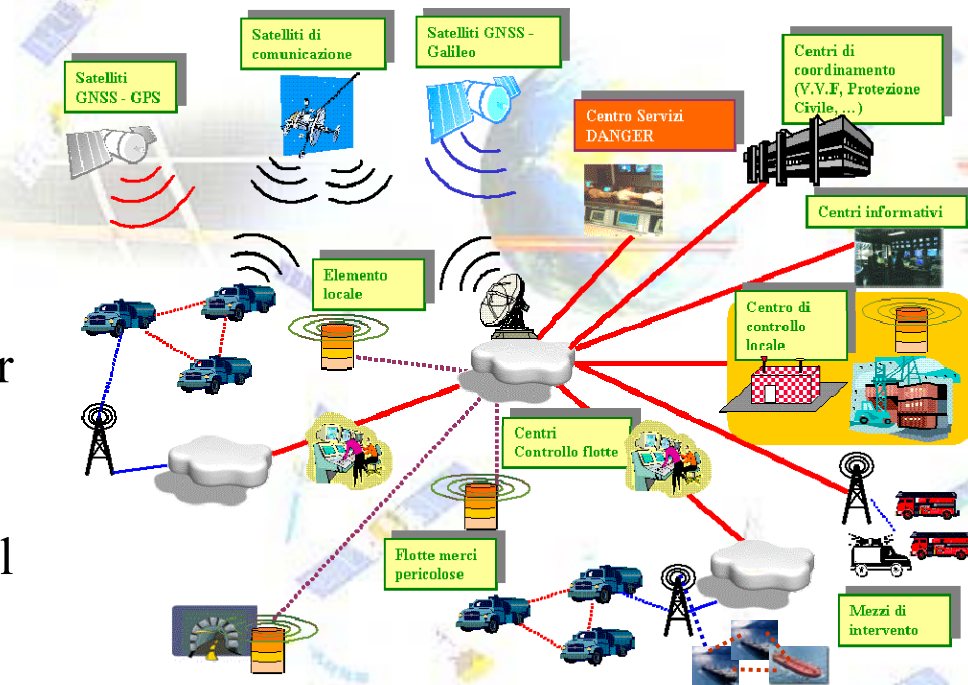
in multi-modal (road, rail, and inland waterways) transport

Major AIMS:

Monitoring: collection, processing and distribution of information to relevant users

Management: use of information for planning purposes

Control: optimisation of operational aspects associated with the transport

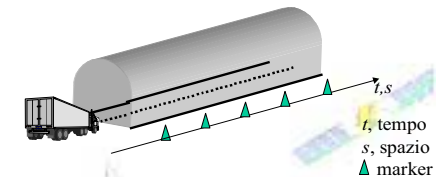
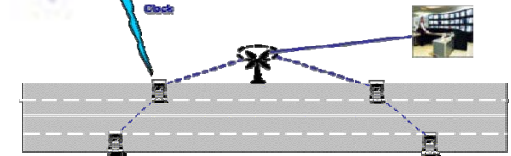




Hazmat Transportation Project



- Major Products:
- **SW Radio on board integrated terminals:**
 - multi-system capabilities (GPS + Galileo)
 - use of local augmentation systems
 - communication components
- **Local Elements for:**
 - navigation performance augmentation
 - positioning certification, dedicated data exchange, interference monitoring, assisted services, etc.
- **Pseudolites for service continuity (eg. tunnels)**
- **Hybridized system for road and river navigation**
- **Drive control algorithms, communication channels optimisation, conflicts management**





Civil Aviation Programme

After a first phase during which ASI launched preliminary projects on the use of satellite navigation in civil aviation, focussed on the main areas:

- en-route navigation and communication control;
- landing and take-off assisted by satellite navigation;
- Control of surface vehicle movements in airport area.



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.



Civil Aviation Programme: SENECA

(Satellite Navigation services for Civil Aviation)

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



Civil Aviation programme: SENECA (Satellite Navigation services for Civil Aviation)

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



Applications to infomobility of Disabled people

Objectives:

Develop and experiment infomobility services for disabled people (blind people, handicapped in movement, etc.)

Special paths will be developed as well to favour mobility in public structures (University areas, Stations, etc),



Integration of various components and techniques to get navigation data with continuity, even in reduced visibility conditions.

The Service Centre should be very innovative in order to promptly respond to user requests, performing tasks shared with the user terminal.



Applications to infomobility of Disabled people: Services

3 level of Services are conceived

– Base Services

- standalone Terminal, outdoor, off-line updates

– Increased Services

- Better accuracy and availability (A-GPS, INS, indoor localisation) and updates from remote

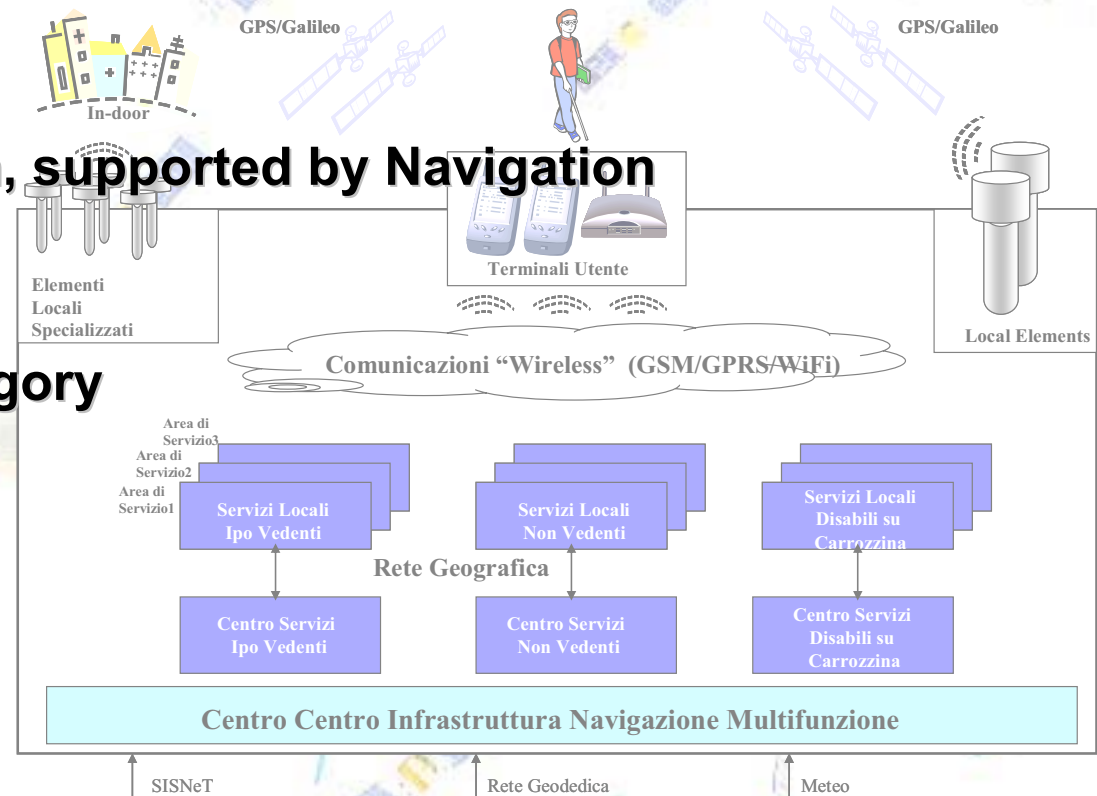
– Interactive Services

- Included health sensors for remote monitoring



Applications to infomobility of Disabled people: innovation

- Algorithms to improve accuracy, availability and integrity
 - Use of A-GPS and INS
- Safe access to the Platform, supported by Navigation
 - Safe paths – driven user
- HMI Interface per user category
- Local Obstacle Detection
 - Sensor Integration
- Seamless NavCom
 - Continuity along areas where GNSS signals are not available (indoor, urban canyon,...)





Road Traffic and Infomobility Project

Objectives:

- Road Tolling and Access Control
- Traffic Monitoring and control
- Emergency response



Social and commercial benefits:

- Pollution reduction, traffic jam decrease
- Better use of road infrastructures
- Safety increase
- Prompt emergency response





Road Traffic and Infomobility Project: Innovation

- Satellite navigation local elements to improve:
 - **accuracy**
 - **availability**
 - **Integrity**
- Service center development
- User terminals
- Typical cases areas
 - **Urban roads with access control, highways paths, parking areas, urban canyons, tunnels, underways,...**
- Safety & Security
- Scalability and relocability of System



Road Traffic and Infomobility Project: Use of satellite navigation

- Combined use of GPS, EGNOS and the potentialities of GALILEO (even if not completely available during the project timeframe)
- Innovative communication solutions (sustainable communications cost)
- Guarantee of Positioning and its continuity.
- Hybridisation



Safety and Security of Territory

Objectives:

Develop services for Administrations and Forces involved in Safety and Security of Territory.

Pave the way for the effective use of PRS GALILEO.



The Services are aimed to develop specialised receivers which make the best use of satellite navigations.

The approach is aimed at technologies integration (satellite navigation with secure telecommunications and earth observation).



Safety and Security of Territory: Applications

- ✓ Police, Intelligence, Civil Defense, Defense, ecc.
(national security, peace keeping)
- ✓ A limited number of organizations operating critical infrastructures (energy distribution, electricity, telecommunications, bank networks, etc.)
- ✓ A limited number of organisations aimed to control persons and value goods



Safety and Security of Territory: Infrastructures

- Infrastructures will be developed to allow operational use of PRS according to safety and security procedures agreed at European level
 - ✓ **Monitoring and management of PRS receivers and associated technologies**
 - ✓ **User Groups management**
 - ✓ **key management**
 - ✓ **Service Denial**
 - ✓ **Monitoring and localisation of disturbing sources for the navigation signals**
 - ✓ **Interaction with European infrastructures related to the suitable use of shared GALILEO resources.**



Software Radio SatNav receivers

Objectives:

Experiment architectures, algorithms and software modules to develop innovative receivers for satellite navigation based on SW Radio technologies.

The aim is to get high flexibility on the architectures and specialization of terminals in relation to specific application requirements.

The first Stage of the Project is developing a Base Model of a general GNSS receiver architecture in SW radio architecture is being developed.

The Base Model will have an open and modular architecture (SCA standard) to allow reconfiguration in order to represent different categories of growing complexity (from a simple single signal receiver to a complex multi-signal, multi-system receiver).



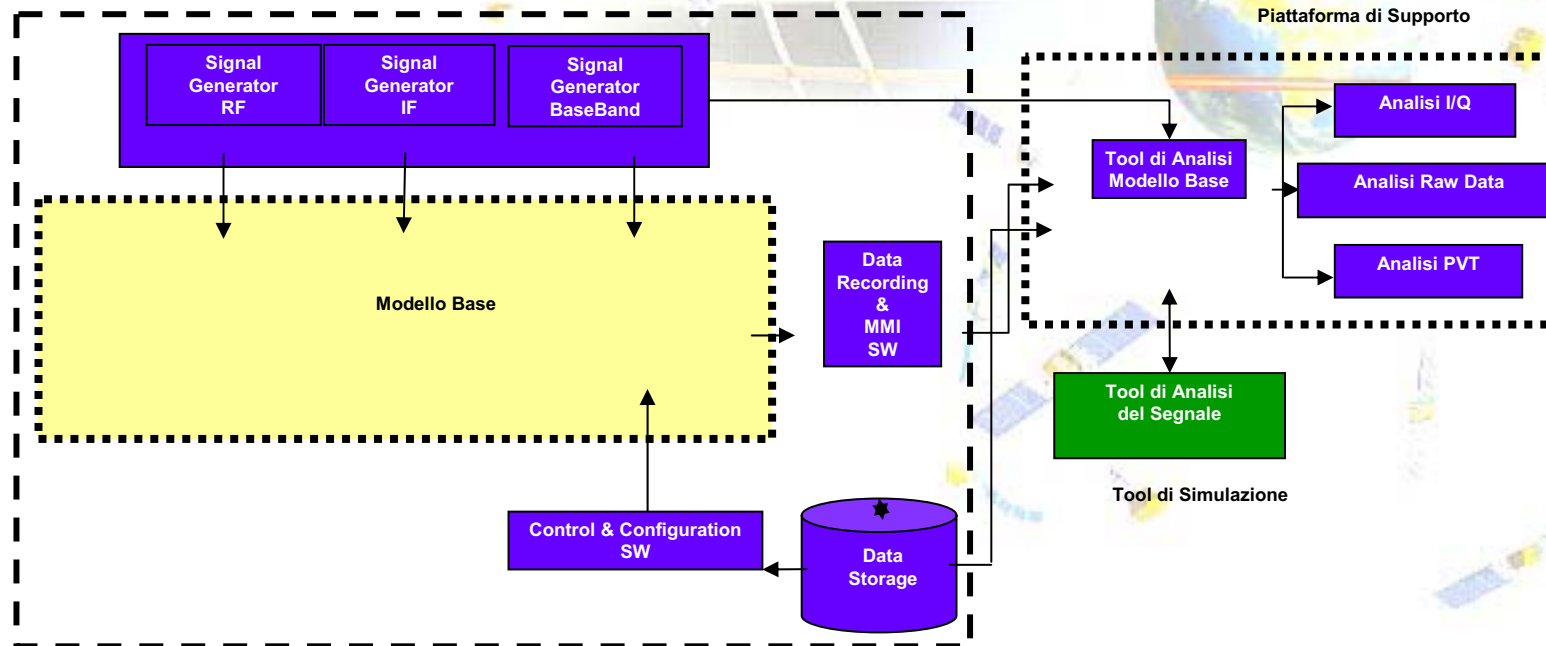
Software Radio SatNav receivers

A Support Platform is being developed which allows to generate real-time and non-real time signals in input to the Base Model.

The Support Platform is mainly constituted by 3 major blocks:

- o Signal generator
- o MMI & data storage
- o Monitoring and performance Analysis tool

Piattaforma di Supporto





The GALILEO TEST RANGE

The Galileo Test Range is a geographical infrastructure which allows for a number of supports in Satellite Navigation programs:

- Emulation of Galileo signals generation;
- Perform GNSS signals analysis and performance evaluation;
- Support development of GNSS standards, validation of Terminals;
- Sustain development of innovative applications and services of satellite navigation.

The Galileo Test Range has been developed in its First Stage by Regione Lazio and ASI is going to bring this facility to its full development in the Second Stage of development.

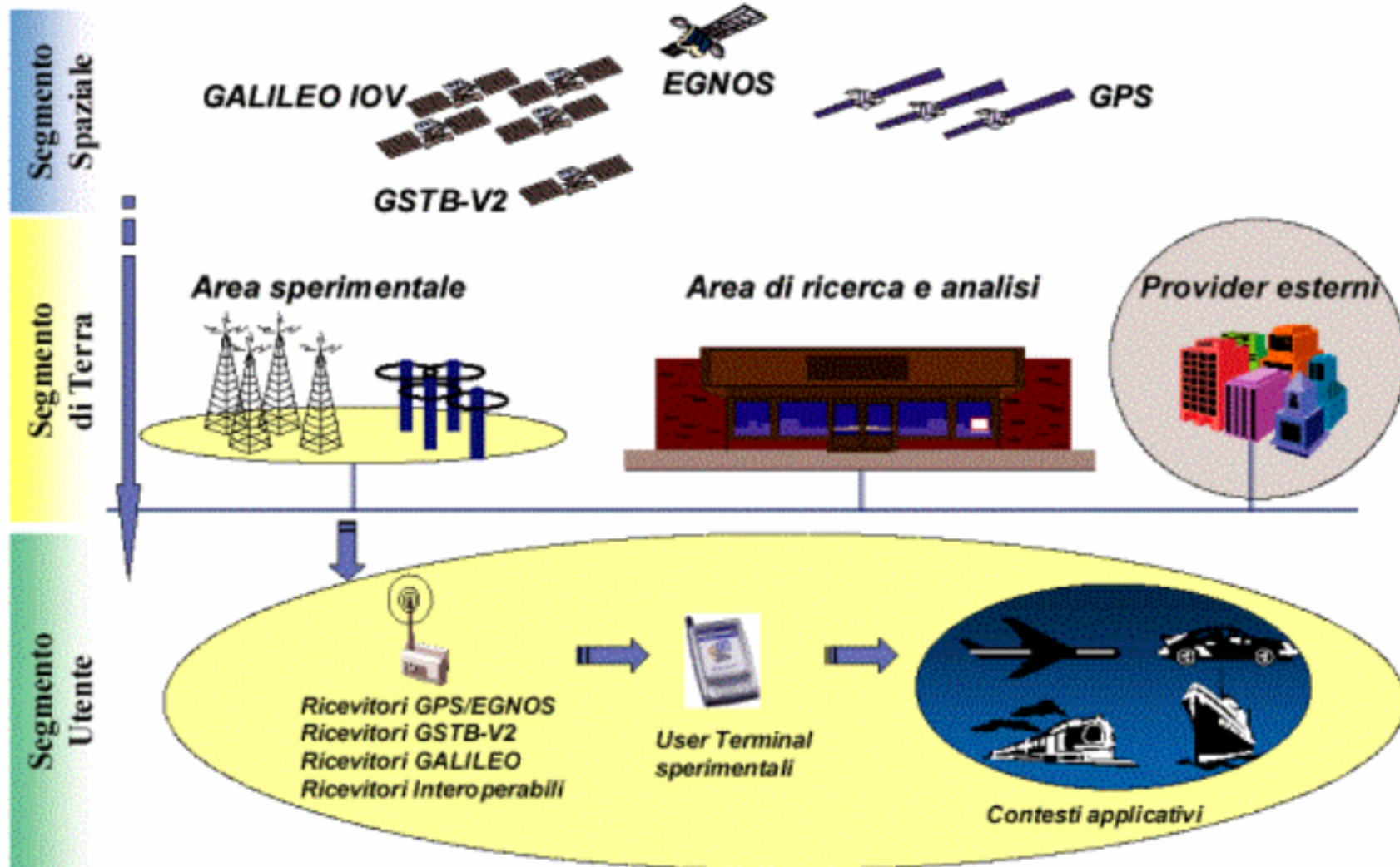
Location of main infrastructures is South-East of Rome

Capability of relocation for pseudolite networks to allow deployment in other geographical regions.



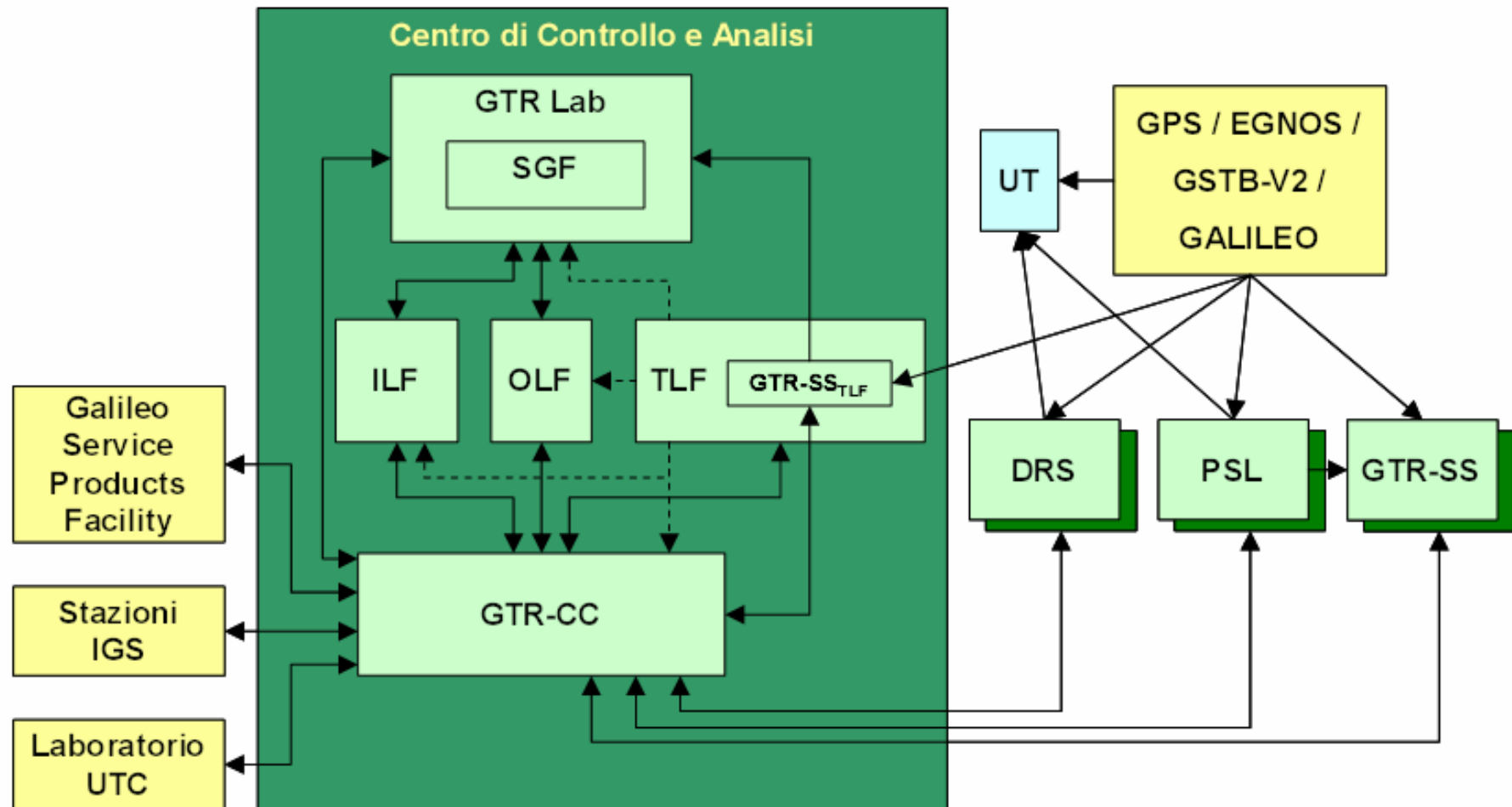
The GALILEO TEST RANGE: Architecture

Architettura GTR





The GALILEO TEST RANGE: Block Diagram





The geographical Area of GTR

GTR geometric visibility area

