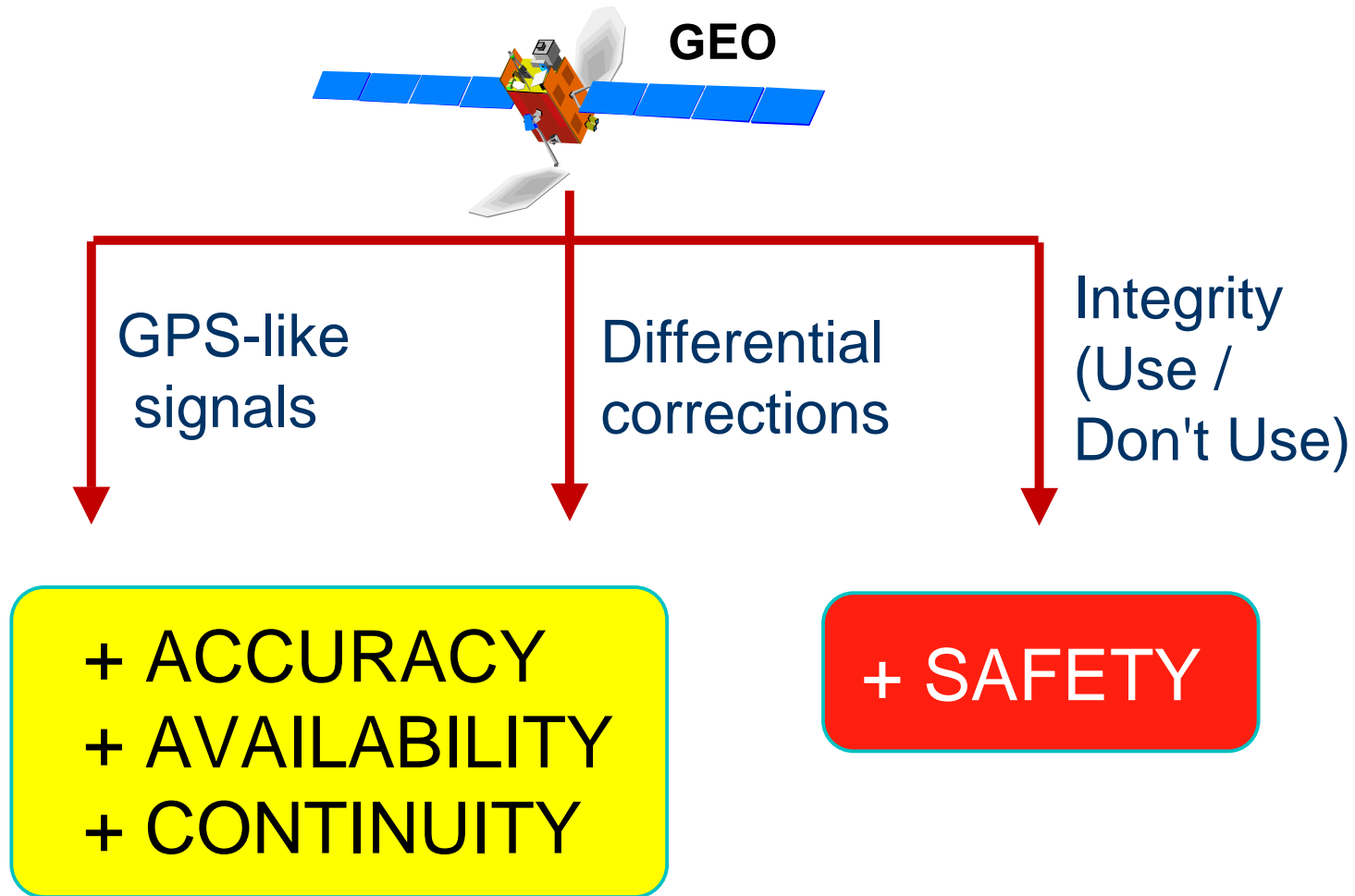# EGNOS/GALILEO Status

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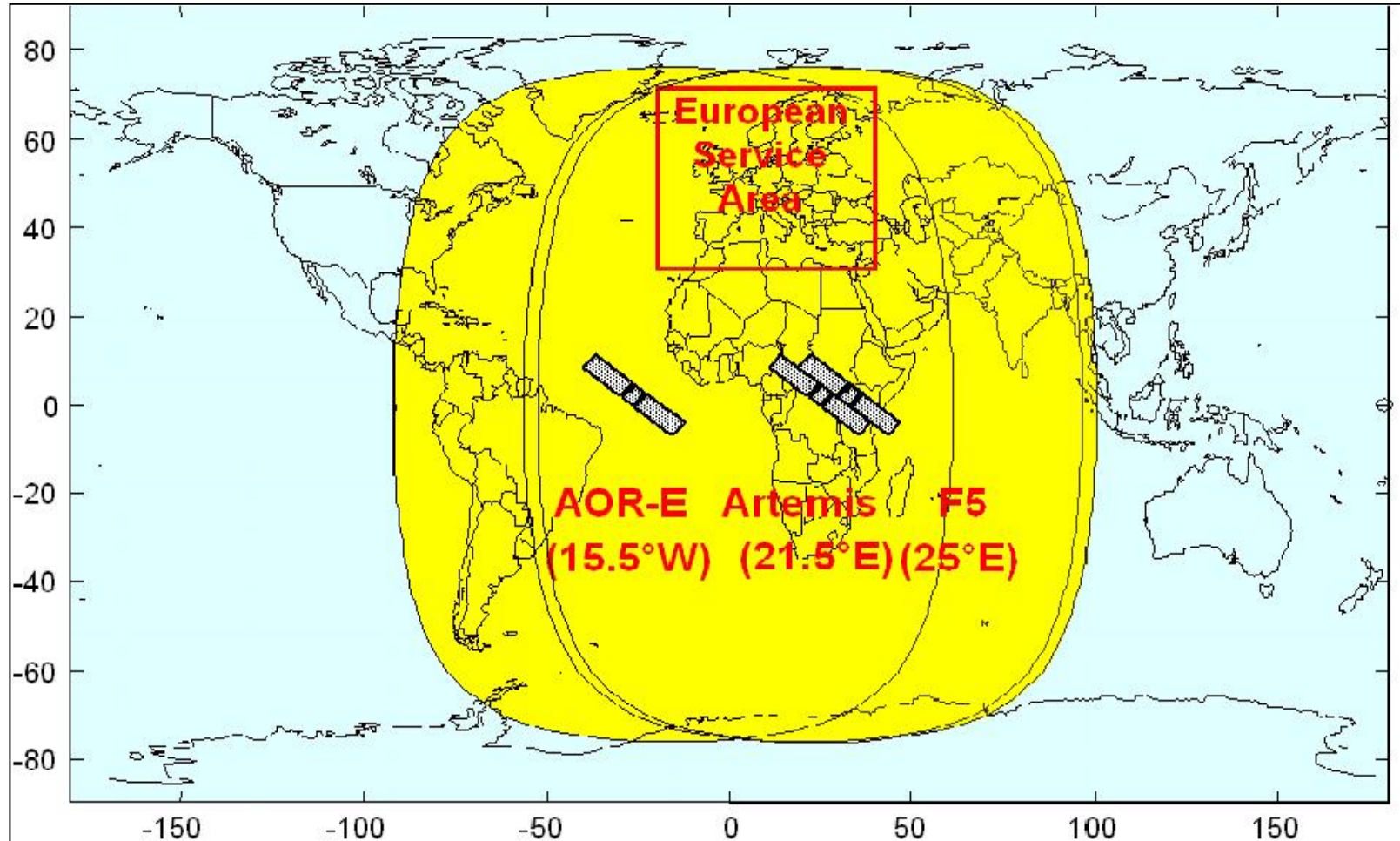
European Satellite Navigation Strategy

- GNSS1: EGNOS
  - Civil complement to GPS and GLONASS
  - Improves integrity, accuracy, availability.
  - Regional coverage with extension capabilities
  - Compatibility and Interoperability with current systems and planed evolutions.

- GNSS2: GALILEO
  - European Autonomous Civil system open to international cooperation.
  - Global coverage
  - Service guarantees
  - Compatibility and Interoperability with current systems and planed evolutions.

EGNOS Services Overview

GEO

GPS-like signals

Differential corrections

Integrity (Use / Don't Use)

+ ACCURACY
+ AVAILABILITY
+ CONTINUITY

+ SAFETY
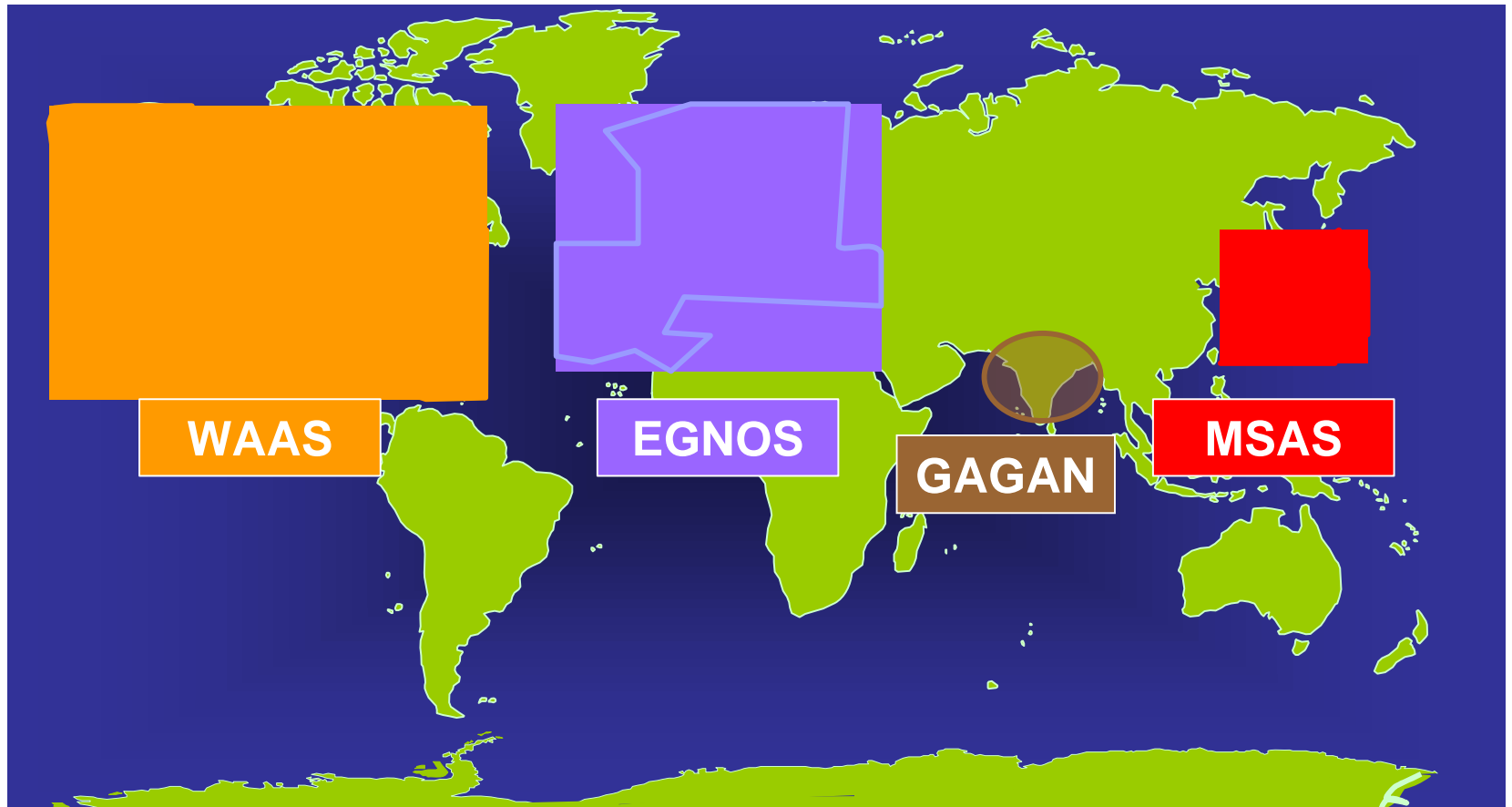
EGNOS will broadcast from 3 Geostationary satellites

EGNOS is fully interoperable with other SBAS services...

WAAS

EGNOS

GAGAN

MSAS

EGNOS Deployment
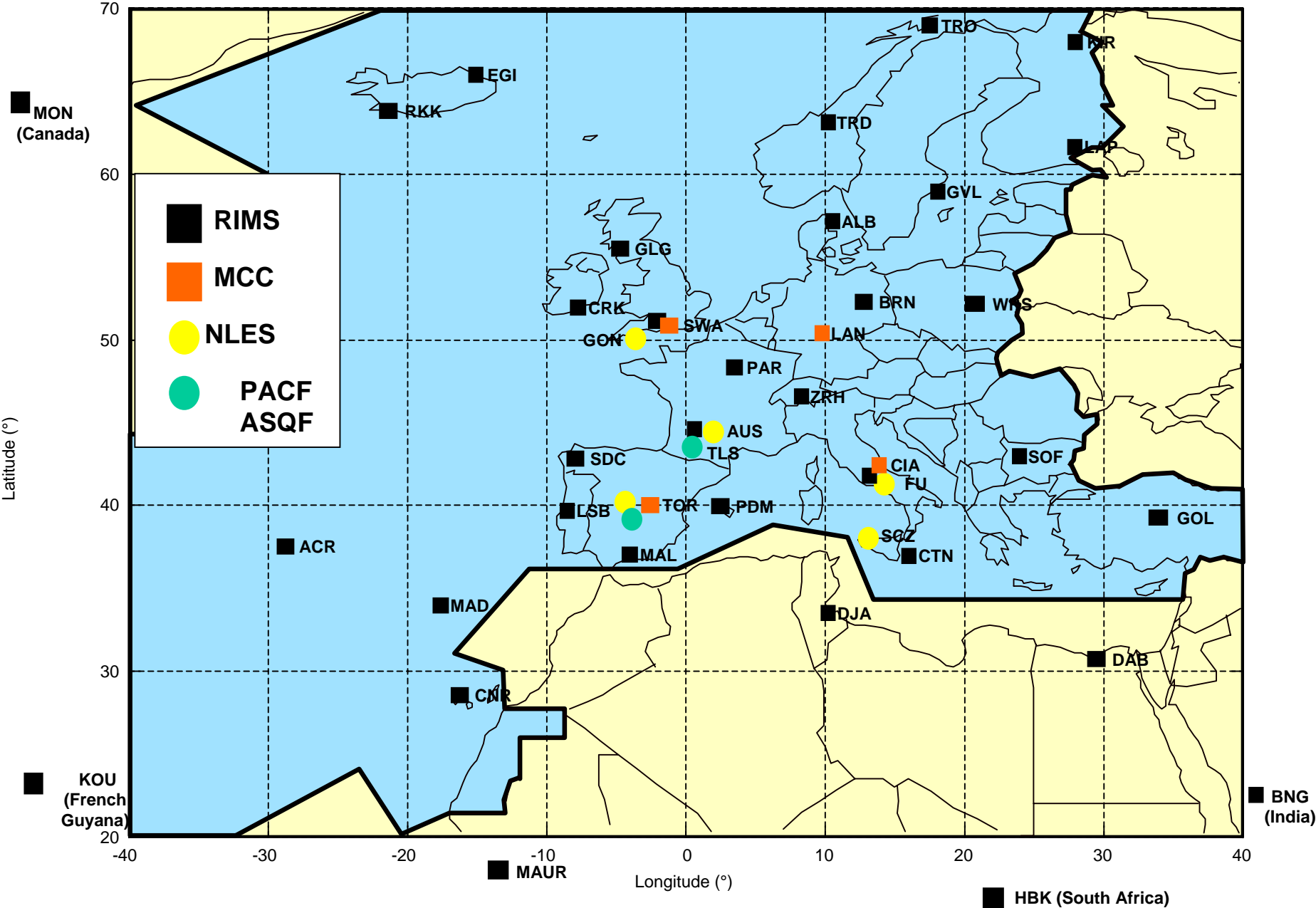
EGNOS Implementation – Master Schedule

99 00 01 02 03 04

System Detailed Design — PDR, CDR

System HW/SW Developments

Site Preparation

System Deployment — SIS

System Technical Validation — TQR, ORR

System Operational Validation

EGNOS TEST BED (ESTB)
Development
Operations

esa · EGNOS · GALILEO

EGNOS System Test-Bed (Egnos Prototype)

Many application projects in Europe have used the ESTB to develop early experience on the use of EGNOS.

Trial campaigns have been extended to other locations world-wide:

- **Supports interoperability**
- **Characterization of iono. effects.**

GALILEO: a satellite navigation system of next generation

30 satellites including 3 in-orbit spares

altitude 23616 km

inclination 56 deg

Period: 14 hr 22 min
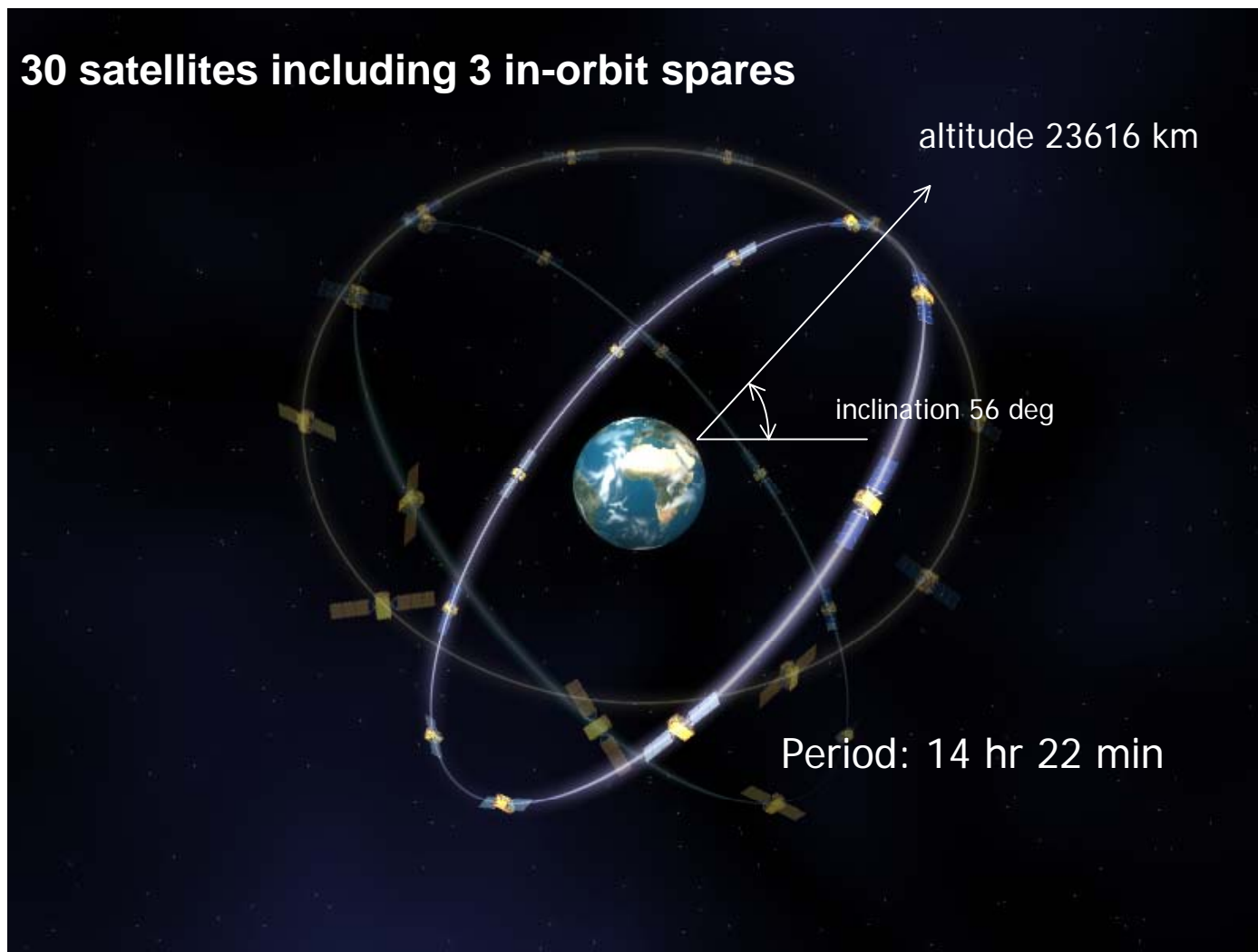
GALILEO services

- **Open Service**
  - Mass-Market applications not requiring guarantees.
  - As accurate as conventional differential GPS but without requiring additional ground infrastructure.
    - Horizontal Accuracy: 4 meters, 95% confidence
    - Vertical Accuracy: 8 meters, 95% confidence

- **Safety of Life Service:**
  - Guaranteed service for Safety-of-Life applications
  - Integrity Alerts

- **Commercial Service:**
  - Professional use.
  - Guaranteed service in return of a fee.
  - System capabilities introduced to foster application with commercial interest (additional navigation signals, low-data rate broadcasting capacity).

GALILEO services

- ## Public Regulated Service:
  - Police, coast guards, customs, strategic civil infrastructure…
  - Access to the service to government authorized-users only.

- ## Search and Rescue Service:
  - Relay of distress alarms to improve existing relief and rescue services.
  - Interoperability and Compatibility with other systems under development (GPS, GLONASS).

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EGNOS
European Geostationary Navigation Overlay Service

GALILEO

Galileo Satellite

- No apogee motor
- AOCS is capable to shift the orbit position of the S/C (spare S/C)
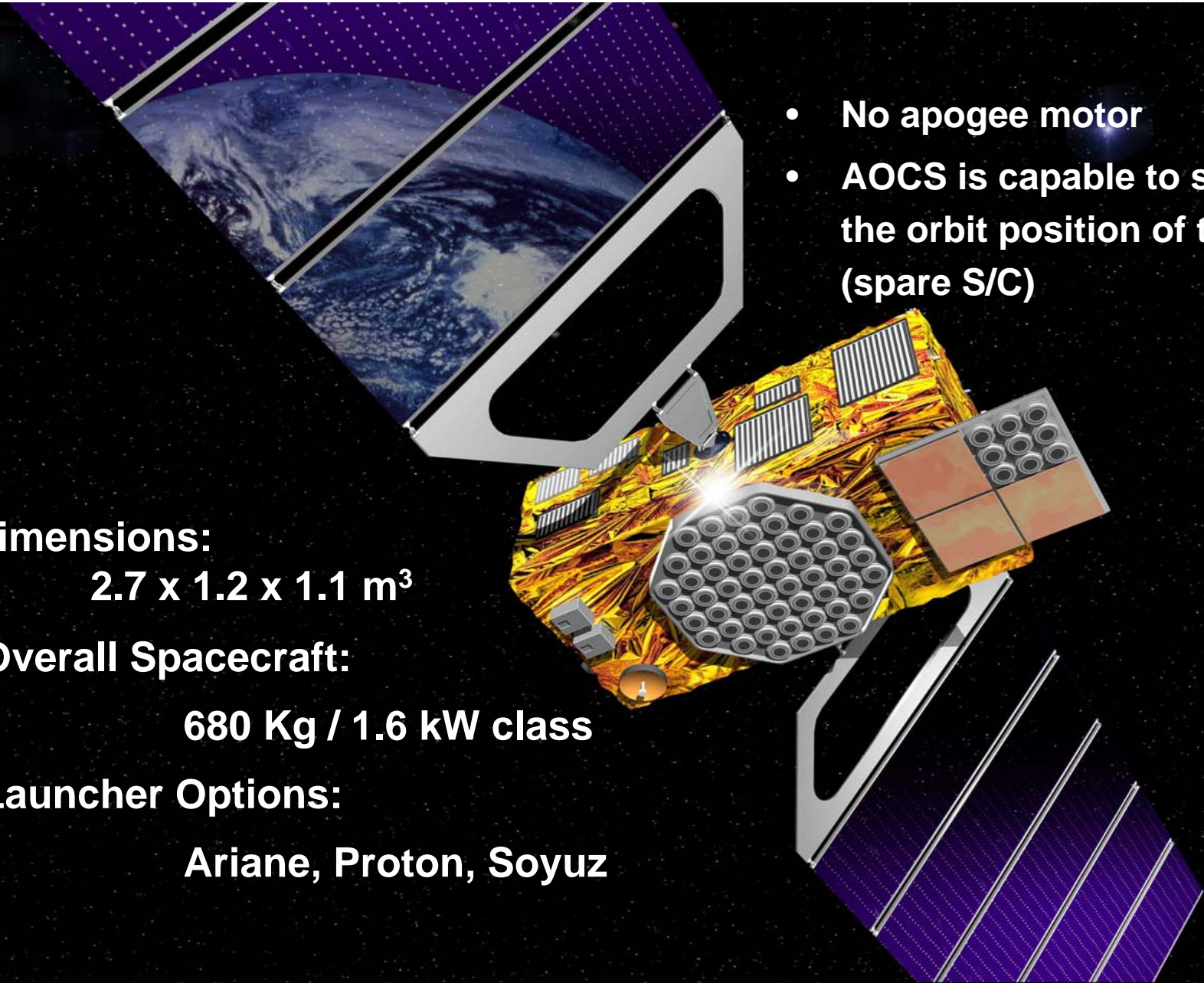
Dimensions:

   2.7 x 1.2 x 1.1 m^3

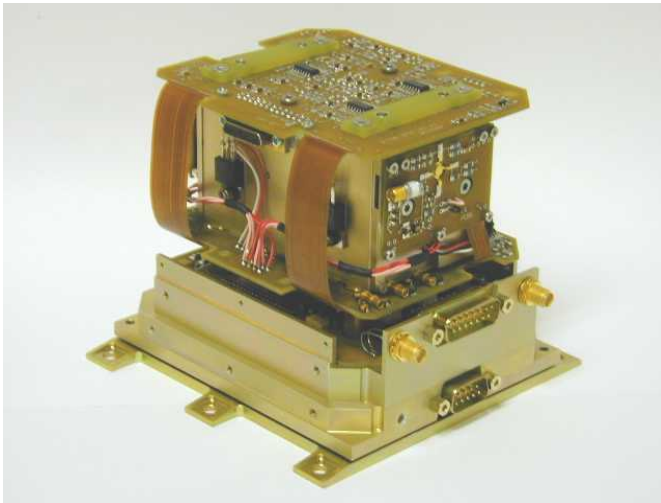**Overall Spacecraft:**

   680 Kg / 1.6 kW class

Launcher Options:

   Ariane, Proton, Soyuz

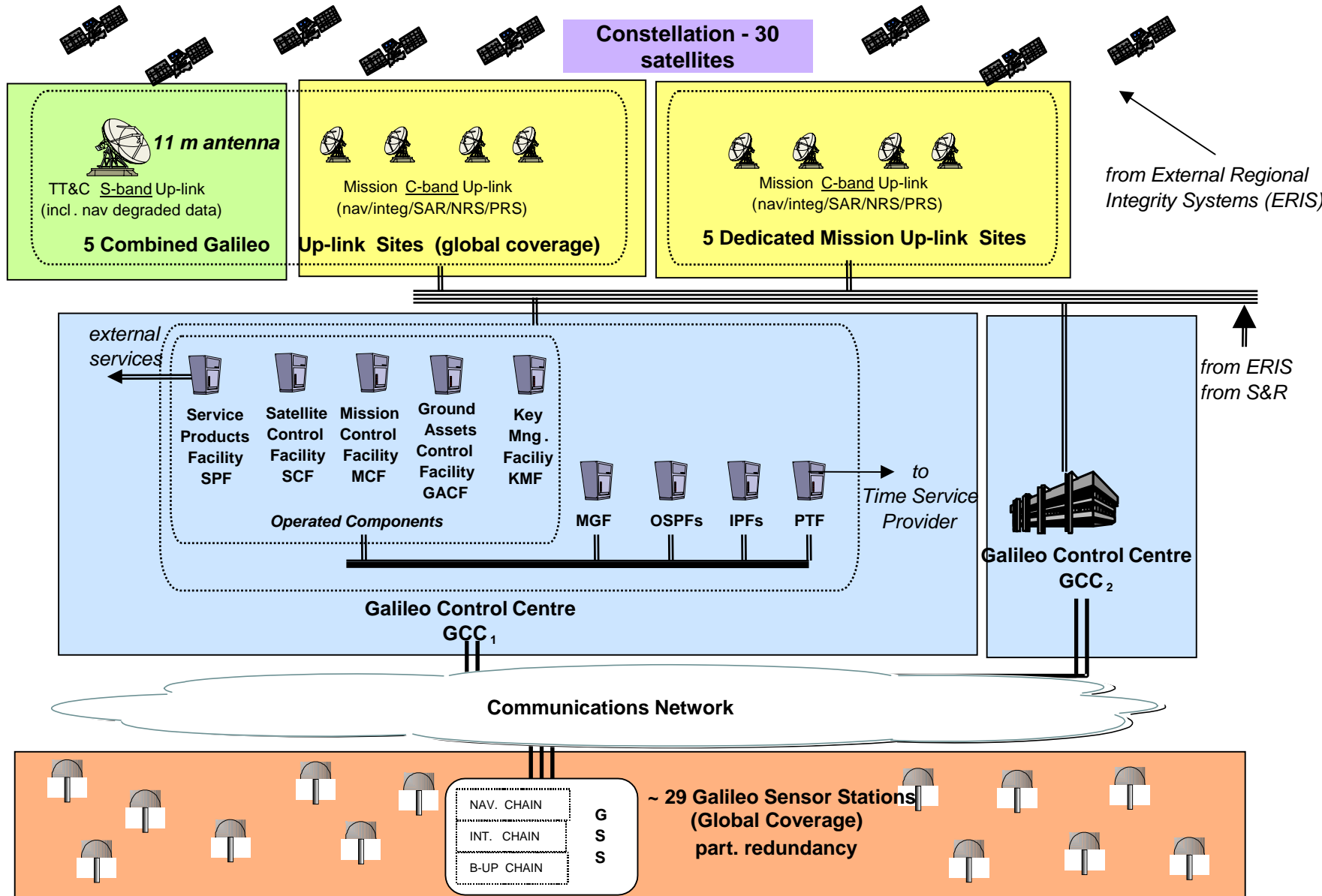# Galileo satellites will carry ultra-stable atomic clocks: 2 Rubidiums and 2 H-Masers

Hydrogen Maser
(less than 1 nsec per day)
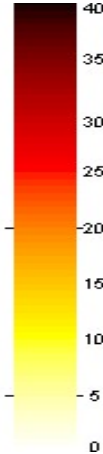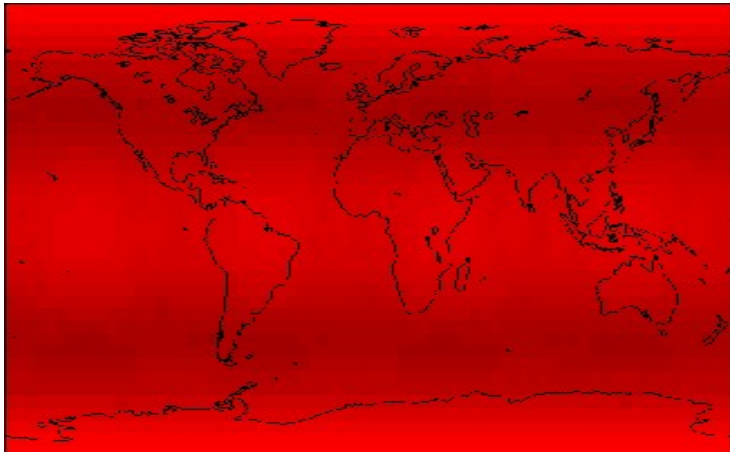

Rubidium Standard
(less than 10 nsec per day)

GALILEO

Overall Architecture

Constellation - 30 satellites

from External Regional Integrity Systems (ERIS)

11 m antenna

TT&C S-band Up-link
(incl . nav degraded data)

5 Combined Galileo Up-link Sites (global coverage)

Mission C-band Up-link
(nav/integ/SAR/NRS/PRS)

Mission C-band Up-link
(nav/integ/SAR/NRS/PRS)

5 Dedicated Mission Up-link Sites

from ERIS
from S&R

external services

Service Products Facility SPF

Satellite Control Facility SCF

Mission Control Facility MCF

Ground Assets Control Facility GACF

Key Mng . Faciliy KMF

Operated Components

MGF   **OSPFs**   **IPFs**   **PTF**

to Time Service Provider

Galileo Control Centre GCC$_2$

Galileo Control Centre GCC$_1$

Communications Network

NAV. CHAIN

INT. CHAIN

B-UP CHAIN

G S S S

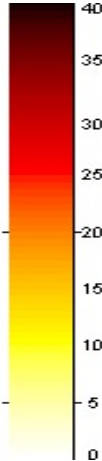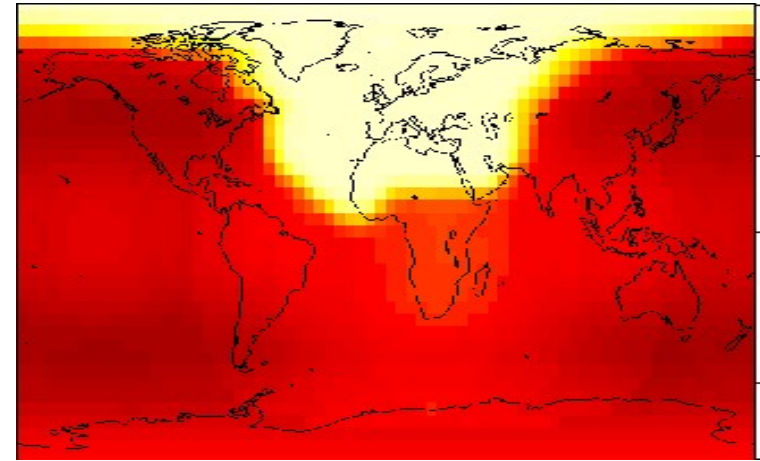**~ 29 Galileo Sensor Stations (Global Coverage) part. redundancy**

Horizontal Accuracy (95%)

GPS

GPS/EGNOS

GPS/EGNOS/Galileo
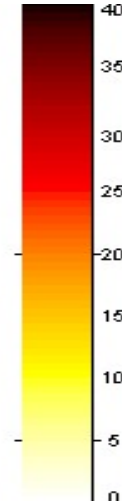
Increased accuracy, integrity and _availability_ worldwide

Search And Rescue/Galileo

Acknowledgment

GALILEO Up-Link

GALILEO Control Center

SAR MEOLUT

Alarm

Search and Rescue Mission Control Center

Rescue Coordination Center
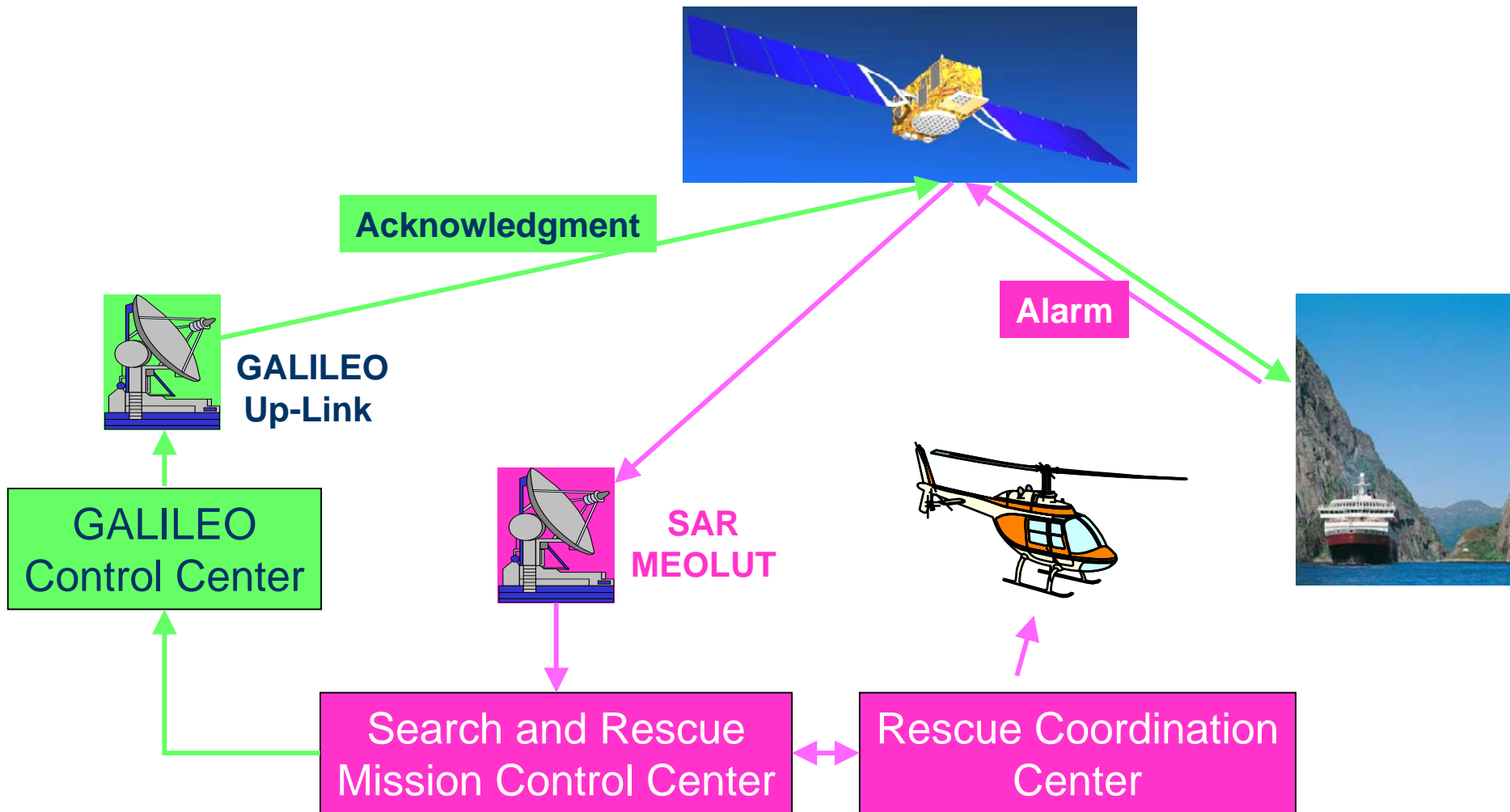
GALILEO Schedule Status

- **Experimental satellite to be launched in 2005.**

- **First block of 3 to 4 operational satellites will follow:**

  - In-Orbit validation of the system with operational satellites and ground segment.

- **Rapid Deployment of operational system**
  - Two years
  - Use of multiple launches (8 satellites with Ariane)
  - Extension of already deployed IOV ground segment

EC/ESA joint effort for GNSS applications

- EC and ESA launched about 100 projects/studies aimed to assess the GNSS applications and services from different point of views.

- Others projects and studies will be funded by EC/ESA and Galileo Joint Undertaking in order to prepare the EGNOS and Galileo User Community and corresponding market.

On-going EC/ESA projects/studies

- **Rail** (13 projects): a big effort is made to demonstrate the potentiality of GNSS for safety improvement in this domain and support to European Standards;

- **Road** (22 projects): projects aimed to introduce GNSS on car guidance, fleet management, road charging and advanced future technology for intelligent nav.;

- **Maritime** (14 projects): control/monitoring of dangerous goods transportation, harbor safety critical maneuvers, in-land waterway navigation, support to IMO standards for vessels Automatic Identification System (AIS);

- **Personal Nav** (21 projects): GNSS/Mobile phone integrated solutions for "location based services", emergency call, civil protection personnel/assets management, blind support, child/people tracking;

- **Aviation** (8 projects): classical navigation for aviation, airport ground movement management, helicopters nav, support to international standards;

- **General**: "horizontal" issues like standards, market, regulatory and legal aspects of GNSS services;

- **Others**: emerging new applications (precision farming, timing, law-enforcement).

Example: GNSS use in Rail

- Rail applications require high levels of integrity.

- This can be achieved today by:

  - Improving integrity at the expense of lower accuracy, or

  - Using combination of sensors.

- Current solutions well suited for low density lines were accuracy is not a driving requirement.

- GPS+GALILEO will bring better accuracy, integrity, availability (increased number of satellites, integrity alarms, better signals).

Example of GNSS being applied as a low cost yet "safe" alternative to automatize level crossing.
GNSS solution reduces the need for local Infrastucture.

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EGNOS
European Geostationary Navigation Overlay Service

GALILEO

Conclusions

- EGNOS will be operational next year to join WAAS and MSAT.

- GALILEO has already entered the Development and Validation Phase.

- GALILEO, EGNOS are open to international cooperation. Concrete examples: China, Africa, Mediterranean Region, India,..

- The availability of GPS, GLONASS, SBAS provides an opportunity for introducing reliable safety-critical applications.

- Higher level of accuracy, integrity, robustness, availability will be possible when GALILEO is operational making even wider the field of applications (e.g. supplemental means to sole-means).

- Important to gain experience with the current systems to be ready to benefit from GALILEO introduction.

Further Information

http://europa.eu.int/comm/dgs/energy_transport/galileo

http://www.esa.int/export/esaSA/navigation.html

http://www.galileoju.com