

Directorate-General
for Energy
and Transport

The European GNSS Programmes EGNOS and Galileo



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European Commission
14 September 2009

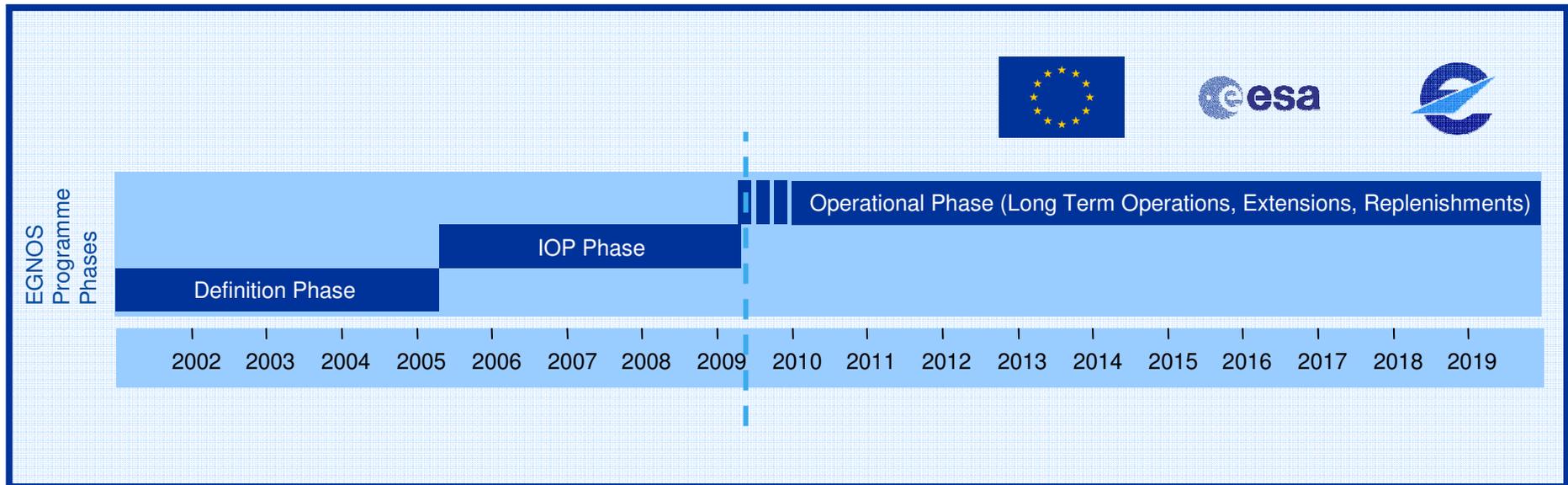


'It's there, use it'

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EGNOS Timeline

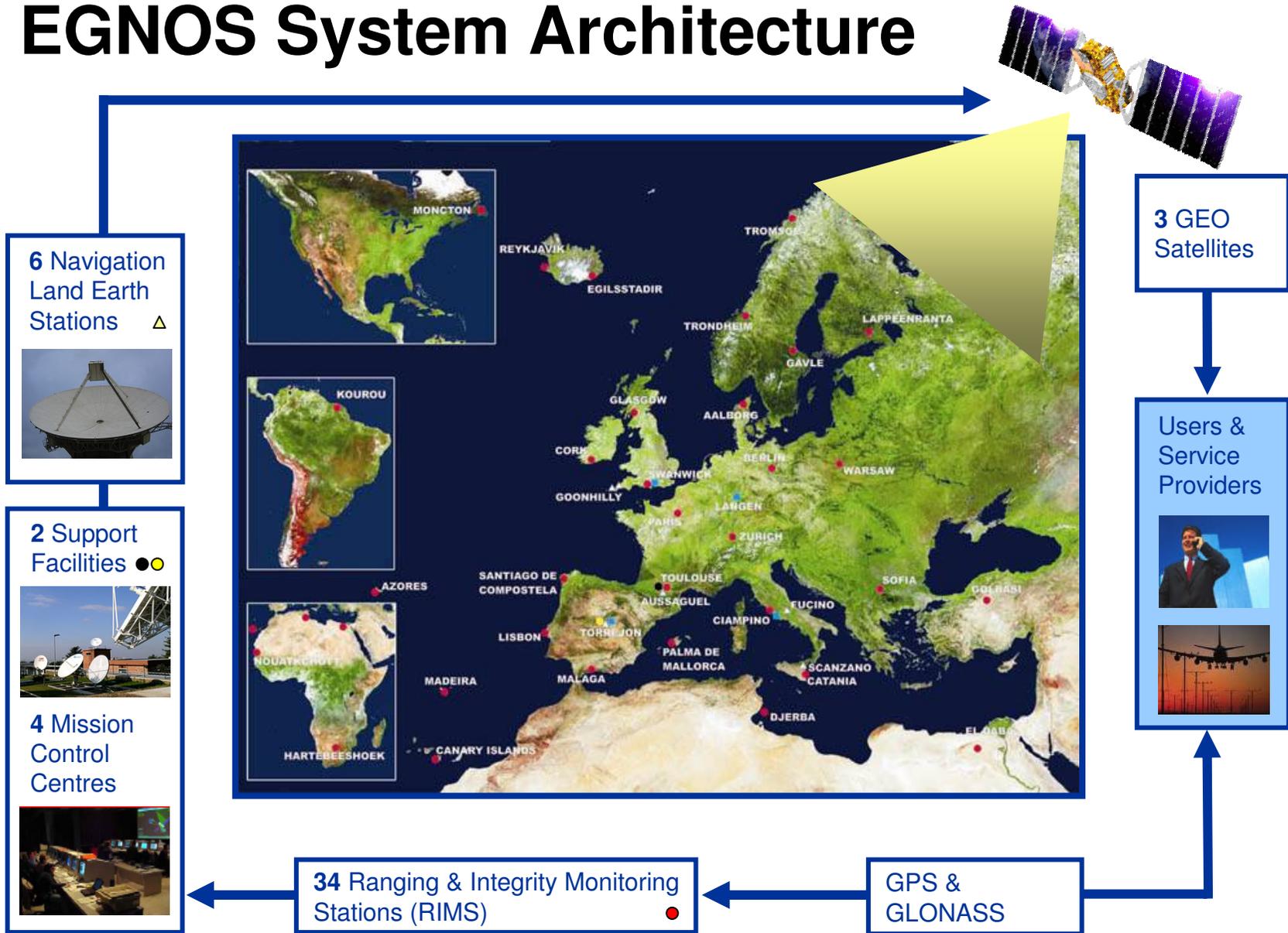


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IOP ... Initial Operations

EGNOS System Architecture



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● EGNOS Services

Service	Transmission Means	Typical User Communities	Guarantee of Service
Open Service	L1 frequency	Pedestrian, in-car navigation	None
Safety of Life Service	L1 frequency	Aviation, maritime, railway	Compliance with ICAO standards (certification)
Commercial Service (EDAS)	Ground network	Pedestrian, in-car navigation, research (e.g. atmospheric, tectonics), high-accuracy	Compliance with SLA when commercialisation will start



● EGNOS Services – Current Status

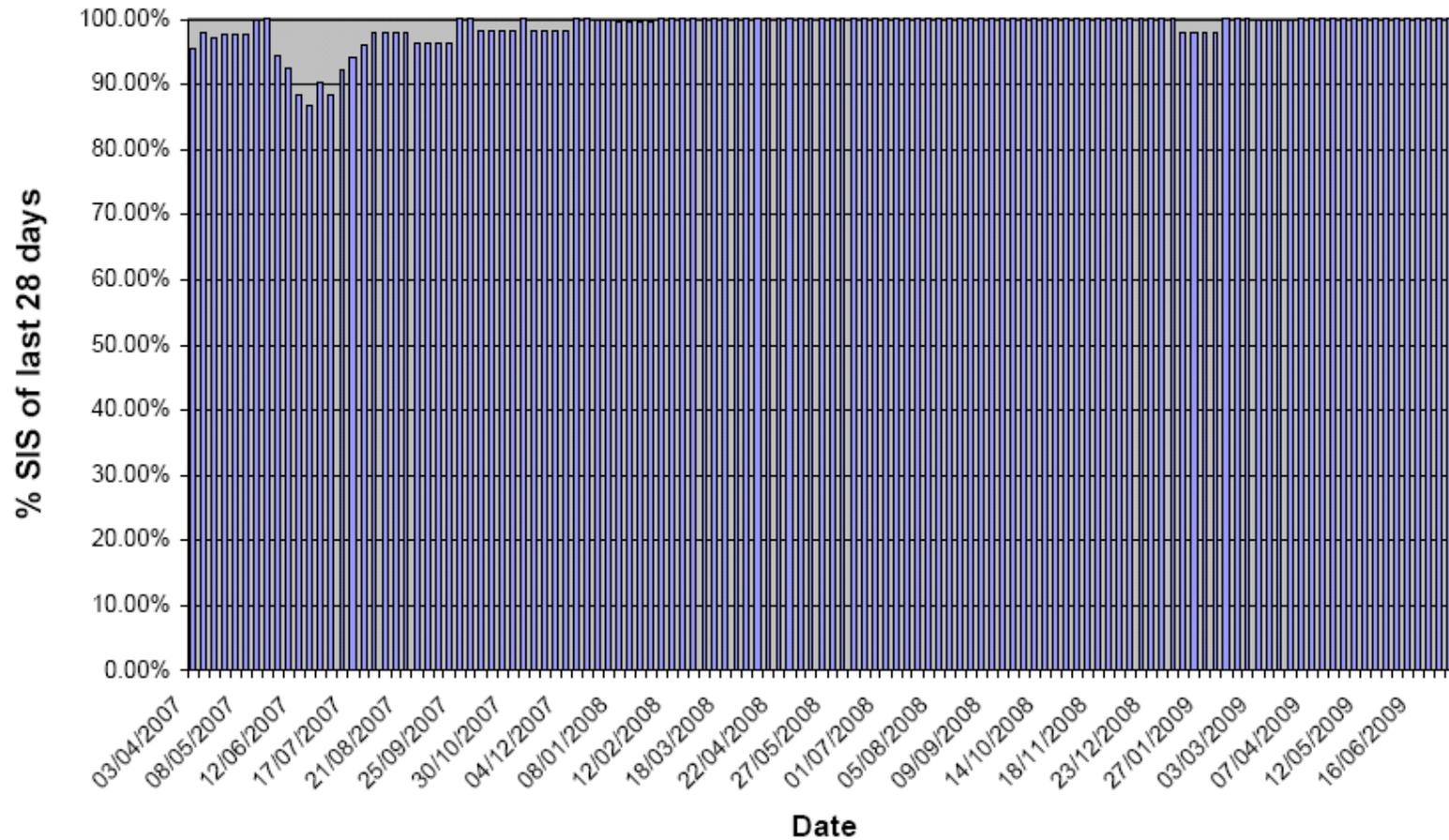
Service	Accuracy	Service Status	Expected Lifetime
Open Service	Typical vertical and horizontal positioning accuracy in the centre of Europe around 1m (spec: 3m horizontal, 4m vertical)	SIS available, declaration of "entry into service" planned for late 2009	20 years
Safety of Life Service	Same accuracy as Open Service. SoL service levels compliant to ICAO SARPS definition for APV1	Test SIS available, declaration of "entry into service" planned for mid-2010	20 years
Commercial Service (EDAS)	Corrections provided by terrestrial network allow for sub-meter accuracy locally or regionally through additional processing	Experimental service available since 2008	20 years





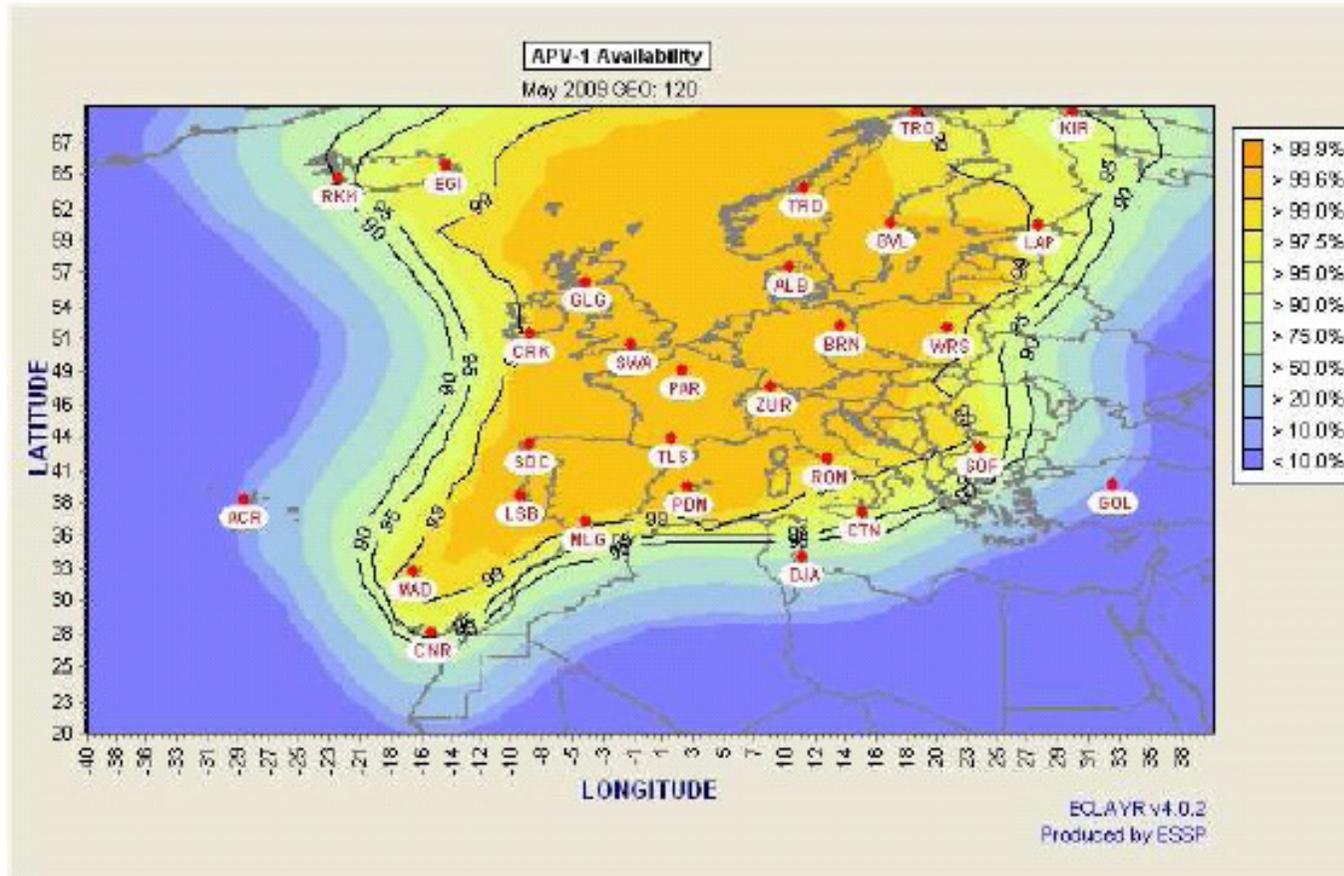
EGNOS Performance (April 2007 – June 2009)

Accumulative SIS



=> More than 99% availability over the last months

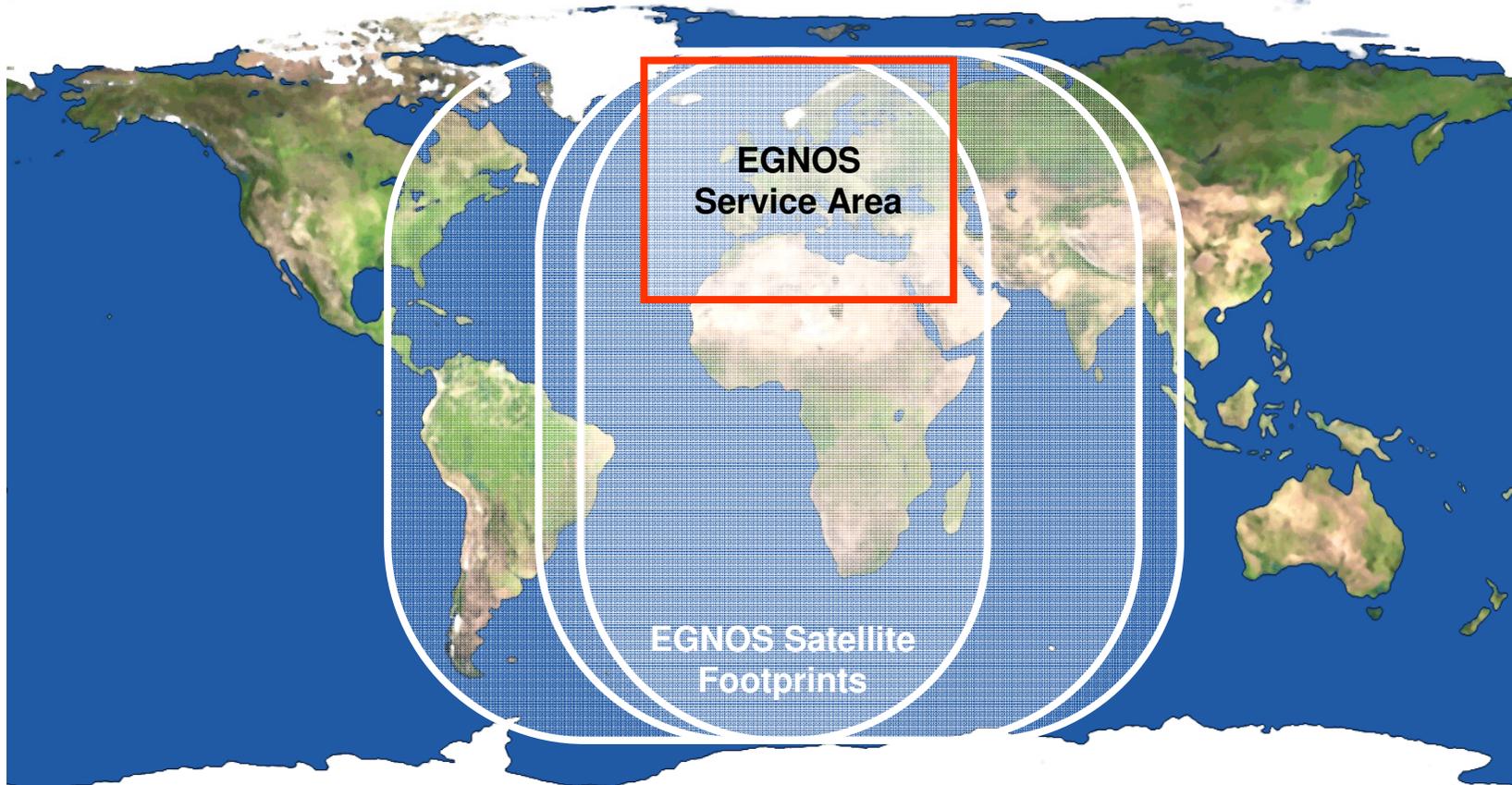
EGNOS Performance (May 2009)



Note : the deployment of additional RIMS in Northern and Eastern Europe, Southern Europe, Northern Africa and the Middle East will increase the availability area of APV-1

APV ... Approach with vertical guidance

● EGNOS Service Area



INMARSAT AOR-E (15.5°W), ARTEMIS (21.3°E), INMARSAT IOR-W (25°E)

● EGNOS Programme Status

● 2009:

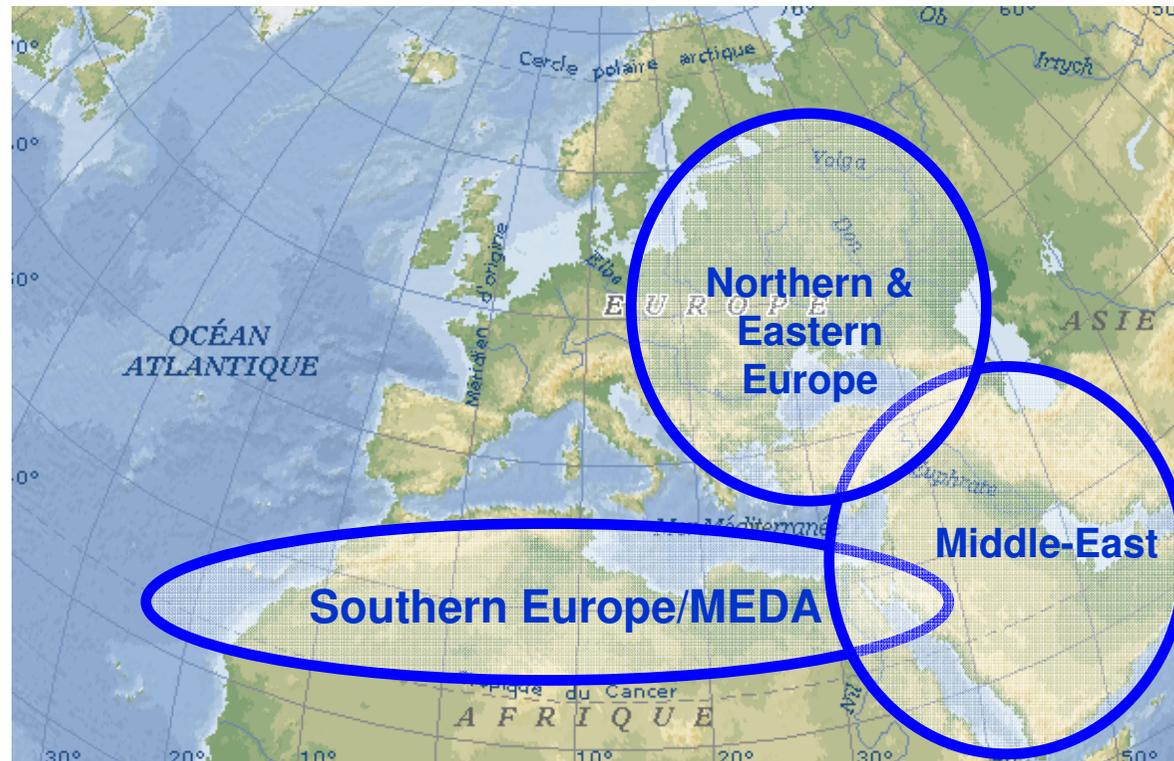
- » Assets were transferred to the European Union on April 1, 2009
- » Short-term operator contract as of April 1, 2009
- » **Open Service declaration** planned for Oct 1, 2009
- » Long-term operator contract planned as of Oct 1, 2009
- » Procurement to replace the transponder on Artemis is finalized
- » Procurement to replace the transponder on the second satellite is ongoing
- » Geographical extension is under study

● 2010:

- » **Safety-of-Life Service declaration** planned for mid-2010, after certification
- » **Commercial Service declaration** planned for end 2010



EGNOS Extensions



Depending on the extension area, technical implementation may vary from:

- Homogeneous extension with deployment of additional RIMS
- Regional infrastructure including additional processing capabilities

● EGNOS Service Evolutions

- Service Provision Improvements ▶ short/medium term
- Coverage Evolution
 - » Eastern Europe, Southern Europe/MEDA, Middle East/ACAC ▶ medium term
 - » Africa ▶ medium/long term
- Frequency Evolution
 - » Extension to the E5a/E5b frequency decided on ARTEMIS replacement
- Evolution of Standards ▶ long term
 - » Standardisation of E5a and E5b, L1 CBOC on-going
 - » Augmentation of new GNSS
- Additional Services
 - » LPV200 service level ▶ medium term (2011)
EGNOS capability to meet this service level currently under technical evaluation
 - » EGNOS time service ▶ medium term
 - » Possible critical communication message (ALIVE concept)



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Galileo Implementation Plan

Full Operational Capability
27 (+3) Galileo satellites

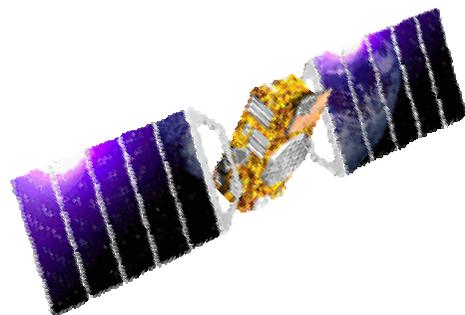
2013

In-Orbit Validation
4 IOV satellites plus
ground segment
2010

Galileo System Testbed v2
2 initial test satellites
2005

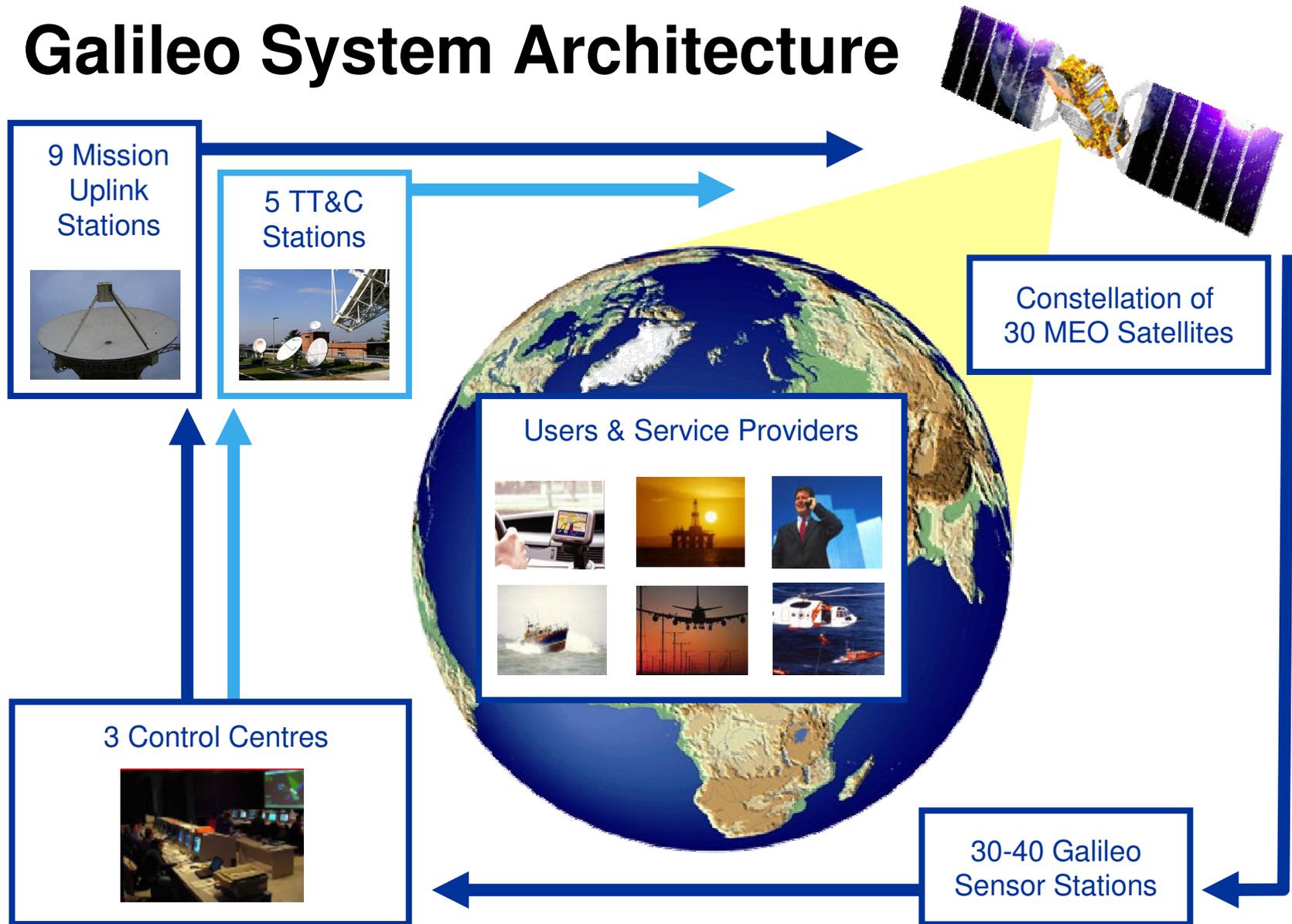
Galileo System Testbed v1
Validation of critical algorithms
2003

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Galileo System Architecture



Galileo Services

Open Service	Free to air; Mass market; Simple positioning	
Commercial Service	Encrypted; High accuracy; Guaranteed service	
Safety of Life Service	Open Service + Integrity and Authentication of signal	
Public Regulated Service	Encrypted; Integrity; Continuous availability	
Search and Rescue Service	Near real-time; Precise; Return link feasible	

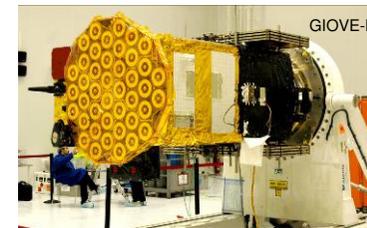
Galileo Performance Requirements (Dual Frequency)

Service	Horizontal Accuracy (95%) (incl. system margins)	Vertical Accuracy (95%) (incl. system margins)	Availability for global coverage	Integrity
Open Service	4 m	8 m	> 99.5%	NO
Commercial Service	Detailed performance requirements under elaboration			
Safety of Life Service	4 m	8 m	> 99.5%	YES (LPV200)
Public Regulated Service	4 m	8 m	> 99.5%	YES

Note : The expected measured performance is higher than the requirements, as is the case with EGNOS

Galileo Test Satellites

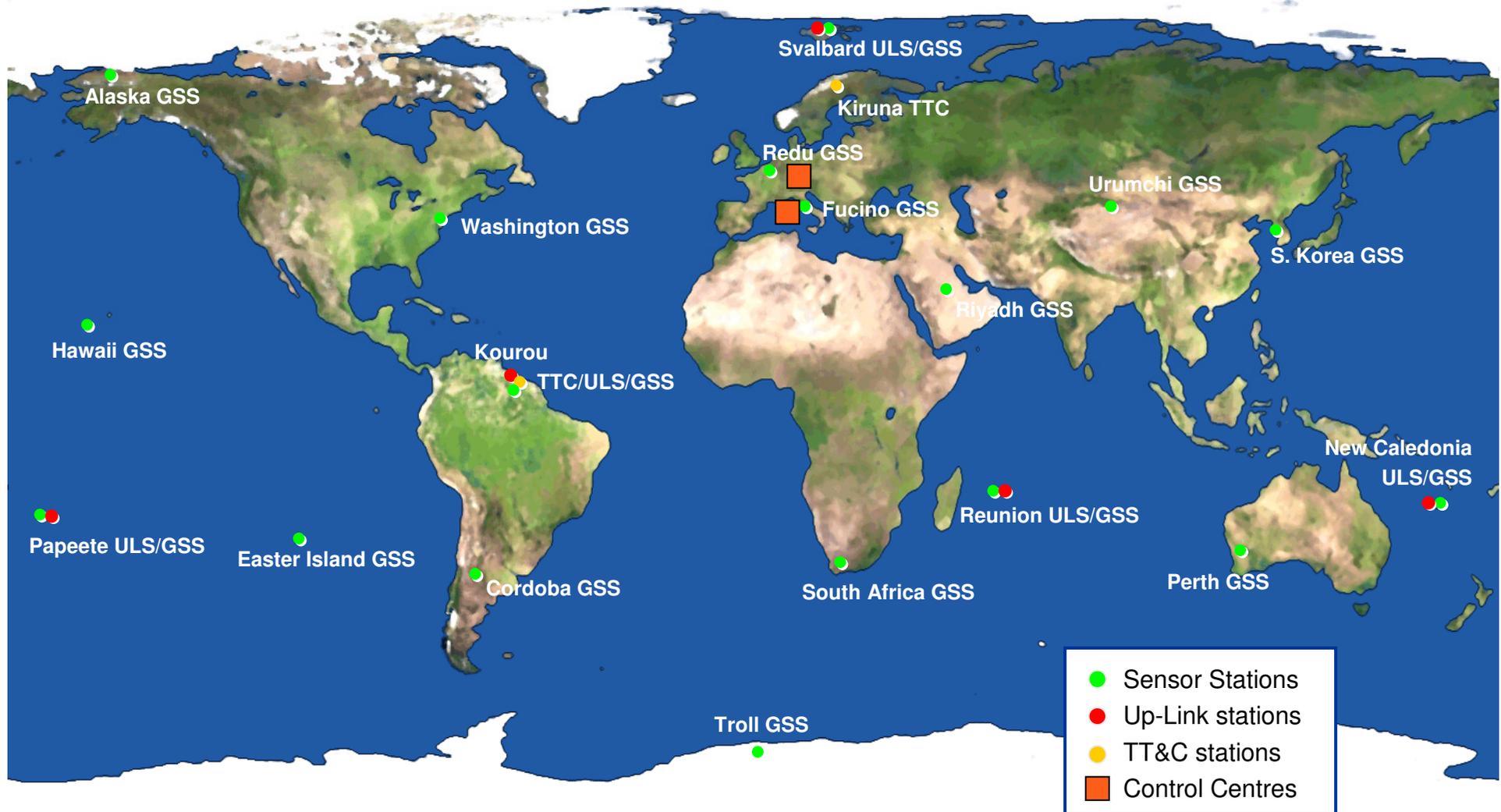
- Giove-A launched on 28 December 2005
 - » Securing of Galileo frequencies
 - » Still operating from a higher orbit
- Giove-B launched on 27 April 2008
 - » First Passive Hydrogen Maser atomic clock ever flown in space
 - » Implementation of CBOC signal
 - » Working as expected



Galileo IOV vs FOC

	Component	IOV Phase	FOC Phase
	Satellites	4	27(+3)
	Control Centres	1	3
	Mission Uplink Stations	5	9
	TT&C Stations	2	5
	Sensor Stations	20	30-40

Galileo IOV Ground Segment Sites



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Galileo IOV Control Centres



Fucino (IT)

Oberpfaffenhofen (DE)



● Galileo IOV Ground Segment Sites



Kiruna Galileo TTC Site Completed (Nov 2007)



Svalbard Galileo ULS/GSS Site Completed (May 2008)



Credits: ESA



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Galileo Oberpfaffenhofen Control Centre



● Galileo FOC Procurement

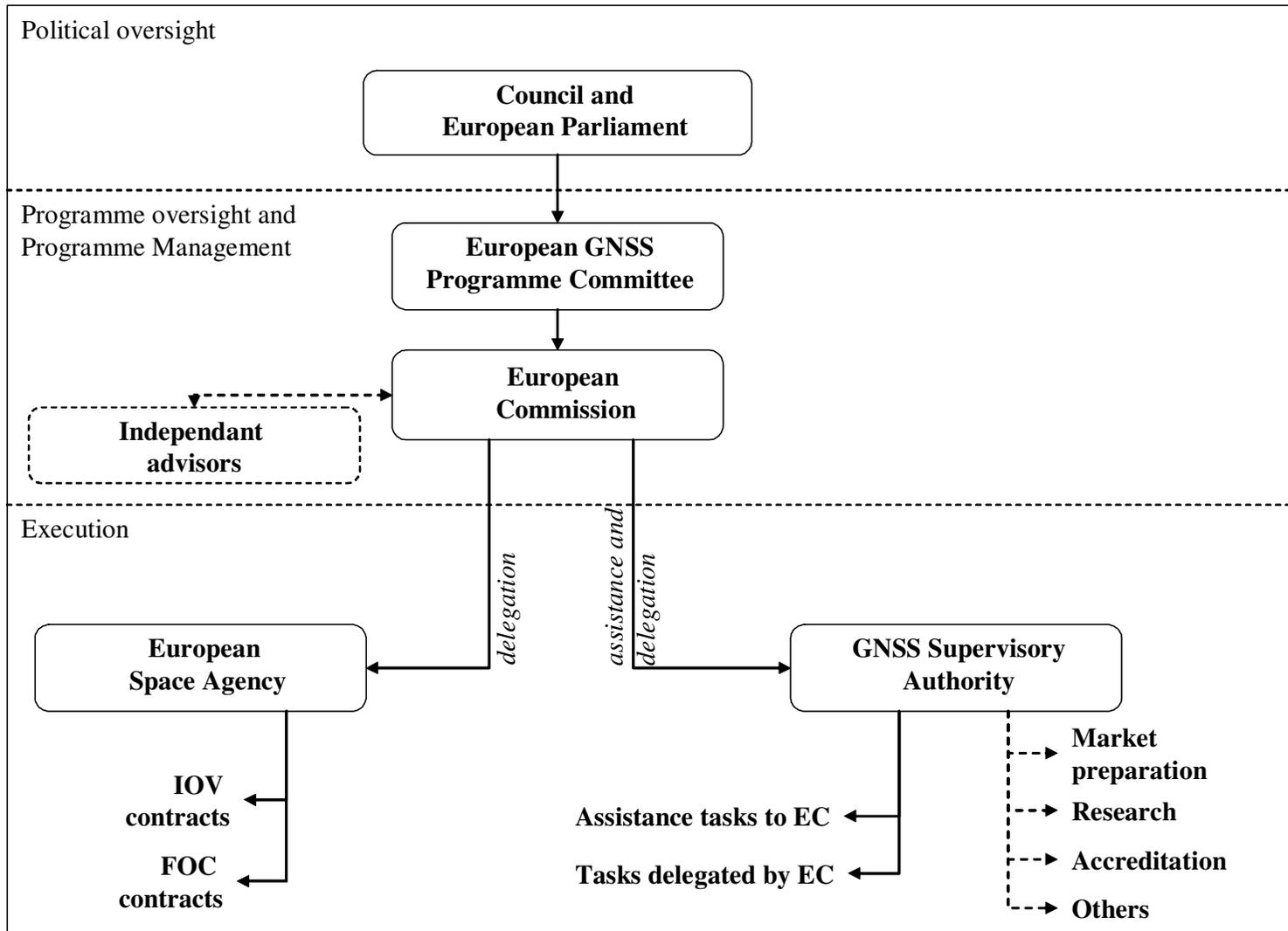
- Infrastructure procurement divided in 6 work packages
- Tender launched on July 1, 2008
- Candidates have been shortlisted and competitive dialogue is under way
- Contracts expected to be signed between now and early 2010

Galileo FOC Procurement

Shortlisted Candidates

Work Package	Retained Candidates
1. System Support	<ul style="list-style-type: none"> ● ThalesAleniaSpace (IT) ● Logica (NL)
2. Ground Mission Segment	<ul style="list-style-type: none"> ● ThalesAleniaSpace (FR) ● Logica (UK)
3. Ground Control Segment	<ul style="list-style-type: none"> ● Astrium (UK) ● G-Nav grouping represented by Lockheed Martin IS&S (UK)
4. Space Segment	<ul style="list-style-type: none"> ● Astrium (DE) ● OHB System (DE)
5. Launch Services	<ul style="list-style-type: none"> ● Arianespace (FR)
6. Operations	<ul style="list-style-type: none"> ● Nav-up grouping represented by Inmarsat (UK) ● DLR (DE) and Telespazio (IT)

Galileo Governance



Galileo International Activities

- Agreements with:

P.R. of China, USA, Israel,
South Korea, Ukraine,
Morocco

- Multilateral:

Founding member of UN
International Committee on
GNSS & Providers Forum,
candidate to host ICG in
2010

- Cooperation *inter alia* on:

- » Compatibility
- » Interoperability
- » Standardisation
- » Development activities
- » Galileo applications
- » Research
- » Trade matters

- Regional training centers:

- » Asia, Africa,
Latin America

● ICG Providers Forum Definitions

- Galileo complies with ICG Providers Forum's definitions of Compatibility and Interoperability as updated at ICG#3 in Pasadena
 - » Used during bi-lateral and multi-lateral coordination meetings

● EU Objectives on Compatibility

- Ensure compatibility at a minimum: ability of space-based PNT services to be used separately or together without interfering with each individual service or signal, and without adversely affecting national security
 - » Radio frequency compatibility (ITU provides a framework)
 - » Spectral separation between PRS and other signals

● EU Objectives on Interoperability

- Achieve interoperability between Galileo open signals (OS, SoL and CS) and other space-based PNT signals when desired for the benefits of users
 - » Focus on the following signals : E1 CBOC, AltBOC E5b (+ E5a & E5b) and E6 BPSK(5) CS signals

Galileo Programme Status

- 2009
 - » IOV : ground infrastructure deployments
 - » FOC : first procurement contracts to be signed from Fall 2009 onwards
- 2010
 - » IOV : first two operational satellites to be launched in Fall 2010
 - » FOC : remaining procurements contracts to be signed by early 2010
- 2011
 - » IOV : third and fourth operational satellites to be launched early 2011
 - » FOC : ground infrastructure deployments
- 2012 onwards
 - » Progressive FOC deployment with step-wise service introduction as of 2013

● Conclusions



EGNOS enters its operational phase

- EGNOS Open Service in Fall 2009
- EGNOS Safety-of-Life-Service and Commercial Service in 2010



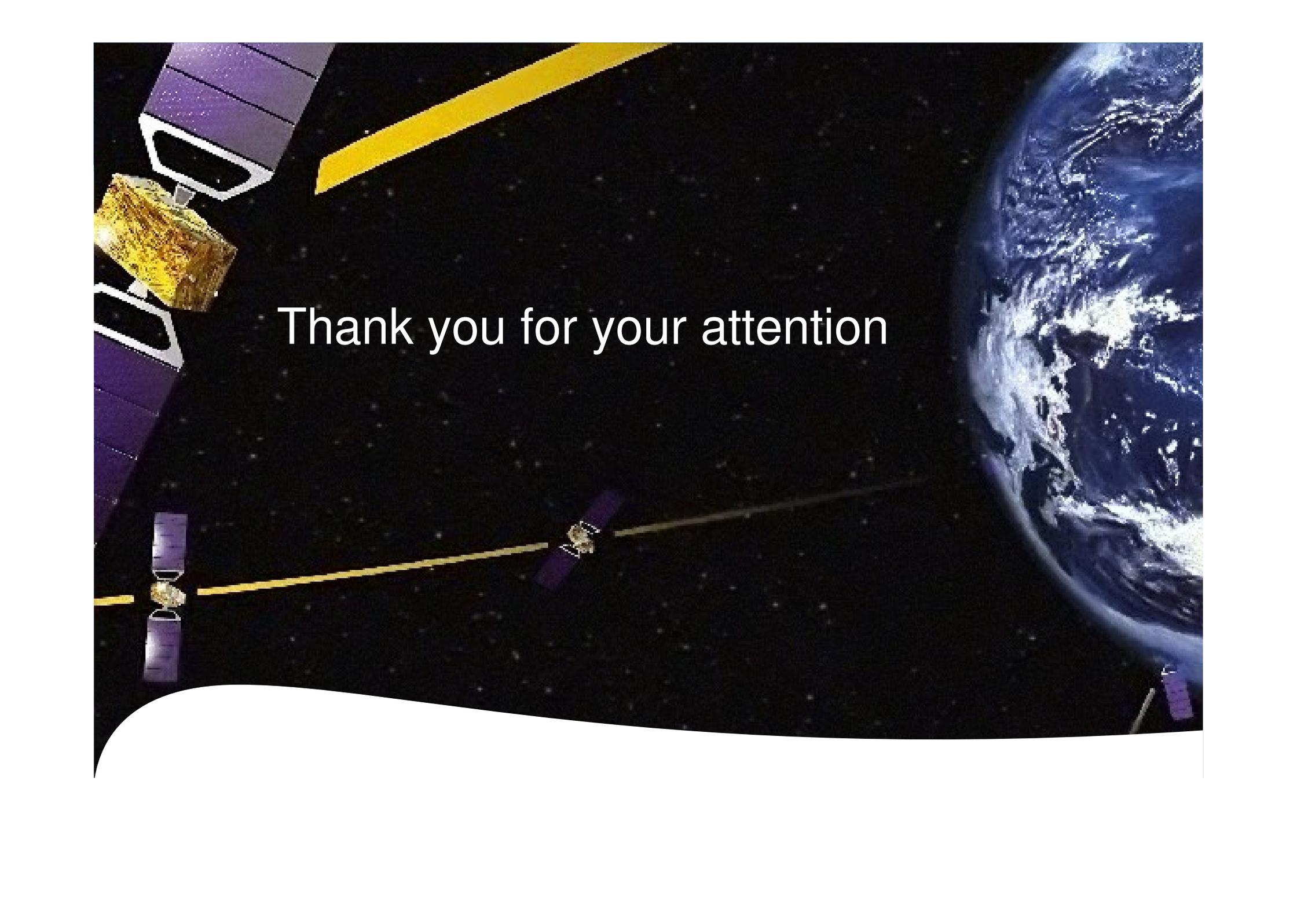
Galileo is progressing, at the crossing between the development (IOV) and deployment (FOC) phases

- GIOVE-A, GIOVE-B missions on-going
- FOC procurement on-going
- First two operational satellites in 2010
- Full Operational Capability as of 2013

International coordination is an important feature

- Ensure compatibility as a minimum
- Achieve interoperability when desired



A satellite with purple solar panels and a gold-colored body is shown in space. The Earth is visible on the right side of the frame. The background is a dark, starry sky. The text "Thank you for your attention" is centered in the image.

Thank you for your attention