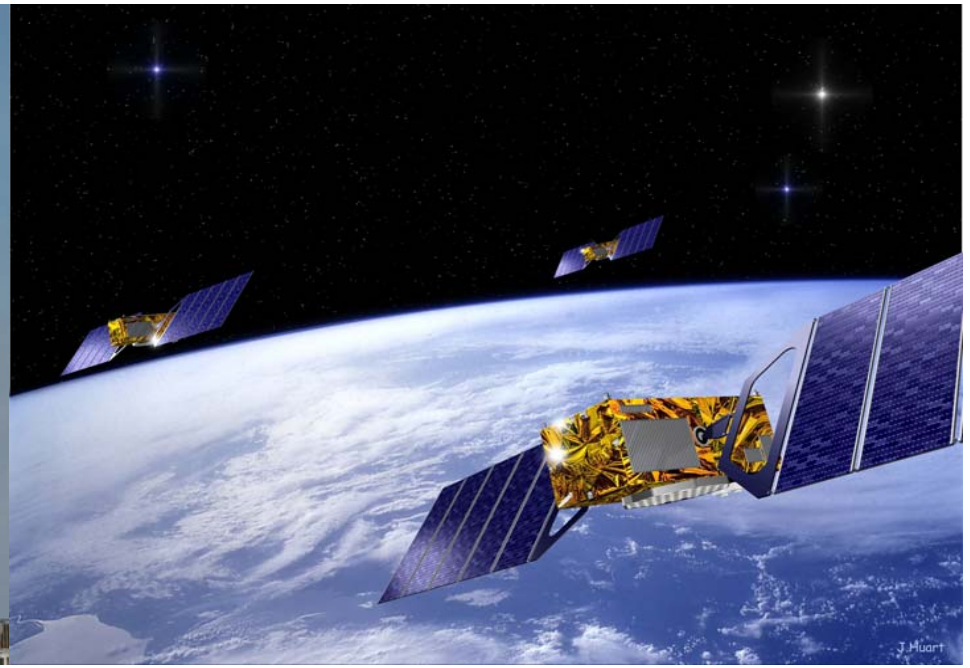

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European GNSS Programmes
Galileo and EGNOS

UN ICG expert meeting, Montreal
Eero Ailio, Jeremie Godet

15 July 2008

EUROPEAN COMMISSION

GALILEO

Galileo: a first…..

- … large industrial project of European Union.
- … major space project of the European Union.
- … cooperation between the European Union and the European Space Agency.
- … significant public EU infrastructure.

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Galileo – 5 services

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

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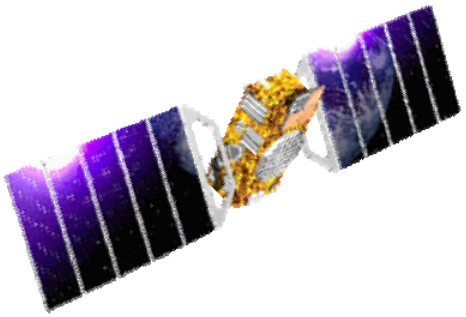
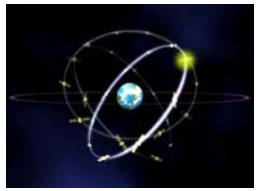
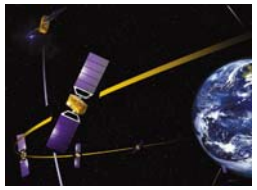
Galileo – an incremental approach



Full Operational Capability
27 (+3) Galileo Satellites



In-Orbit Validation
4 satellites plus
ground segment



Galileo System Testbed v2
GIOVE Satellites

GALILEO
GIOVE

Galileo System Testbed v1
Validate critical algorithms

GALILEO
GSTB-V1

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Galileo International Activities

Perspectives

- **New worldwide infrastructure**
- **Regional & Local components**
- **Research**
- **Industrial cooperation**
- **Promotion of trade in GNSS services and products**
- **Global Standards and certification**

Regional cooperation

Southern Mediterranean Galileo centers

Asia (Beijing)
Mediterranean Region (Cairo)
Latin America (Brasilia)

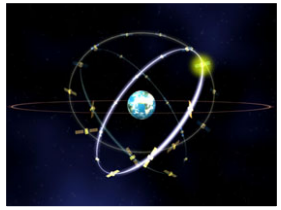
Cooperation foreseen with UN centers

Agreement EU-MS and..	Signed / Initialed
U.S.A.	✓
China	✓
Israel	✓
India	✓
Morocco	✓
South Korea	✓
Ukraine	✓

**Exploratory talks on going with other countries, including Russian Federation and Japan*

Galileo – An infrastructure

30 satellites
Constellation

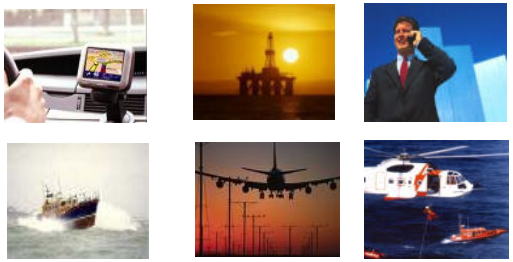


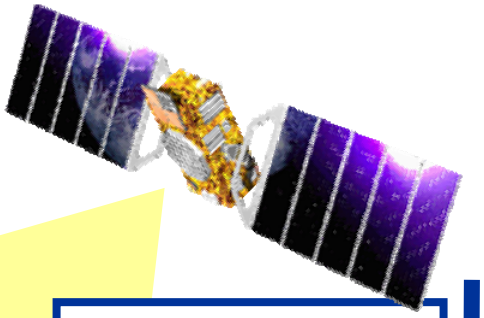
5 TT&C Stations

9 mission
Uplink stations

3 Control Centres

Users & Service Providers

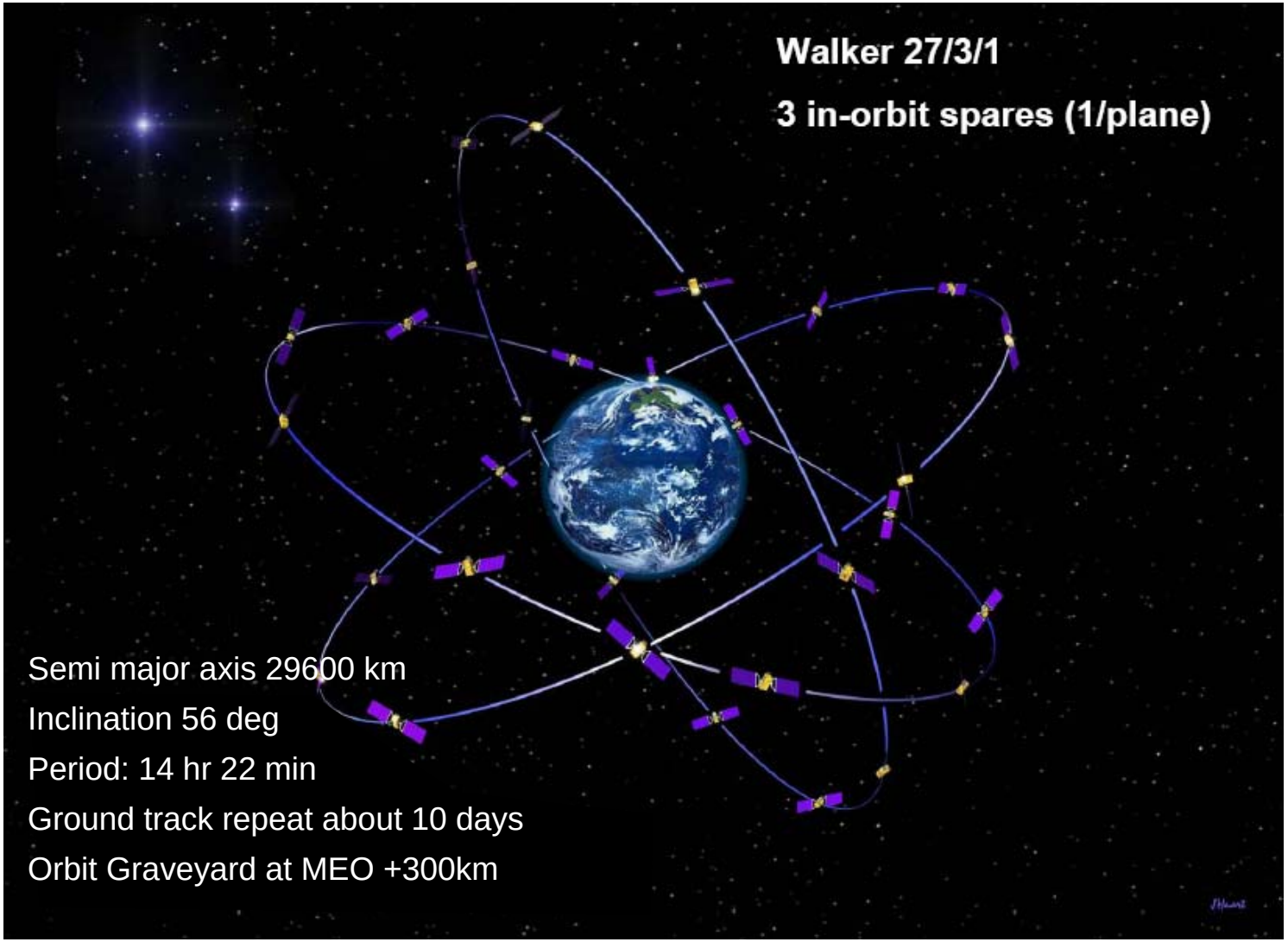




30
MEO satellites

30-40 Galileo
Sensor Stations

Galileo – A: Space Segment



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Galileo – B: Ground Segment

Control Centres: Oberpfaffenhofen – Fucino – Madrid

TT&C stations: Kiruna – Kourou – Papeete – Réunion – Nouméa

ULS stations: Svalbard – Kourou – Papeete – Réunion - Nouméa
+ 4 (FOC)

GSS stations: Fucino – Redu – Svalbard - Canary Islands / Azores – Reunion – Noumea – Kourou - Papeete Troll (Antarctica) - Haarthebesthoek - Riyadh Cheju-do (Kor) - Urumqi (China) - Perth (Aus) Fairbanks (USA) - Washington DC- Hawaii Easter Island (Chile) - Cordoba (Arg)
+ 10-20 (FOC)

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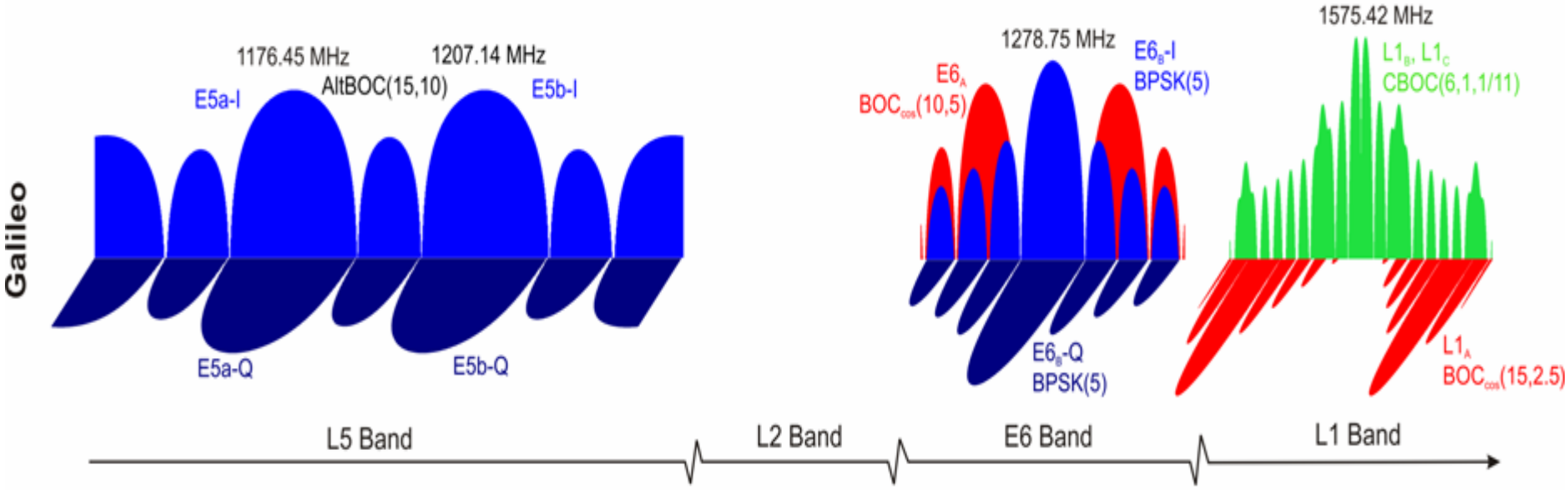
Galileo – C: Current Signals



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Galileo – Signals/compatibility and interoperability

- ***Compatibility*** **refers to the ability of space-based positioning, navigation, and timing services to be used separately or together without interfering with each individual service or signal, and without adversely affecting national security.**
  - **Radio frequency compatibility: signals do not unacceptably interfere with use of other signals**
  - **Spectral separation between PRS and other signals**

- ***Interoperability*** **refers to the ability of civil space-based positioning, navigation, and timing services to be used together to provide better capabilities at the user level than would be achieved by relying solely on one service or signal.**

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Galileo – D: System time and geodetic reference frame standards

- Galileo System Time:
  - » Steered to TAI (International Atomic Time)
  - » The difference between GST and TAI and between Universal Time Coordinated (UTC) and TAI broadcasted to the users via the SIS
  - » GPS-Galileo Time Offset broadcasted

- Galileo Terrestrial Reference System (GTRS)
  - » Realisation (GTRF) within < 3 cm (2 sigma) wrt. ITRF (International Terrestrial Reference Frame)

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Galileo – E: Performance standards

Galileo Service	Horizontal Accuracy (95%)	Vertical Accuracy (95%)	Availability	Integrity
Open Service	4 m	8 m	> 99.8%	NO
Safety of Life	4 m	8 m	> 99.8%	YES
Commercial Service	Detailed performance requirements under elaboration			
Public Regulated Service	4 m	8 m	> 99.8%	YES

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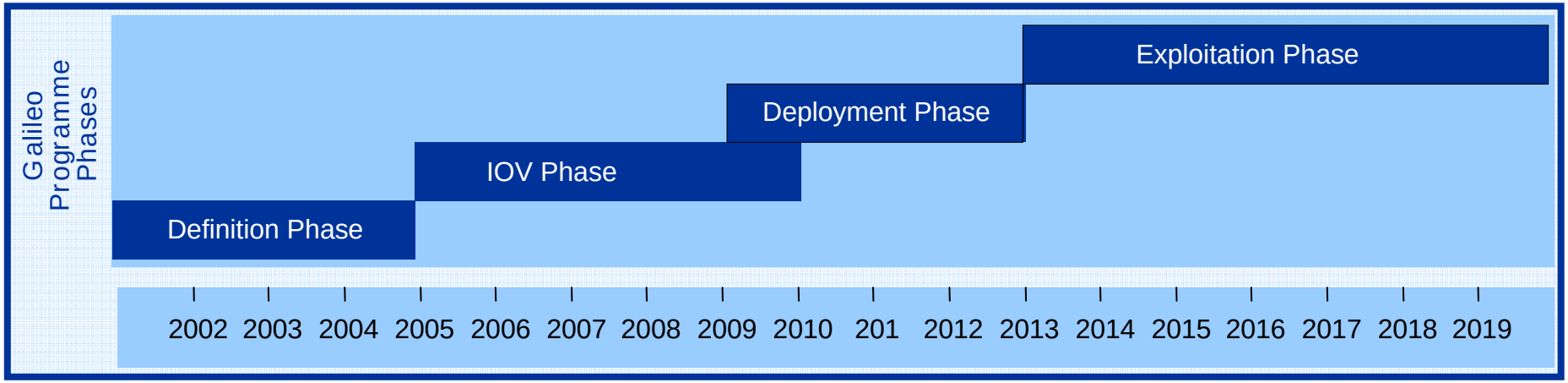
Galileo – F: Time table



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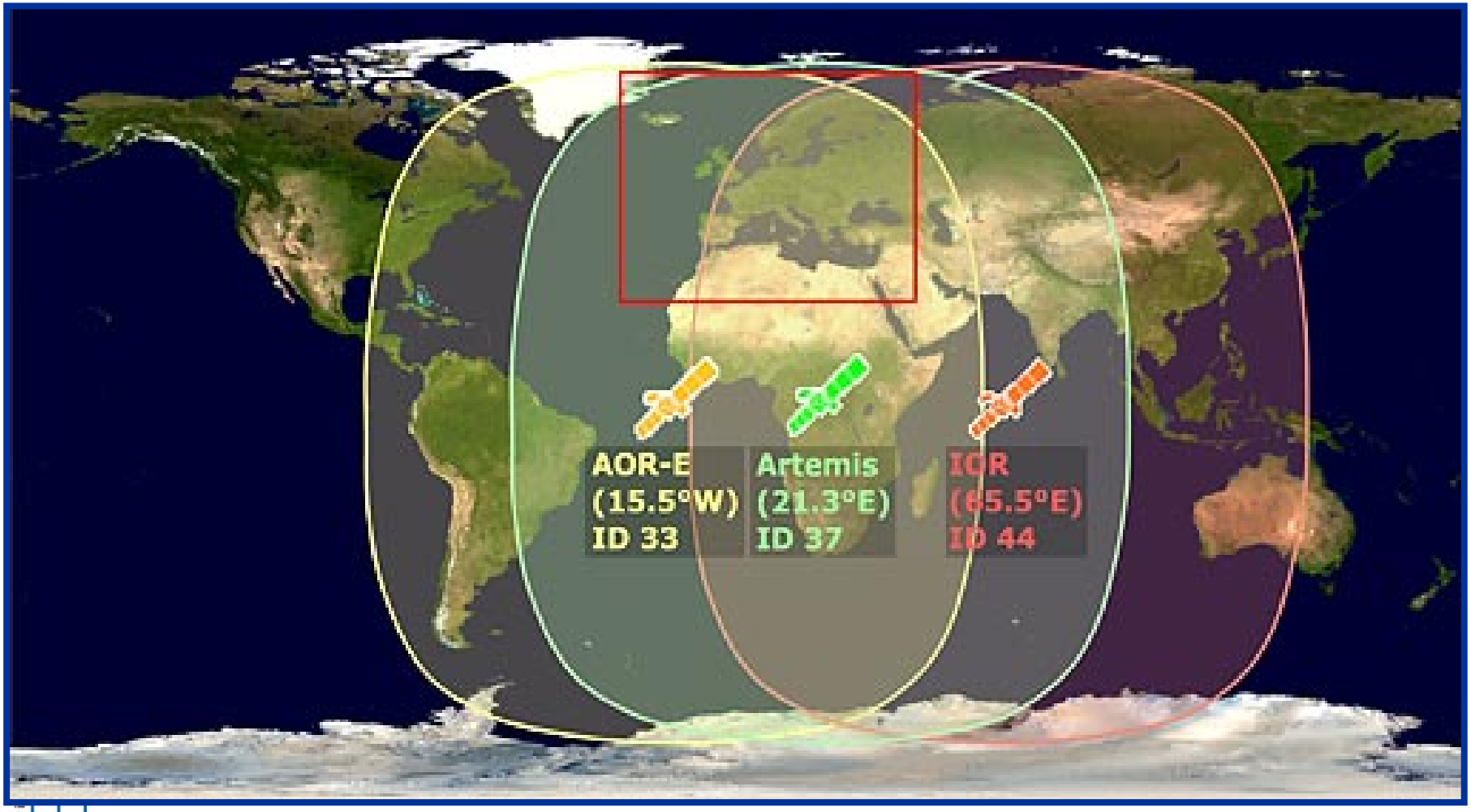
EGNOS – A: Space Segment



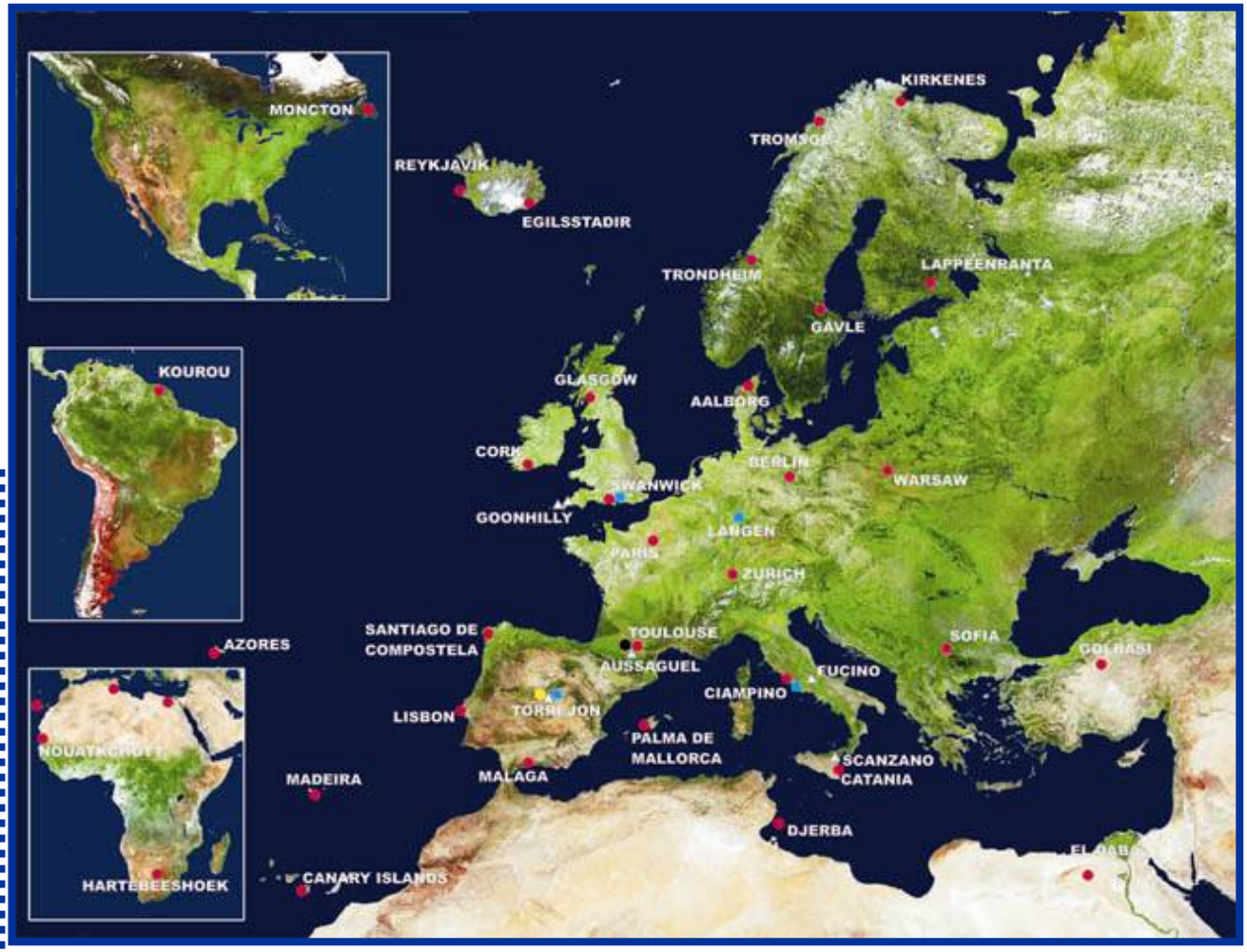
EGNOS – B: Ground Segment

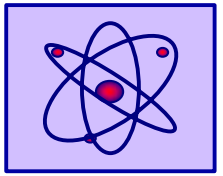
Users

△ 6 NLES Navigation Land Earth Stations

● 2 Support ○ Facilities

□ 4 MCC Mission Control Centers





● 34 RIMS Ranging & Integrity Monitoring Stations

EWAN EGNOS Wide Area Network

EGNOS – C: Current and Planned Signals

- Current: L1 SBAS compliant signals
- Planned: under study

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EGNOS – E: Performance standards

Standards v Actual Performance (5-11 August, 2007)

	APV-1 requirement	Measured at Toulouse (France)	Measured at Warsaw (Poland)	Measured at Brussels (Belgium)
Horizontal Accuracy	16 m	0.91 m (95% HNSE)	2.23 m (95% HNSE)	0.91 m (95% HNSE)
Vertical Accuracy	20 m	1.34 m (95% VNSE)	2.58 m (95% VNSE)	1.34 m (95% VNSE)
Availability	99%	99.9049%* (worst day: 99.33%)	97.6457%* (worst day: 95.08%)	99.9049%* (worst day: 98.219%)
Continuity	$1\text{-}8.10^{-6}$ / 15s	Not measured	Not measured	Not measured

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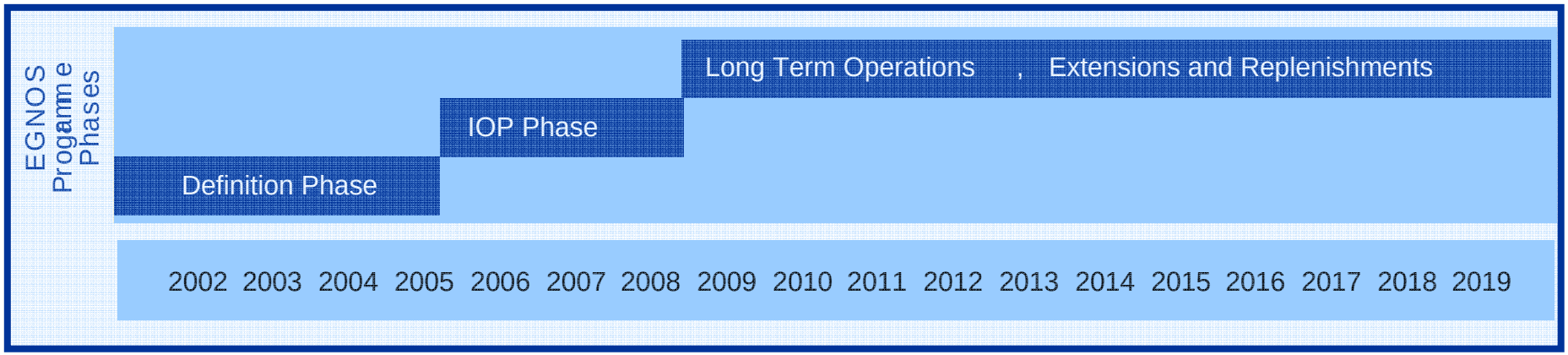
EGNOS – F: Time table



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Conclusions

EGNOS is in its Operational Validation Phase

- Initial Commercial Services starting in 2007
- Open Service in 2008
- Safety of Life Service in 2009

Galileo is in its Development Phase

- GIOVE-A mission on-going
- GIOVE-B was launched in April 2008 and passed successful In Orbit Test
- Initial 4 satellites by 2010
- Full Operational Capability by 2013

International Cooperation is an important feature within both the EGNOS and Galileo programmes:

- Infrastructure & Services
- Research & Development
- Market Development