

# ● European GNSS programmes Update

ION 2008, Savannah, Georgia, 16  
September 2008

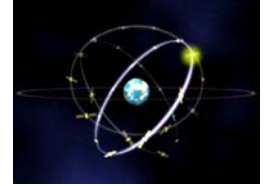
Paul Verhoef

16/09/2008,

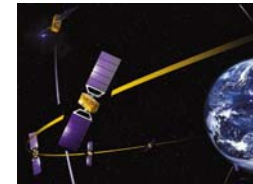


# Galileo Implementation Plan

**Full Operational Capability**  
27 (+3) Galileo Satellites  
**2013**



**In-Orbit Validation**  
4 satellites plus  
ground segment  
**2010**



**Galileo System Testbed v2**  
Initial Test Satellites  
**2005**



**Galileo System Testbed v1**  
Validate critical algorithms  
**2003**



Validate critical algorithms

**2003**

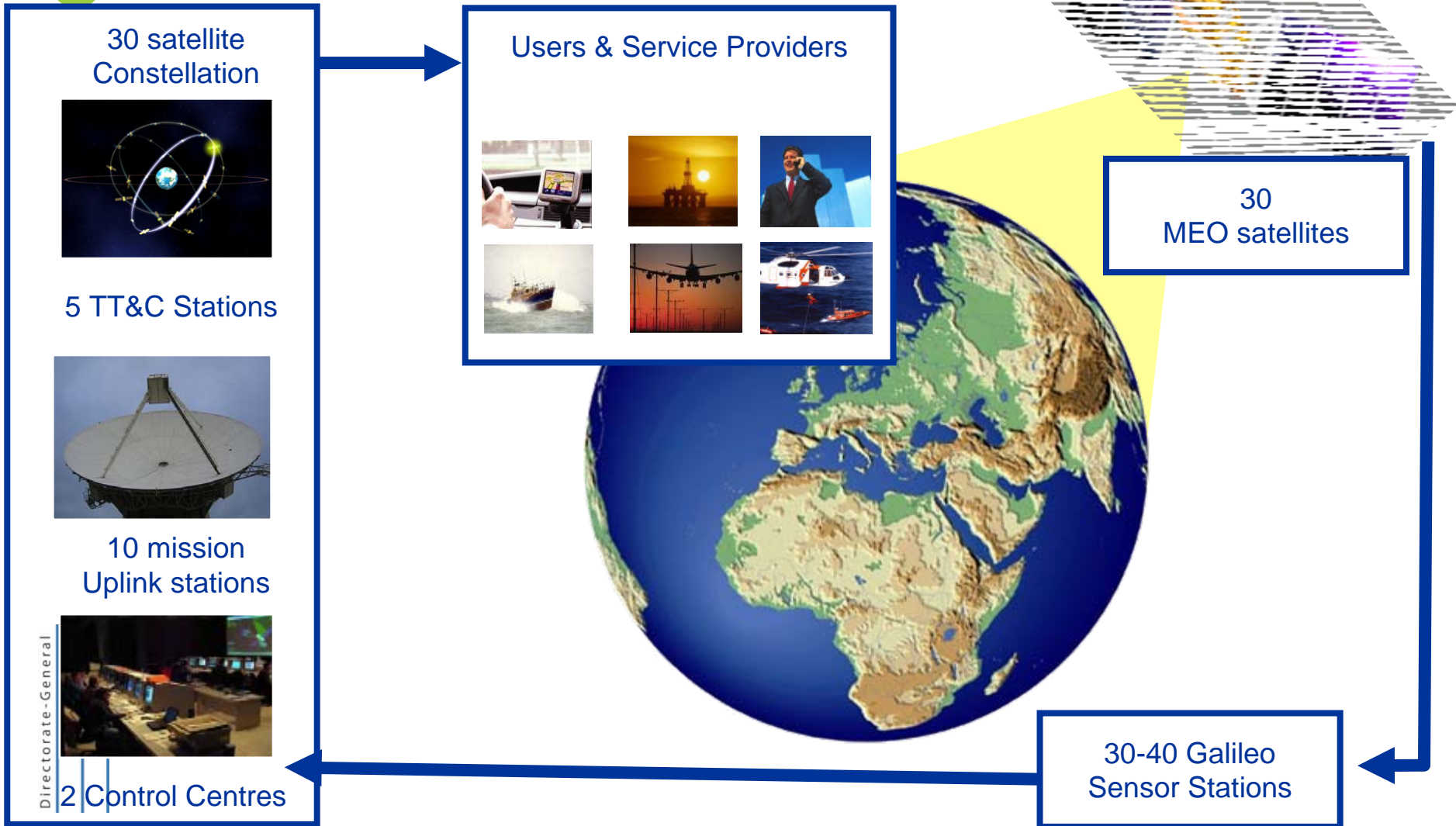
Directorate-General  
for Energy  
and Transport



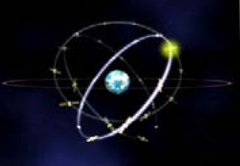




# GALILEO re-structuring

- Year 2007: re-structuring
  - » PPP: private sector limitations
    - Unable to accept market risks
    - Unable to accept technical risks
    - High financing costs
  - » Implementation funding secured for public procurement: 3.4 billion € for 2008-2013 (some 4.7 billion \$)
  - » European Commission
    - Fully in charge
    - Owner, on behalf of the European Union








# Galileo System (FOC)



# Galileo IOV vs FOC

	Component	IOV Phase	FOC Phase
	Satellites	4	27(+3)
	Control Centres	1	2
	Mission Uplinks	5	10
	TT&C	2	5
	Sensor Stations	20	30-40

# Galileo Services

Service			Receiver	Benefits	Target user groups	Availability
Open Service	OS		<b>Single frequency</b>	<ul style="list-style-type: none"> <li>Additional satellites for better multi-system coverage (e.g., deep urban)</li> <li>Coding and modulation advances for increased sensitivity and multi-path mitigation</li> <li>Pilot signal for fast acquisition</li> </ul>	<ul style="list-style-type: none"> <li>Low end mass market (e.g., LBS, outdoor)</li> </ul>	<b>Open</b>
			<b>Double frequency</b>	<ul style="list-style-type: none"> <li>As above + increased accuracy with 2<sup>nd</sup> frequency</li> </ul>	<ul style="list-style-type: none"> <li>High end mass market (e.g., car navigation, maritime)</li> </ul>	<b>Open</b>
Commercial Service	CS		<b>Double frequency</b>	<ul style="list-style-type: none"> <li>Increased accuracy using additional frequencies and signals</li> <li>Additional features under investigation (e.g., data rate capacity)</li> </ul>	<ul style="list-style-type: none"> <li>Professional markets (e.g., surveying, precision agriculture)</li> </ul>	<b>Commercial basis</b>
Safety of Life Service	SoL		<b>Single frequency (Level B)</b>	<ul style="list-style-type: none"> <li>As OS +</li> <li>Integrity and authentication of signal</li> <li>Continuity and service guaranty</li> </ul>	<ul style="list-style-type: none"> <li>Aviation (en route)</li> </ul>	<b>Certified receivers</b>
			<b>Double frequency (Level A and C)</b>	<ul style="list-style-type: none"> <li>As above at higher performance levels suitable for stringent dynamic conditions</li> </ul>	<ul style="list-style-type: none"> <li>Aviation (A)</li> <li>Maritime (C)</li> <li>Road, Train (A)</li> </ul>	<b>Certified receivers</b>
Public Regulated Service	PRS		<b>Dual frequency</b>	<ul style="list-style-type: none"> <li>As OS +</li> <li>High Continuity (in times of crisis)</li> <li>Improved Robustness (vs jamming, spoofing)</li> </ul>	<ul style="list-style-type: none"> <li>Law enforcement</li> <li>Strategic infrastructure</li> </ul>	<b>Regulated</b>
Search and rescue	SAR		<b>Single frequency</b>	<ul style="list-style-type: none"> <li>Almost instantaneous reception of emergency calls</li> <li>Exact positioning of emergency beacon</li> </ul>	<ul style="list-style-type: none"> <li>Emergencies</li> </ul>	<b>Certified &amp; registered beacons</b>



# Galileo Performances

## Dual Frequency

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

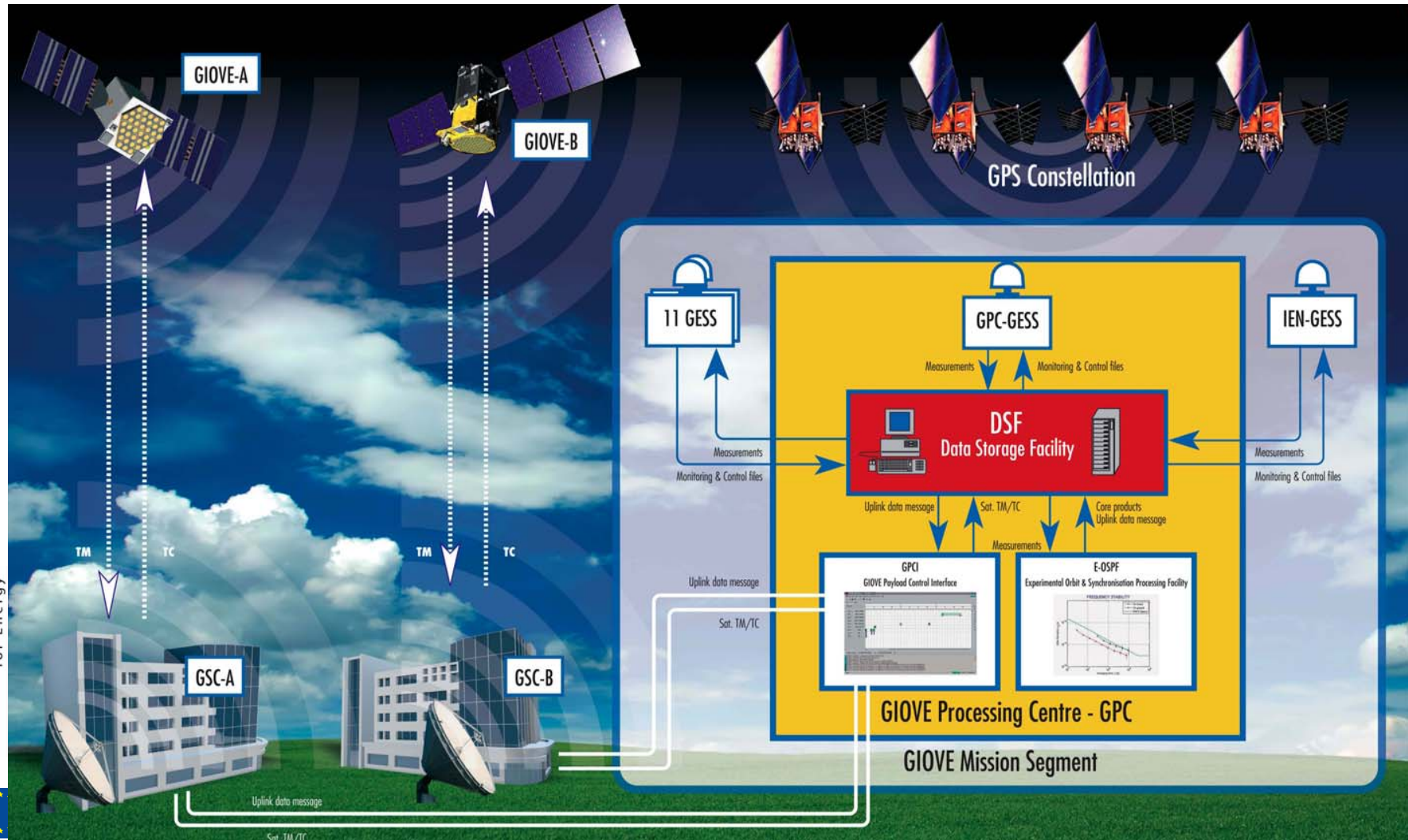
# Galileo Test satellites

- Giove-A still operating
- Giove-B launched on 27 April 2008
  - » Works as expected
  - » First maser atomic clock ever flown
  - » MBOC signal première





# GIOVE Architecture



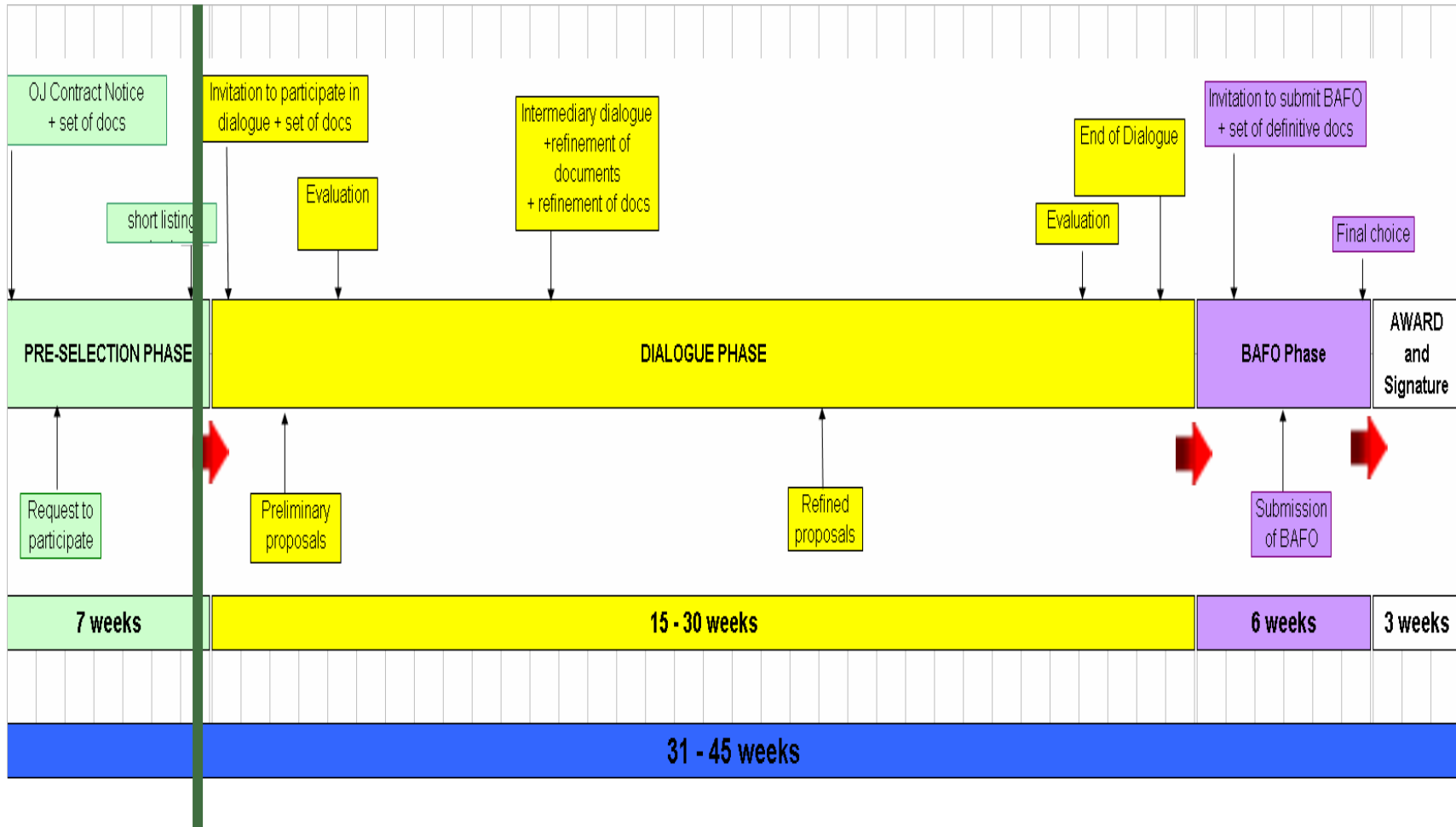
# ● GALILEO FOC procurement

- Contract notice release: 1 July 2008
- EC procurement rules (subject to WTO commitments on trade)
- Infrastructure in 6 workpackages

# GALILEO FOC procurement

- Candidates selected for each workpackage with good level of competition
- Enter the « Competitive Dialogue » phase
- Contracts foreseen for first half 2009
- Full Operational Capability in 2013

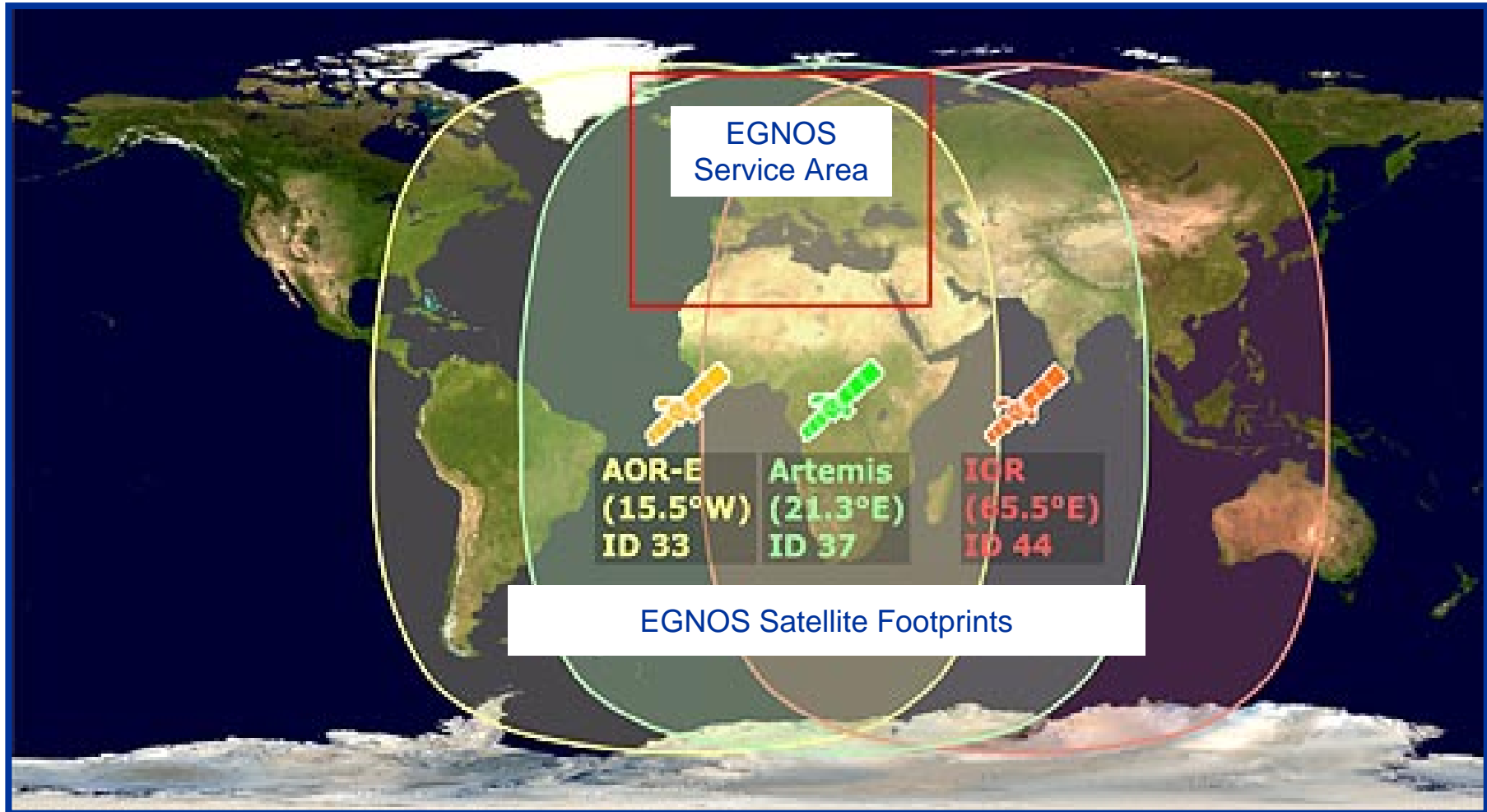
# FOC procurement overall planning



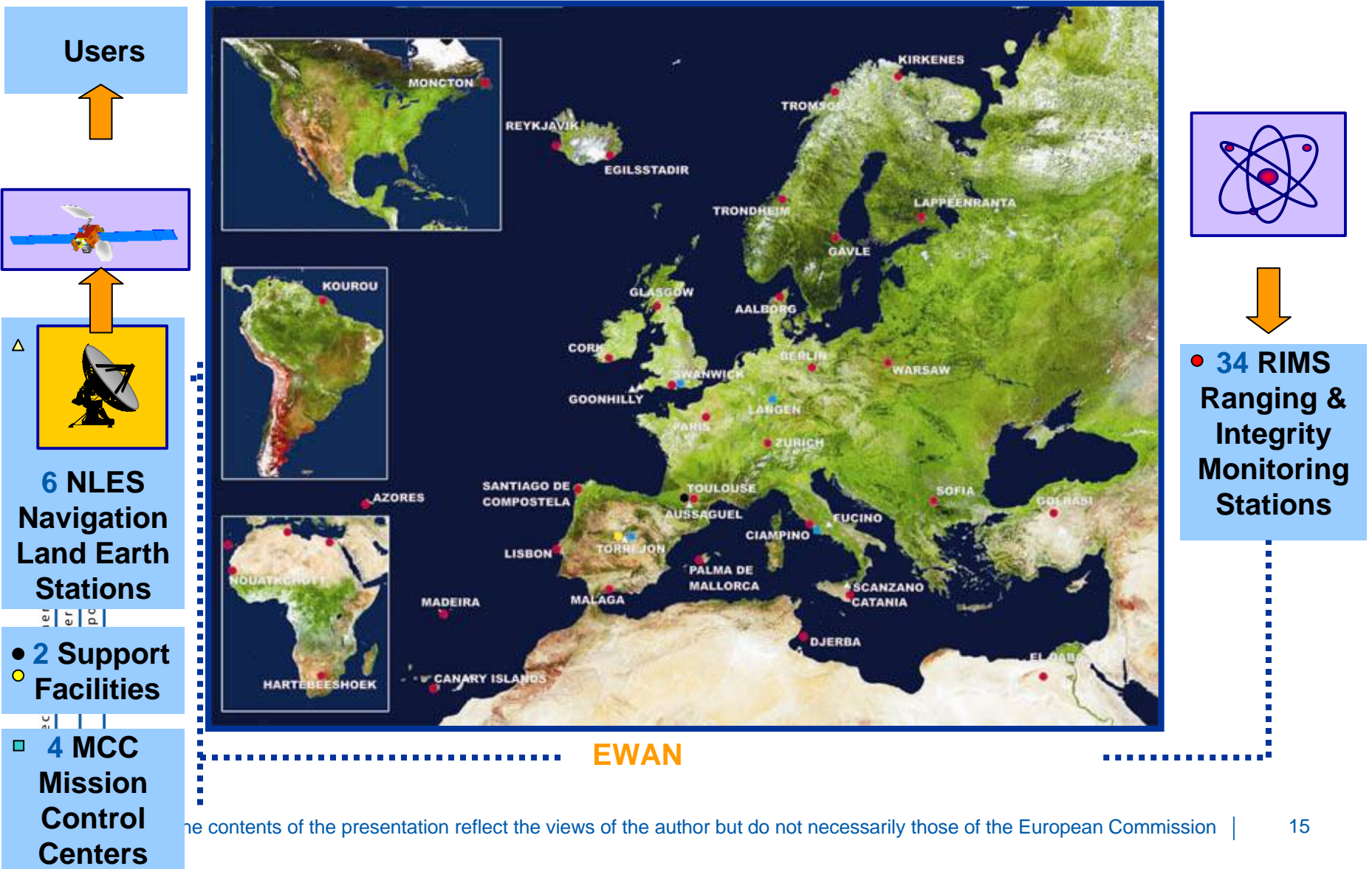
# ● EGNOS

- Assets transfer from European Space Agency to European Commission
- European Commission will contract an operator
- Broadcasting signals of excellent quality, yet will enter officially into operations Spring 2009
- Certification for aviation foreseen for end 2009
- Geographical service extension under study

# EGNOS Overview



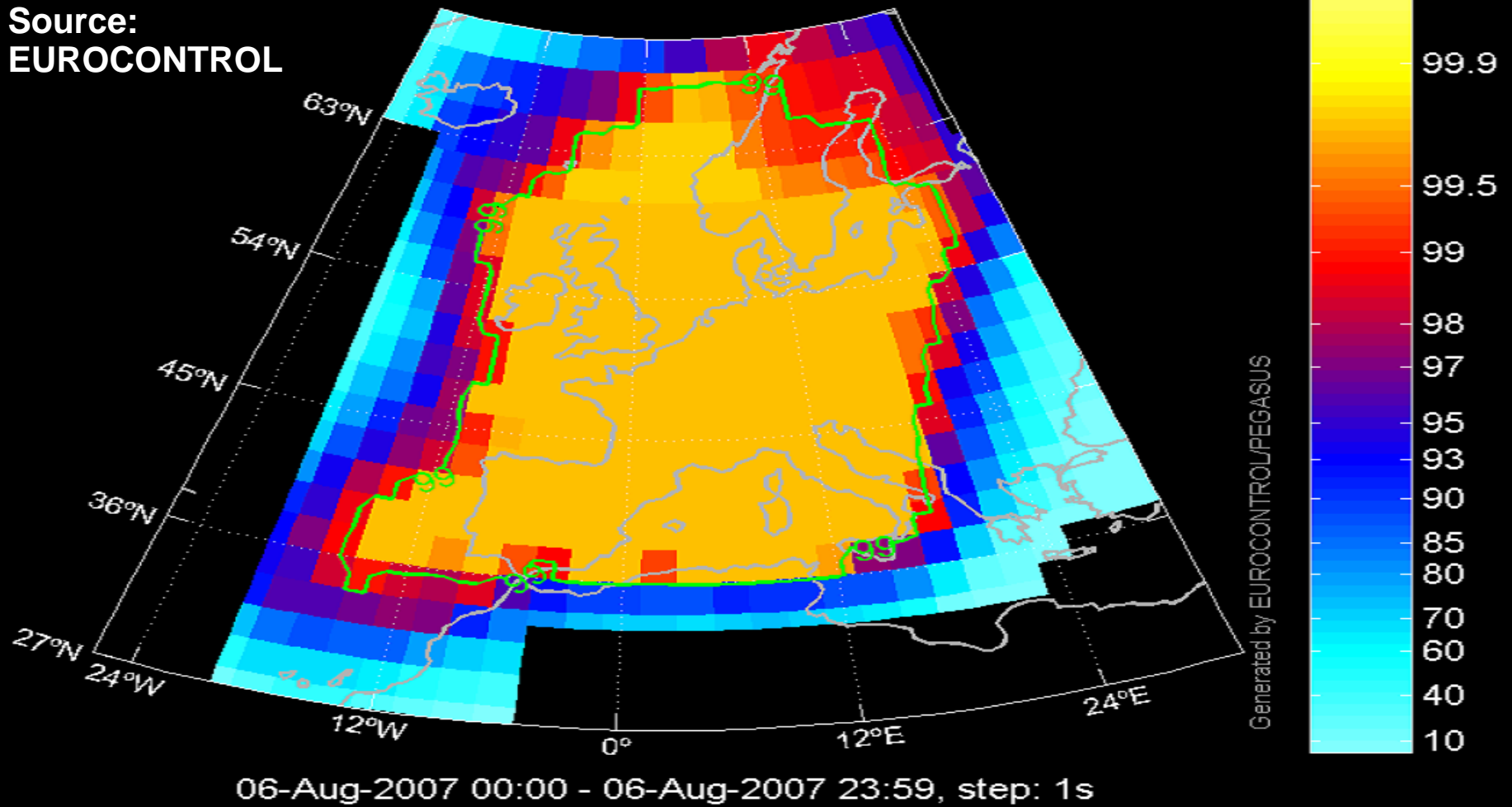
# EGNOS System Architecture



# EGNOS Performance (ECAC)

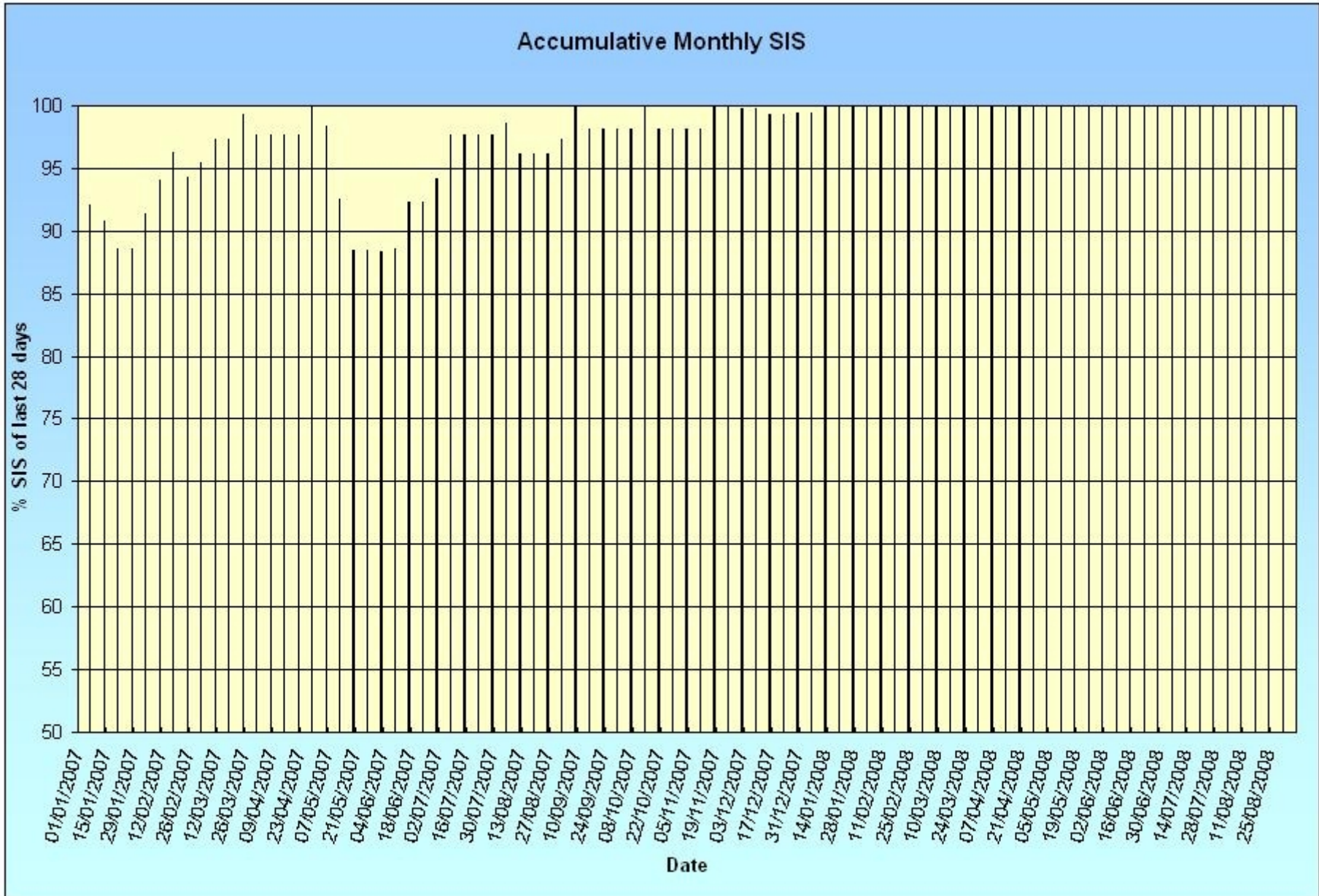
Source:  
EUROCONTROL

Availability APV1

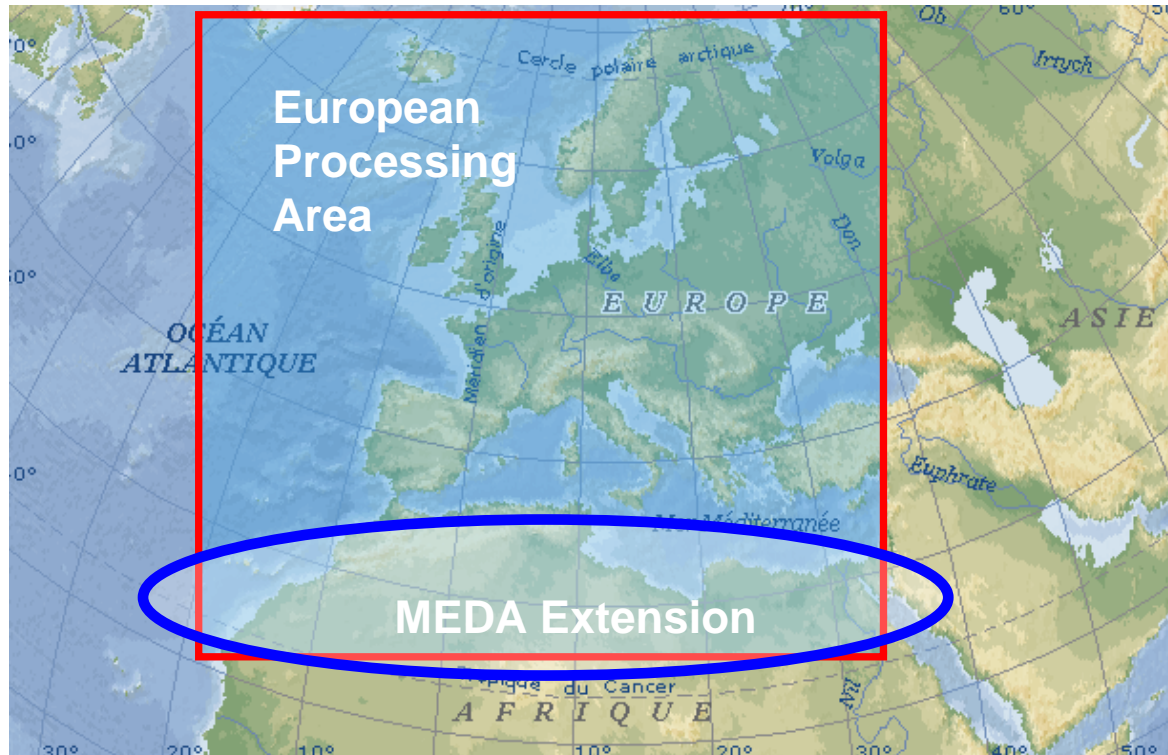




# EGNOS Performance 01/2007-08/2008



# EGNOS Extensions - MEDA



MEDA region falls within the EGNOS European Processing Area

- Homogeneous extension
- Extension of EGNOS network (Addition of 4-6 RIMS)
- EGNOS Central processing

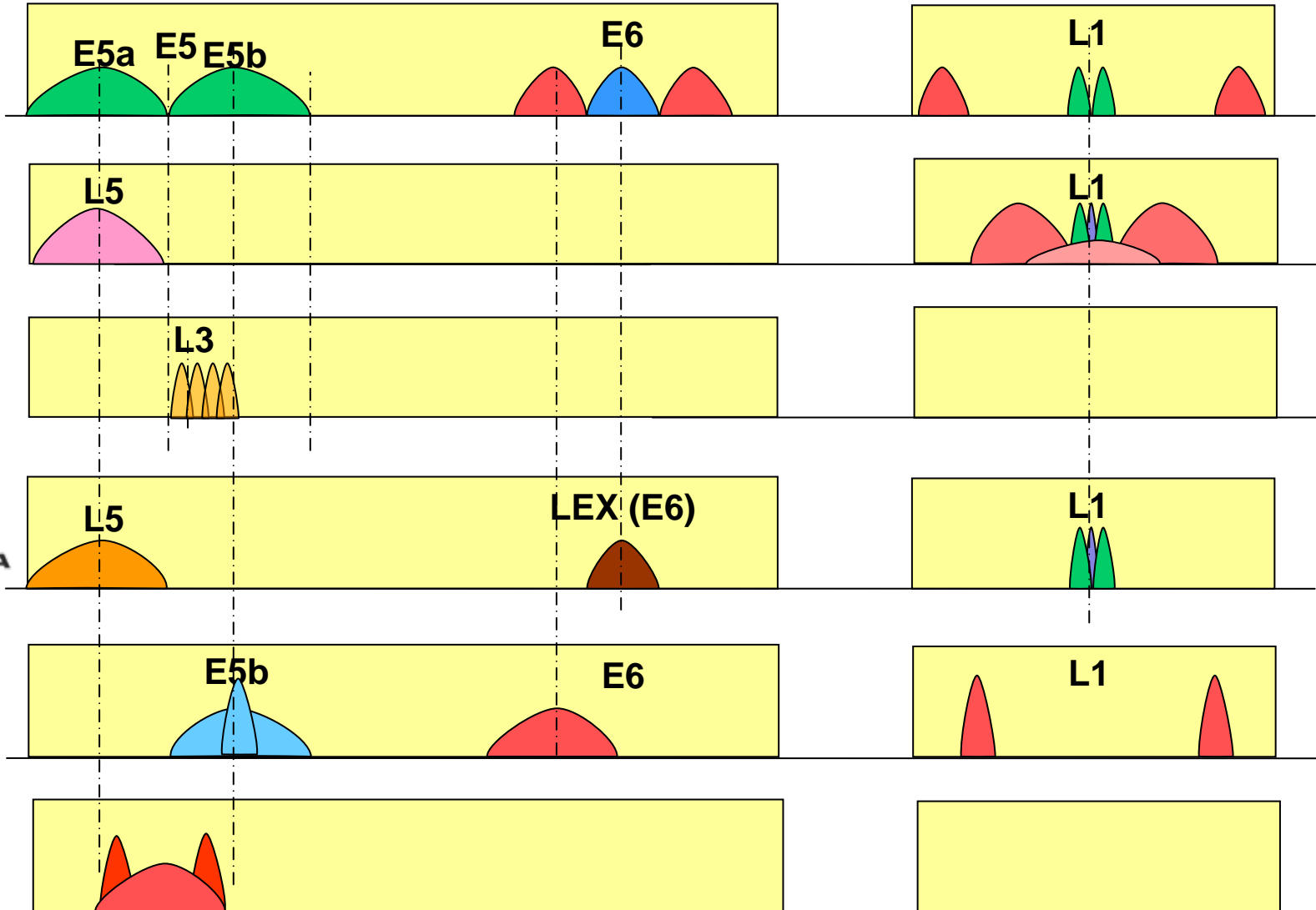
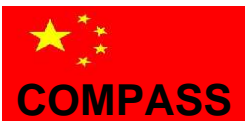
# EGNOS Extensions - ACAC



ACAC region falls outside of EGNOS European Processing Area

- Regional extension
- Extension of GPS integrity monitoring
- Additional ionospheric monitoring

# Compatibility & interoperability with other GNSS



# IGC: Compatibility & interoperability of GNSS

- ***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.
- ***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.

# ● Compatibility & interoperability of GNSS (2)

## ● Galileo and..

### » GPS:

- EU-US Agreement signed on June 2004
- 6 Working Group meetings on compatibility and interoperability (WGA) in 2005-2007

### » GLONASS:

- 3 Technical Group meetings in 2004-2005; restarted in 2007

### » QZSS:

- 6 Technical group meetings in 2004-2007

### » Nigcomsat:

- 1 coordination meeting in 2007

### » COMPASS:

- 1 initial coordination meeting in 2007

A satellite constellation is shown in orbit around Earth. The Earth is on the right side of the image, showing blue oceans and white clouds. Several satellites are visible, each with two rectangular solar panels. Two prominent yellow lines represent orbital paths. The background is a dark space filled with stars.

*Thank you for your attention!!*