



## EGNOS status, roadmap, extension to Euromed

Joint ACAC/ICAO Workshop on GNSS  
Rabat, 7-8 Nov 2017



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European Commission (EC)





## EU GNSS Programmes

# European satellite navigation consists of two systems



## □ EGNOS

- SBAS
- Improves GPS performance (and Galileo)
- 3 services (operational since 2009)
- Continental (European/regional) coverage



## □ Galileo

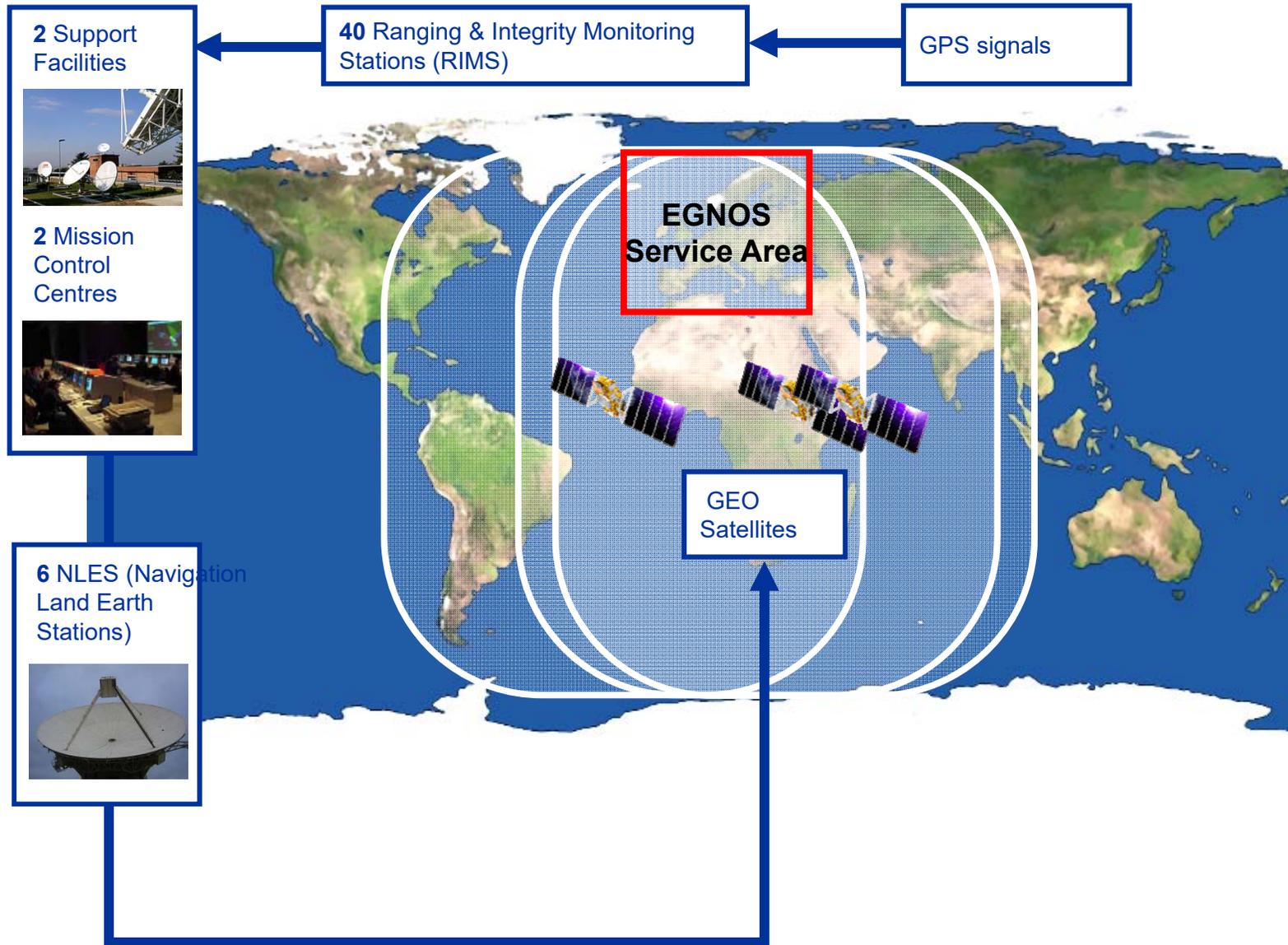
- Autonomous infrastructure
- Performances and features better than GPS
- 5 services (OS, SAR launched 2016)
- Worldwide coverage





**EGNOS**

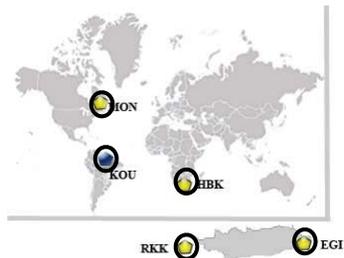
# EGNOS System Architecture and Service Area



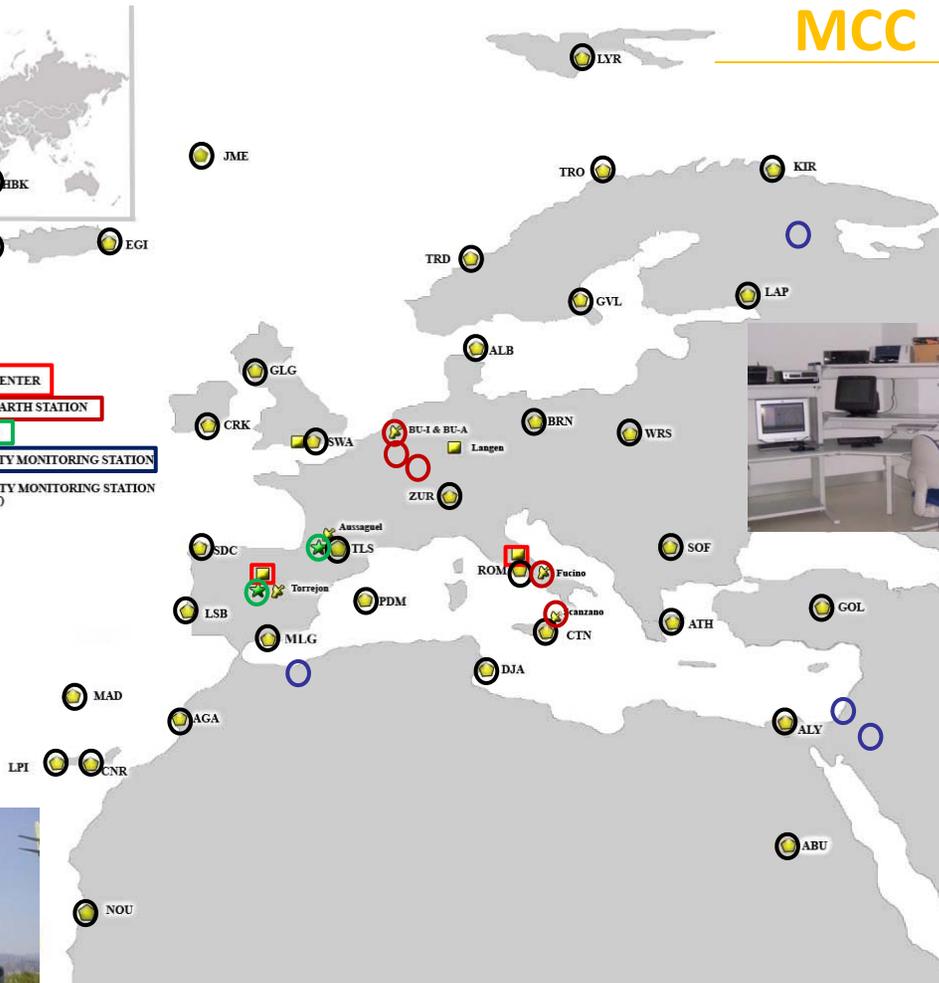
# EGNOS GROUND & SUPPORT SEGMENT



**NLES**



-  MISSION CONTROL CENTER
-  NAVIGATION LAND EARTH STATION
-  SUPPORT FACILITIES
-  RANGING & INTEGRITY MONITORING STATION
-  RANGING & INTEGRITY MONITORING STATION (ON TEST)



**MCC**



**RIMS**



**C**

**B**

**A**

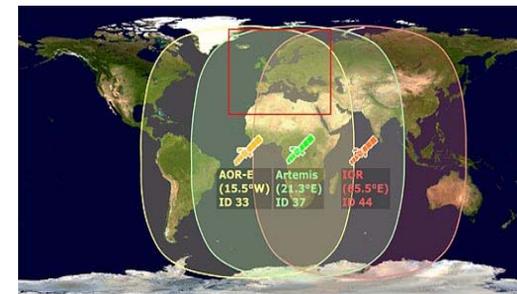
## EGNOS services are delivered on a long-term basis

<b>Open Service (OS)</b>	Accuracy ~1m, free	
<b>Safety of Life Service (SoL)</b>	Accuracy ~1m, compliant to aviation standards	
<b>EGNOS Data Access Service (EDAS)</b>	Accuracy <1m, corrections provided by terrestrial networks	

**SoL (APV-1)**  
**SoL (LPV-200)**

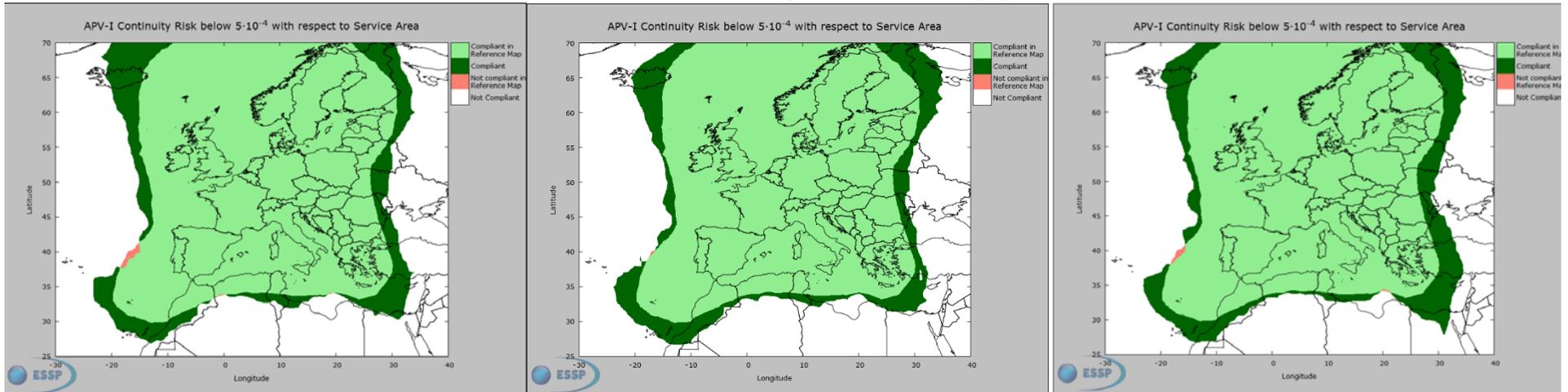
# EGNOS SoL is fully operational for aviation

- ❑ **Safety of Life** service has been declared operational in March 2011
- ❑ EU committed to keep it free of charge (letter to ICAO), for at least 20 years and with 6-years notice
- ❑ Service provider certified based on the Single European Sky Regulatory package
- ❑ EGNOS landing procedures being developed around EU for their benefits:
  - Very precise vertical guidance
  - Safer landings at airports not equipped with ground-based navigation aids (e.g. ILS)
  - Increased airports capacity

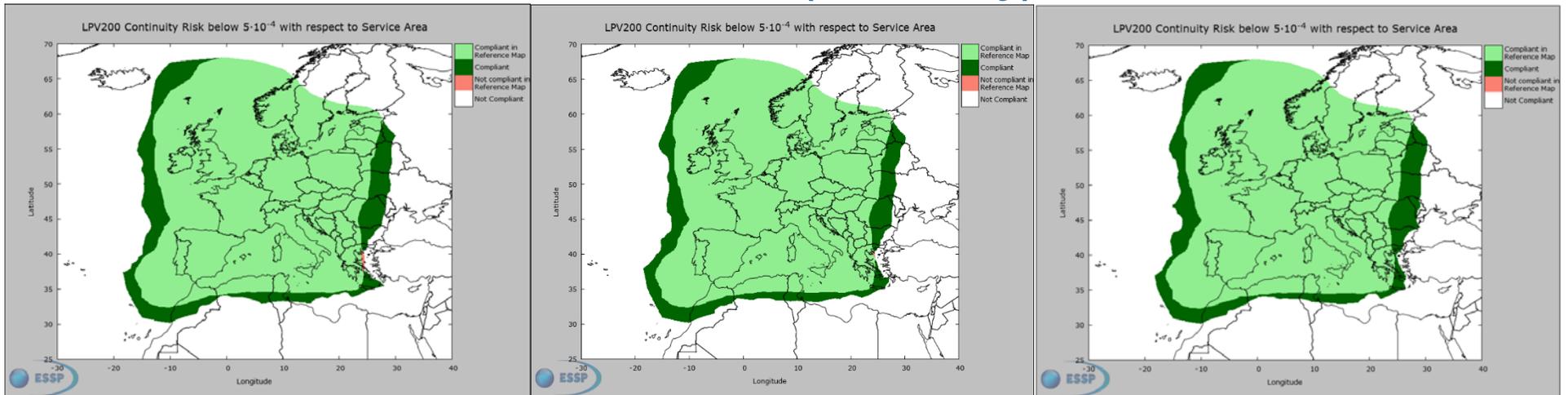


**About 380 approach procedures use EGNOS for aircraft landings in 20 countries**

## APV-1 Service (continuity)



## LPV-200 Service (continuity)



June 2017

July 2017

August 2017

# Landing procedures implementation status and forecast



Navigation solutions powered by Europe

**As of today**  
**377 LPV procedures**  
**→ Serving 223 airports**



**Plans by 2018**  
**> 450 LPV procedures**



Source: ESSP, GSA

# Manufacturers offer Commercial, Business and General Aviation SBAS-ready aircraft / rotorcraft ...

**AIRBUS**  
Airbus A350, Beluga

**BOMBARDIER**  
Bombardier CRJ  
700/900/1000, CS100/300,  
Dash 8 Q400

**AgustaWestland**  
AW109SP, AW119Kx,  
AW139, AW169,  
AW189

**Cessna**  
Citation Mustang, M2, CJ2+,  
CJ3+, CJ4, XLS+, Latitude,  
Sovereign+, X+ and Longitude

**DASSAULT**  
SB Falcon 900LX/5X/  
7X/2000LXS/2000S;

**Gulfstream**  
G650 and G280, SB  
G150/G550/G450/G350

**Piper**  
Meridian, Seminole, Mirage, Matrix,  
Archer, Seneca V and Arrow

...and many operators have adopted EGNOS

**USEGALILEO.EU**  
FIND A GALILEO-ENABLED DEVICE TO USE TODAY

ON THE ROAD ON THE WATER ON THE TRAIN **IN THE AIR** ABOUT

GOING MOBILE ON THE FARM ON THE MAP DURING AN EMERGENCY TEXT SEARCH CONTACT

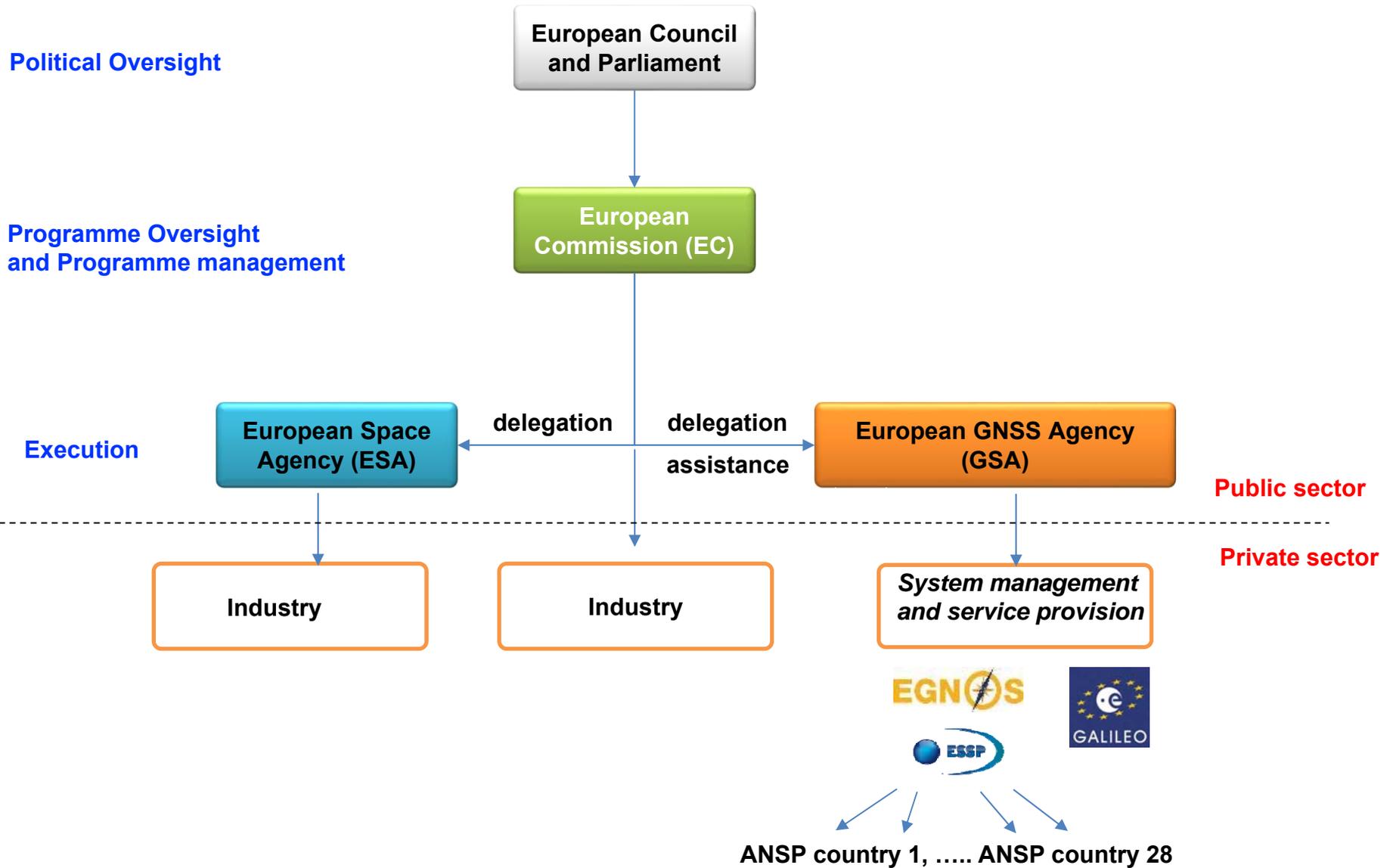
**In The Air**

With global air traffic continuing to increase, there is growing pressure to better utilise our airspace. EGNOS - the European Geostationary Navigation Overlay Service - helps accomplish this by enabling more accurate routes, optimising airport access and improving flight safety. In the future, also Galileo will support aviation operations, while the receivers for Unmanned Autonomous Systems (UAS) are already using Galileo.

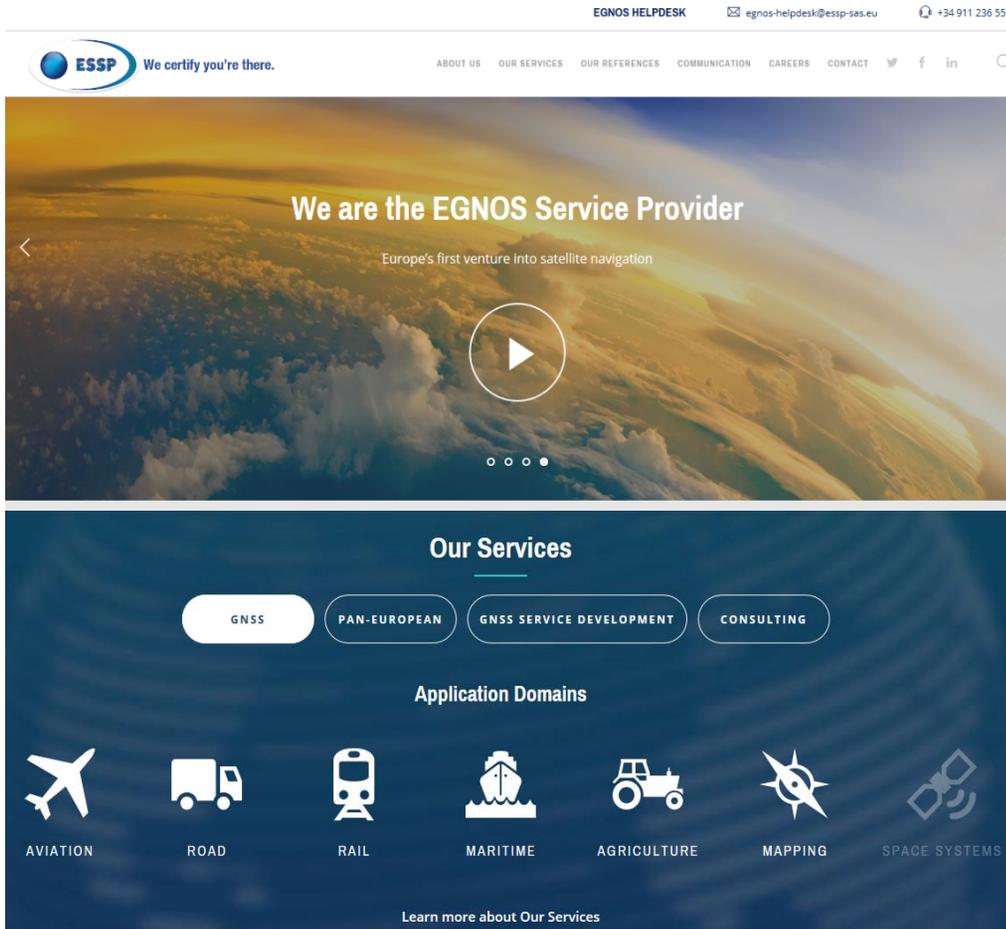
As of today the 8 items listed below are EGNOS-capable or Galileo-ready.

Operator	Status
Airports	<input type="radio"/>
EGNOS-enabled avionics	<input type="radio"/>
Flight operators	<input type="radio"/>
Business aviation operators	<input type="radio"/>
Commercial/regional aviation airlines	<input checked="" type="radio"/>
UAS (Unmanned Aerial Systems) receivers	<input type="radio"/>
Air Baltic	EGNOS soon with GSA support
Air Nostrum	Your airline is flying with EGNOS
Aurigny Air Services	Your airline is flying with EGNOS
Eastern Airways	EGNOS soon with GSA support
HebriideanAir	Your airline is flying with EGNOS
HOP!	EGNOS soon with GSA support
Isles of Scilly	Your airline is flying with EGNOS
LoganAir	Your airline is flying with EGNOS

# Who provides EGNOS services?



# EGNOS Service Provision: ESSP (European Satellite Service Provider)



The screenshot shows the ESSP website homepage. At the top, there is a navigation bar with the ESSP logo and the tagline "We certify you're there." followed by menu items: ABOUT US, OUR SERVICES, OUR REFERENCES, COMMUNICATION, CAREERS, CONTACT, and social media icons for Twitter, Facebook, and LinkedIn. A search icon is also present. Below the navigation bar is a large hero section with a background image of a sunset over a landscape. The text in the hero section reads "We are the EGNOS Service Provider" and "Europe's first venture into satellite navigation". A play button icon is centered over the image, indicating a video player. Below the hero section is a "Our Services" section with four buttons: GNSS, PAN-EUROPEAN, GNSS SERVICE DEVELOPMENT, and CONSULTING. Underneath is an "Application Domains" section with seven icons representing different sectors: AVIATION (airplane), ROAD (truck), RAIL (train), MARITIME (ship), AGRICULTURE (tractor), MAPPING (compass), and SPACE SYSTEMS (satellite). At the bottom of the page, there is a link that says "Learn more about Our Services".

- ❑ Certified provider of **Safety of Life service** in aviation in EU in March 2011.
- ❑ Air Navigation Service Providers **have to sign an EGNOS Working Agreement (EWA) with ESSP** to be able to activate use of EGNOS SoL.
- ❑ Other uses (non-SoL) take place without any formal step.

<https://www.essp-sas.eu/>

# EGNOS is operational - OS since October 2009, SoL service since March 2011 - : our priorities



## ☐ **Ensure that EGNOS is used**

- Fostering procedures and receivers in aviation domain
- Communication plan & EGNOS branding in other domains

## ☐ **Ensure the continuity of the EGNOS services**

- Maintain the certificate of Safety of Life service, process and resolution of safety incidents
- Deploy and declare new system versions and master the Obsolescence and the Maintainability
- Ensure evolution of system technology

# Galileo is operational too!



- Deployment is being accelerated (18 Satellites / 30)  
Early OS/SAR/PRS services from 2016, full services by 2020
- From 3 receiver manufacturers in 2010 to more than 20 in 2017, representing more than 95% of the suppliers in the world.

2010

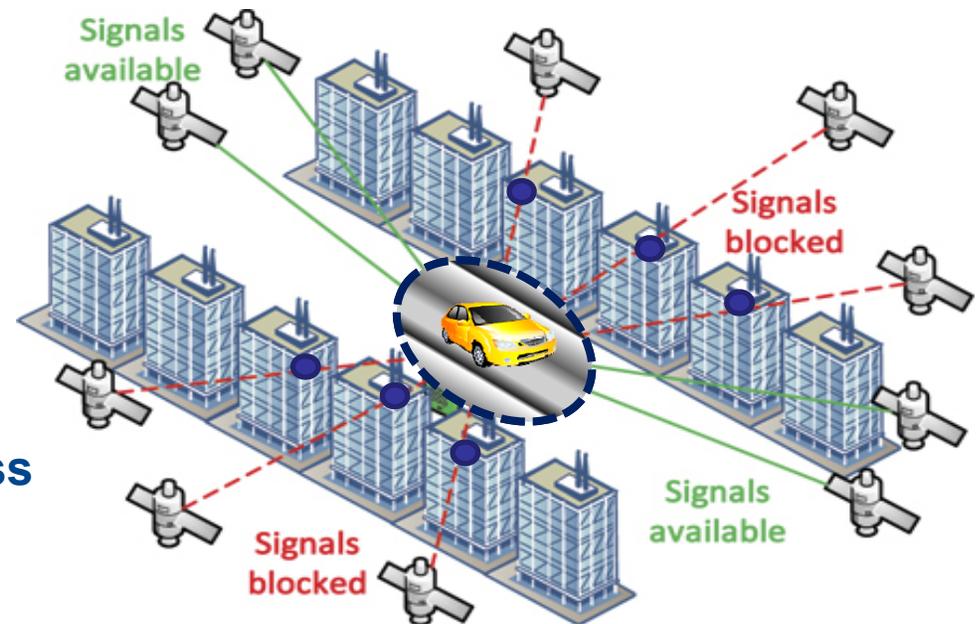


2017



## Example: GNSS for transport of dangerous goods: Galileo/multi-constellation

- **Multi-constellation (Galileo+ GPS + Glonass + BeiDou):** when obstacles block the signal and reduce the number of visible satellites, the availability of more constellations ensures a further more accurate/robust position
- **Multi-frequency increases robustness of the position against jammers,** because even if a satellite is not available or providing incorrect data, a reasonable accuracy will be achieved
- **Consumer-grade receivers are multi-constellation ready**



# EGNOS/Galileo services more and more linked to EU policies

- Aviation: En route/Terminal, Drones, Surveillance & Tracking, ....
- Timing for Critical Infrastructures
- Approved as a Global Maritime Distress & Safety System
- European Radio-Navigation Plan (ERNP)
  - Modernise, rationalise infrastructure
  - Synergies between sectors

## Examples of EU legislation requiring EGNOS/Galileo technologies

**Performance Based Navigation: EGNOS (and Baro) as mean of compliance for civil aviation in EU (by 2020 EASA implementing rule)**

**Digital Tachograph: device that registers position, velocity, etc and requires Galileo compatible receiver:**

- Compulsory in EU for all new trucks (freight or passengers) registered from 15 June 2019

**eCall: device that sends automatically to the emergency centers information of the car upon a crash, including a position base Galileo, airbag and sensors information, etc It requires:**

- Compulsory in EU for new types of cars from April 2018



of 17 July 2015

setting out the necessary technical and operational specifications for implementing version 3 of the EGNOS system

TECHNICAL AND OPERATIONAL SPECIFICATIONS

1. Main characteristics of EGNOS v3 which are maintained or improved from, or added to EGNOS v2

	EGNOS v2	EGNOS v3
Receivers modes	— Mono-frequency mono-constellation: GPS L1	— Mono-frequency mono-constellation: GPS L1 — Dual-frequency mono-constellation: GPS L1/L5 or Galileo E1/E5a — Dual-frequency dual-constellation: GPS L1/L5 + Galileo E1/E5a
Specific services for Aviation	— En-route/non-precision approach — Approach with vertical guidance APV-I — LPV-200 approach	— En-route/non-precision approach — Approach with vertical guidance APV-I — LPV-200 approach — CAT-I precision approach
Specific services for Maritime	n.a.	— Oceanic areas — Navigation in harbour entrance, harbour approaches and coastal waters
Capability of the system to be replicated	yes	yes
Compatibility of service performance at user level vs. previous version	n.a.	yes
Limitation of services <sup>(1)</sup>	— Safety of Life area limited to [40W, 40E], [20N, 70N] — Maximum number of stations limited to 60	None <sup>(2)</sup>

V3 technology enables seamless EGNOS service extensions

<sup>(1)</sup> User access for open service and safety of life services limited to visibility area of the geostationary satellites.

<sup>(2)</sup> Absence of limitation to allow the design of EGNOS v3 to include additional stations in order to extend, in a continuous manner, the EGNOS service area in accordance with Article 2(5) of Regulation (EU) No 1285/2013.



Beyond EU



# EGNOS beyond EU – the drivers (EU)



- Promote use of SBAS, especially for air transport.
- Pursuing other EU policies (i.e. cooperation, external relations, neighbouring, transport harmonisation).
- Enhance the opportunities for the European GNSS technologies and application industries (upstream and downstream).

- Aviation: use EGNOS/SBAS to comply with ICAO requirements on PBN
  - Save on ILS investment
  - Increase safety
  - Open new routes
  - Improve operations efficiency
  
- Use the EU SBAS technology in other transports & non-transport domains.
  
- Cooperate with EU on space matters.

- **EGNOS SoL / autonomous SBAS signal coverage (infrastructure)**
- **EGNOS SoL: International Agreement/SES compliance + EWA for use in aviation**

# EGNOS beyond EU: extensions without infrastructure service to non-EU areas (already SoL-covered)



Navigation solutions powered by Europe

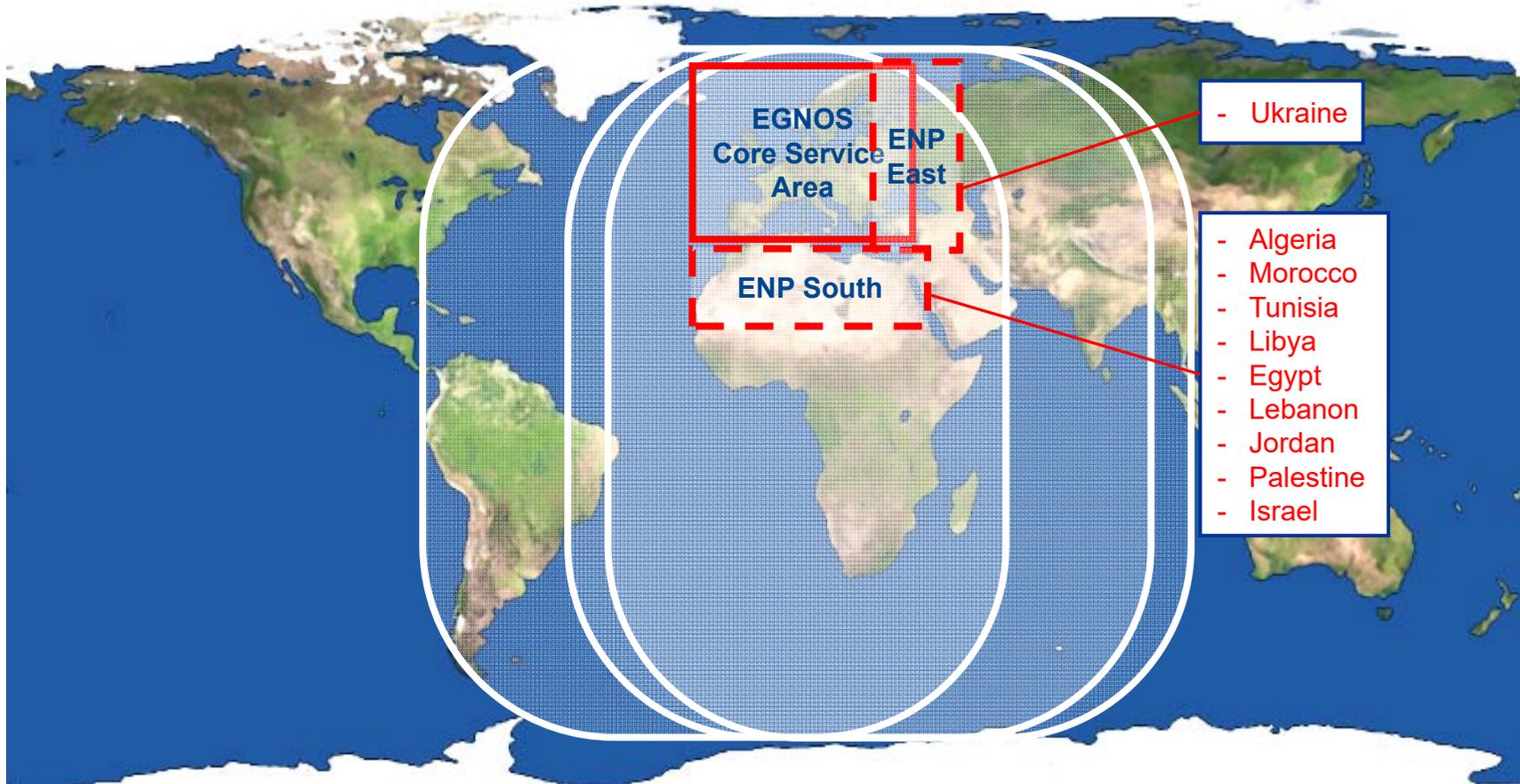


- Albania
- Bosnia-Herzegovina
- Kosovo
- FYR of Macedonia
- Montenegro
- Serbia

## We need:

- Assessment of compliance with Single European Sky regulation
- Operational agreements ESSP-local ANSP (EGNOS Working Agreement, EWA)

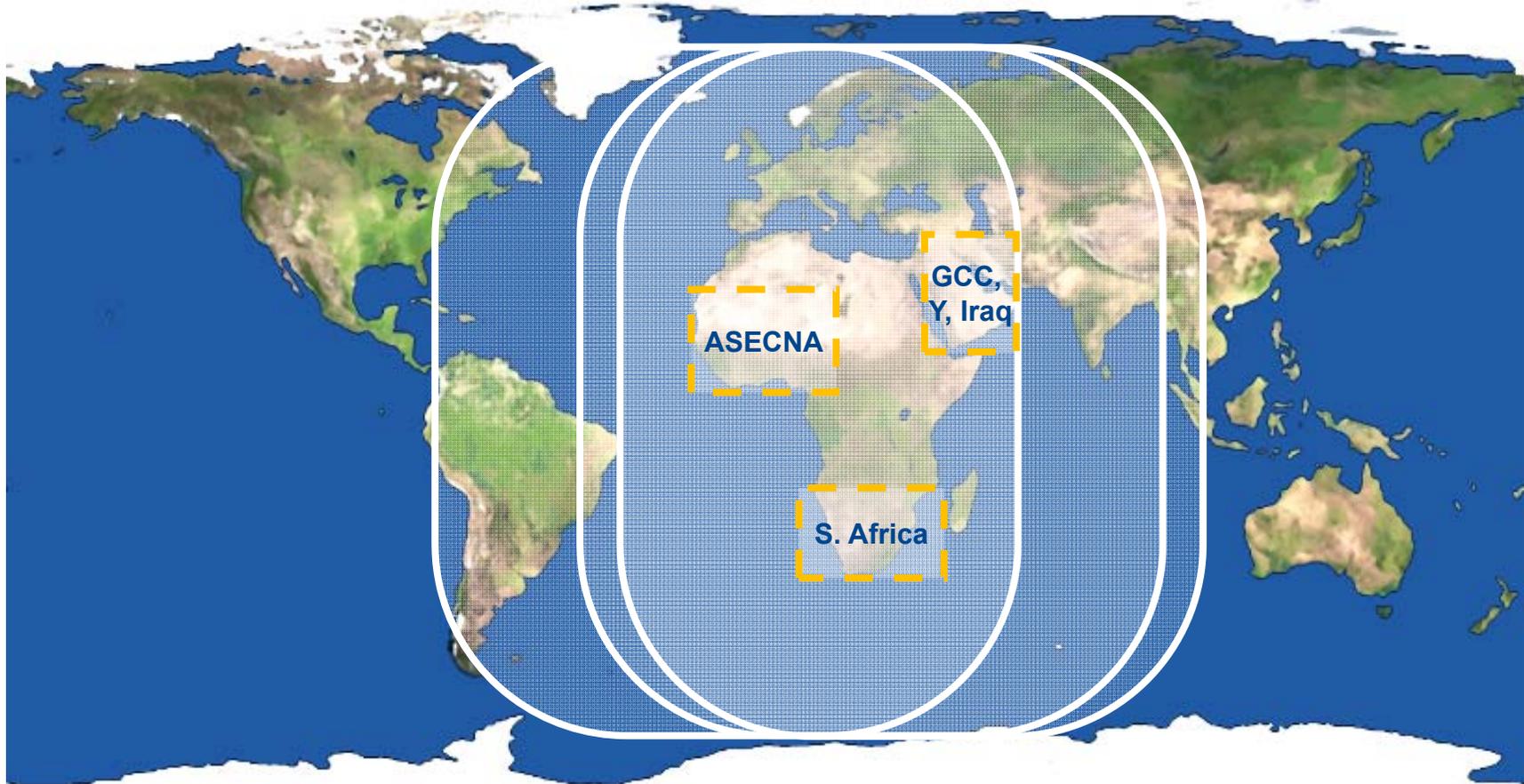
# EGNOS beyond EU: extensions of core system, with expansion of ground segment (RIMS)



## We need:

- Funding from other EC funds (DG NEAR) to connect new RIMS
- International bilateral agreements EU-each State (to define liability in case of EGNOS failure which results in death/injury/loss/damage to equipment)
- Operational agreements ESSP-local ANSP (EGNOS Working Agreement, EWA)

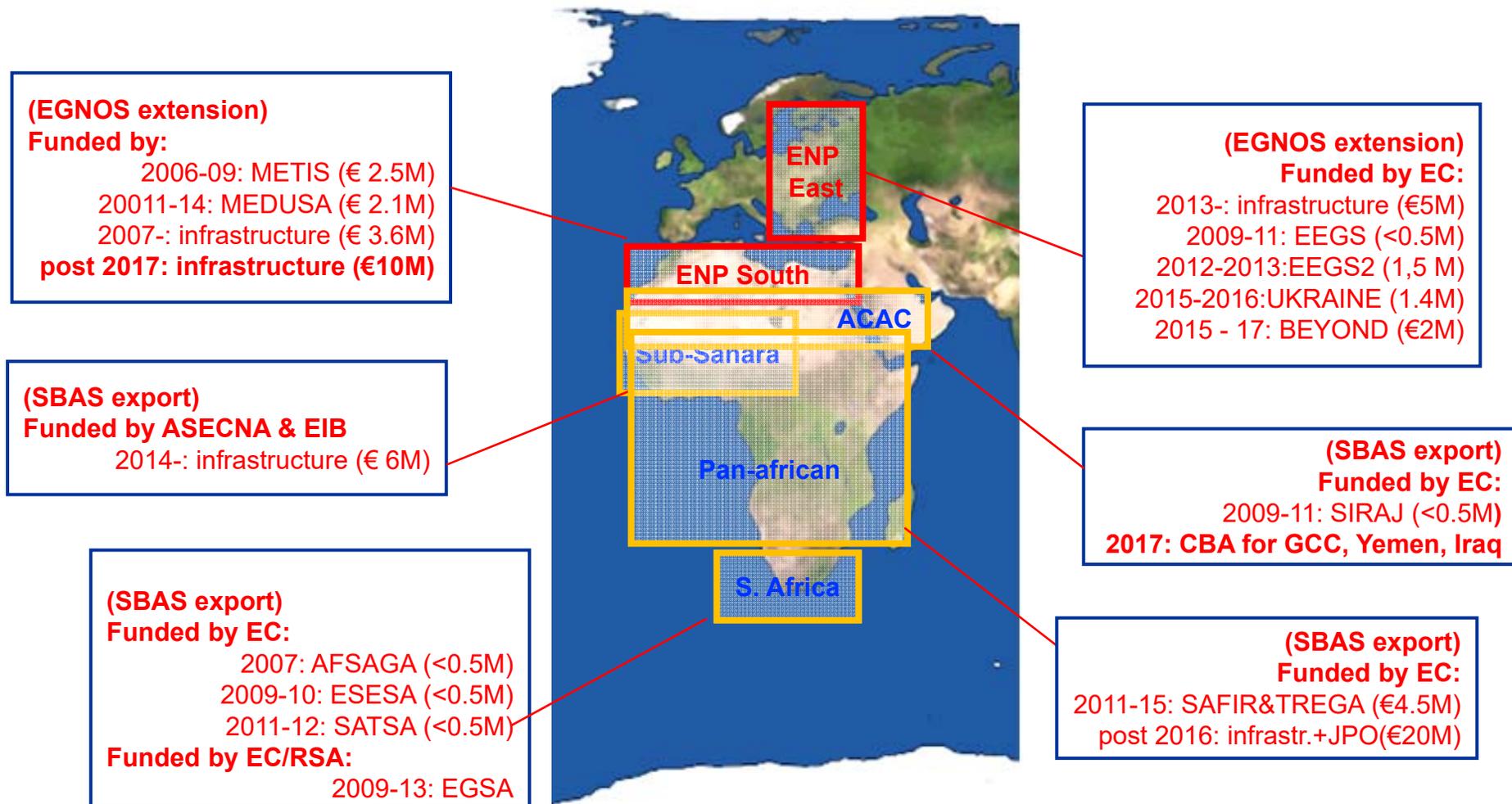
# EGNOS beyond EU: autonomous systems (based on EU SBAS technology export)



## We need:

- Funding (other EC funds for Africa, own funds for GCC, Yemen, Iraq, S. Africa)

# EGNOS beyond EU: extensions & EU SBAS technology export – activity to date



**Areas covered:**

- 1) Users needs, real life tests and demo (e.g. SoL)
- 2) GNSS skills
- 3) System infrastructure
- 4) Governance, regulatory roadmap to adoption

# EGNOS extension to ENP South (Euromed) – technical assistance to countries

## MEDUSA

Expanding EGNOS in North Africa/Middle East

The European Geostationary Navigation Overlay Service (EGNOS) and Galileo also provide benefits to non-EU countries, in terms of increased **accuracy** and **reliability**.

EGNOS delivers three distinct services with European regional coverage:

- EGNOS Safety-of-Life Service (SoL) certified for use in aviation applications since 2011
- EGNOS Open Service (OS) for use with consumer-grade receivers and in mass-market applications
- EGNOS Data Access Service (EDAS) for professional applications requiring accurate and reliable positioning.

Backed by the European Commission under the umbrella of its **Neighbourhood Policy**, the Euromed GNSS programme promotes EGNOS service extension to countries in **North Africa and the Middle East around the Mediterranean**.

These nations are **Algeria, Egypt, Israel, Jordan, Lebanon, Libya, Morocco, Palestine, Syria, and Tunisia**.

From 2006 until 2015, through two sequential phases, **METIS** and **MEDUSA**, Euromed GNSS ran programs providing **technical assistance, training, capacity building and regulatory analysis**, and involving the Ministries of Transport and aviation authorities of the participating countries.



### EGNOS SoL in aviation

**LPV approach procedures validated at Monastir airport (Tunisia): the first outside Europe**

**8 GNSS procedures for runways (RWYs) developed for 4 airports/countries:**

- 2 RWYs Monastir/Tunisia
- 3 RWYs Beirut/Lebanon
- 2 RWYs Bejaia/Algeria
- 1 RWY Ben-Gurion/Israel

**Training courses on:**

- GNSS/EGNOS receivers, data sources/collection, data performance analysis tools, GPS+RAIM monitoring
- GNSS procedures design (PANS OPS 8168 advanced class)
- Guidelines for safety assessment

**EGNOS adoption in operations:**

- Institutional process
- Regulatory framework based on 20 ICAO provisions
- States' regulatory analysis
- States' readiness and identification of next steps
- Recommendations for GNSS national strategy

# Proposed roadmap for EU SBAS solutions in ACAC (EGNOS extensions + EU SBAS export)\*

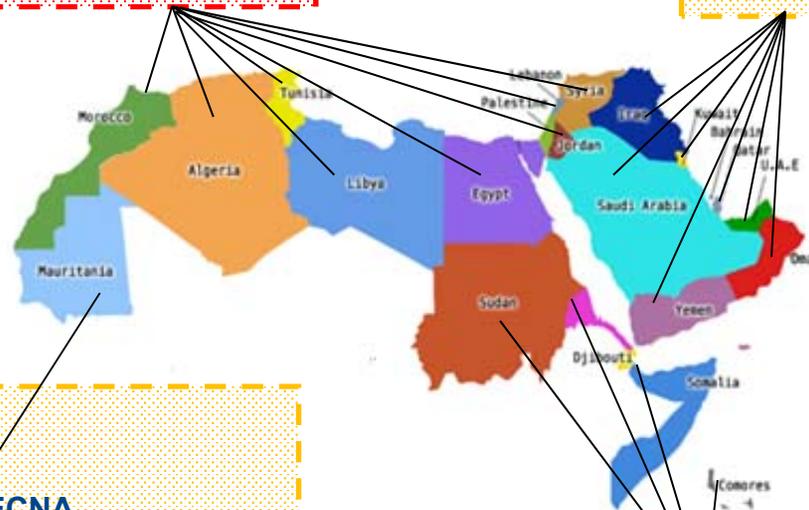
## ENP South (Euromed) extension of EGNOS

- 1) Funding for infrastructure identified
- 2) International agreements to be signed with each State.

## GCC, Yemen, Iraq

System feasibility study (Thales) and cost-benefit analysis (TPZ) performed.

Autonomous SBAS system identified.



## West Africa

Agreement signed with ASECNA.

Technical solution (i.e. infrastructure) being developed via Africa development funds.

Study to be launched to define budget, timeline and development plan of EGNOS V3 extension.

## East Africa

Technical solution (and consequent infrastructure) to be identified. Cooperation funds available to follow ASECNA-like approach.

(\* Conclusions of ACAC/ICAO MID workshop on GNSS on "Regional developments related to GNSS" (Rabat-Morocco, 5 April 2016)

# EGNOS extension to ENP South (Euromed) - Conclusions and next steps



- Extension of core EU system for EGNOS SoL requires only three RIMS (instead of 5), according to recent industry proposal.
- EC (summer 2017) identified funding options (€10M).
- EC will ask EU Member States permission to start negotiating International Agreements.
  
- As of today, 6 States formally interested (Morocco and Egypt not included)
  - Workshop held in May 2017
  - 2018: Planned technical assistance for the 6 States
  - 2018: Initial technical work (e.g. site surveys) to identify RIMS sites
  
- The technical work for installing RIMS can run in parallel of International Agreement negotiations.



**EGNOS SoL service available in 2020-23**



**Thank you for the attention**

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