EGNOS Programme Update

prepared by ESA-EGNOS Project

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EGNOS ON BOARD (large/medium size aircrafts equipped with EASA certified avionics)

780 A350 ordered by dec 2014
GLS/SBAS/EGNOS (Rockwell/ Collins)

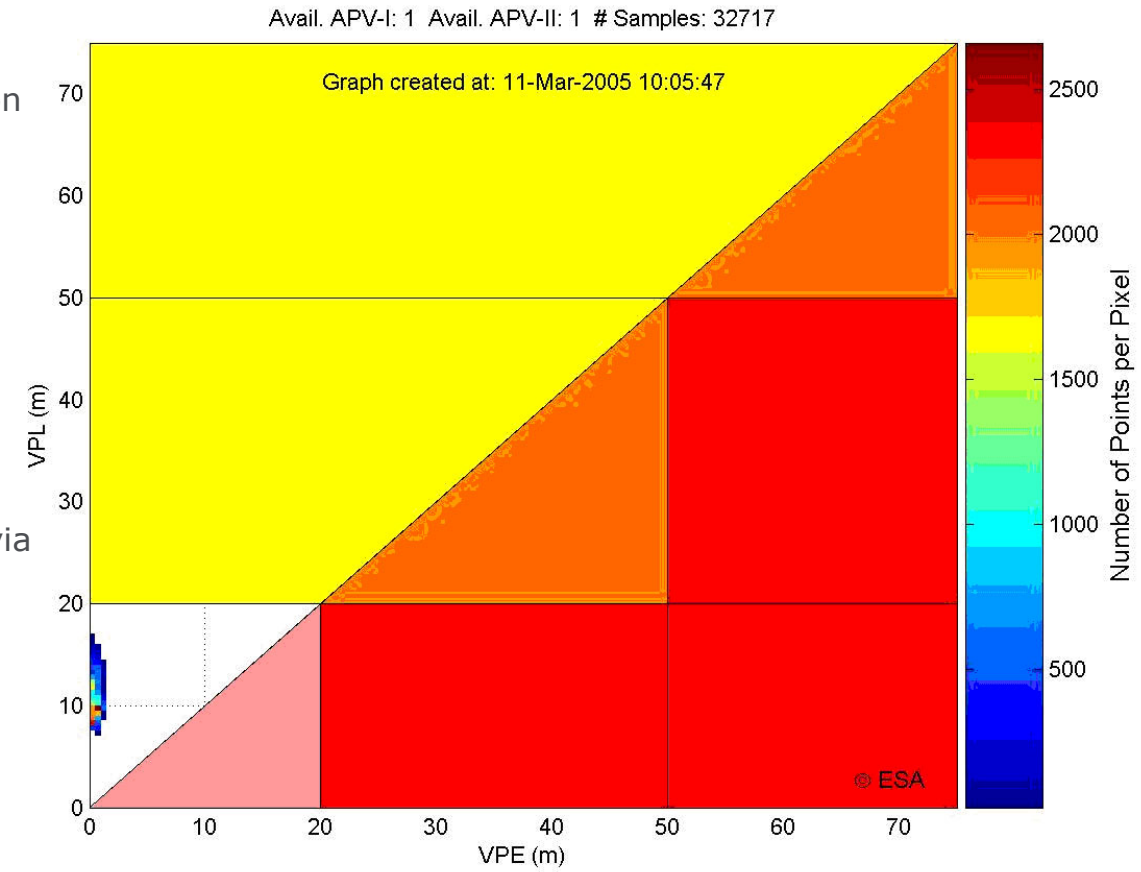
A400 M (180 ordered)
EGNOS MMR (Thales Av)

AIRBUS Beluga (10)
(SBAS/EGNOS CMC)

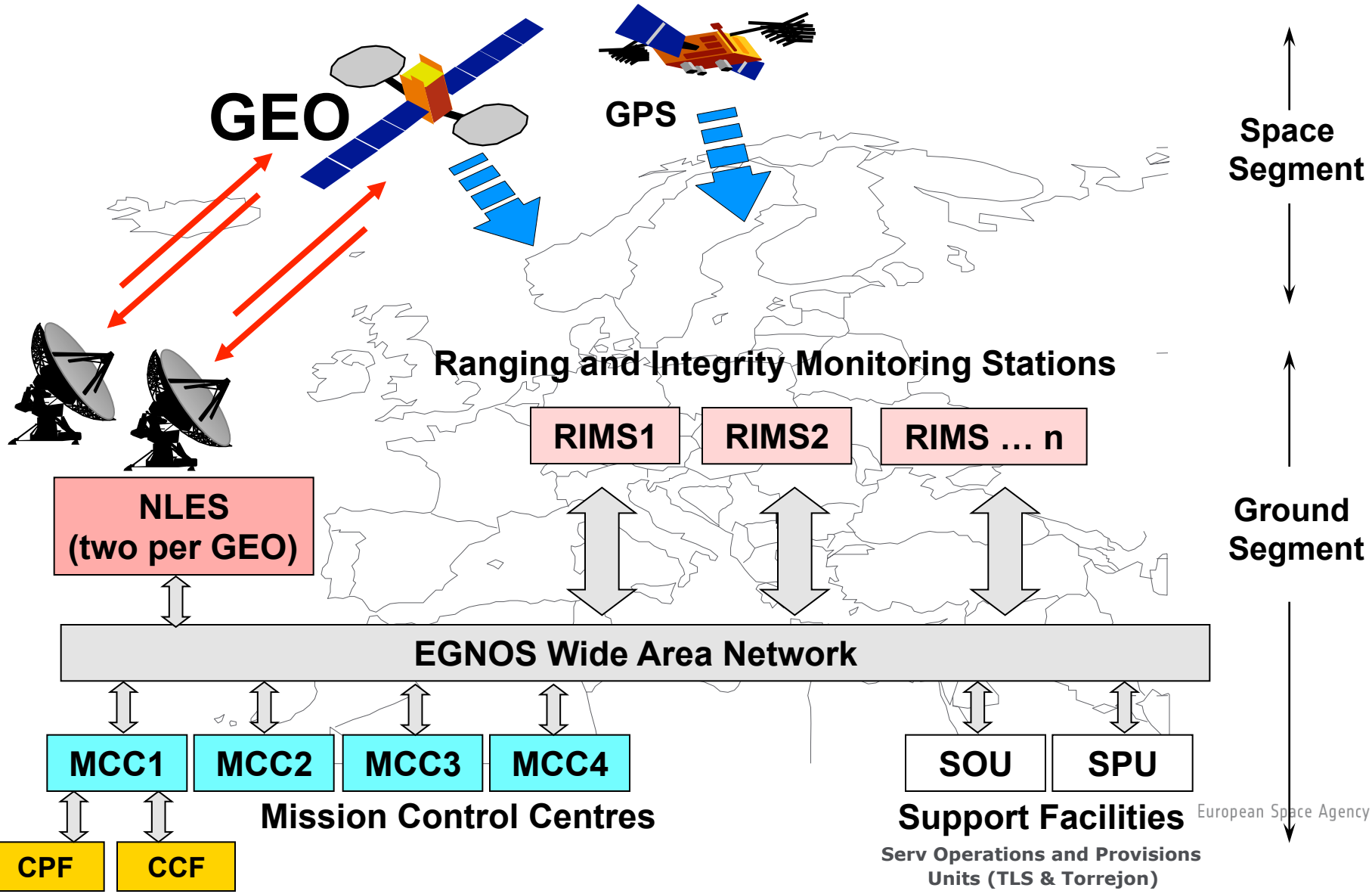
ATR 600's - 500 ordered
(Nav Suite - MMR Thales Av)

What is EGNOS?

- EGNOS = European Geostationary Navigation Overlay Service
- augments the US GPS satellite navigation system supporting safety critical applications (eg: flying aircraft or navigating ships)
- Joint project of ESA, EC and Eurocontrol
- ownership of EGNOS was transferred to the European Commission on **1 April 2009** and now managed and operated via European Satellite Services Provider (ESSP)
- Safety of Life service has been officially declared available for aviation on 02 March 2011



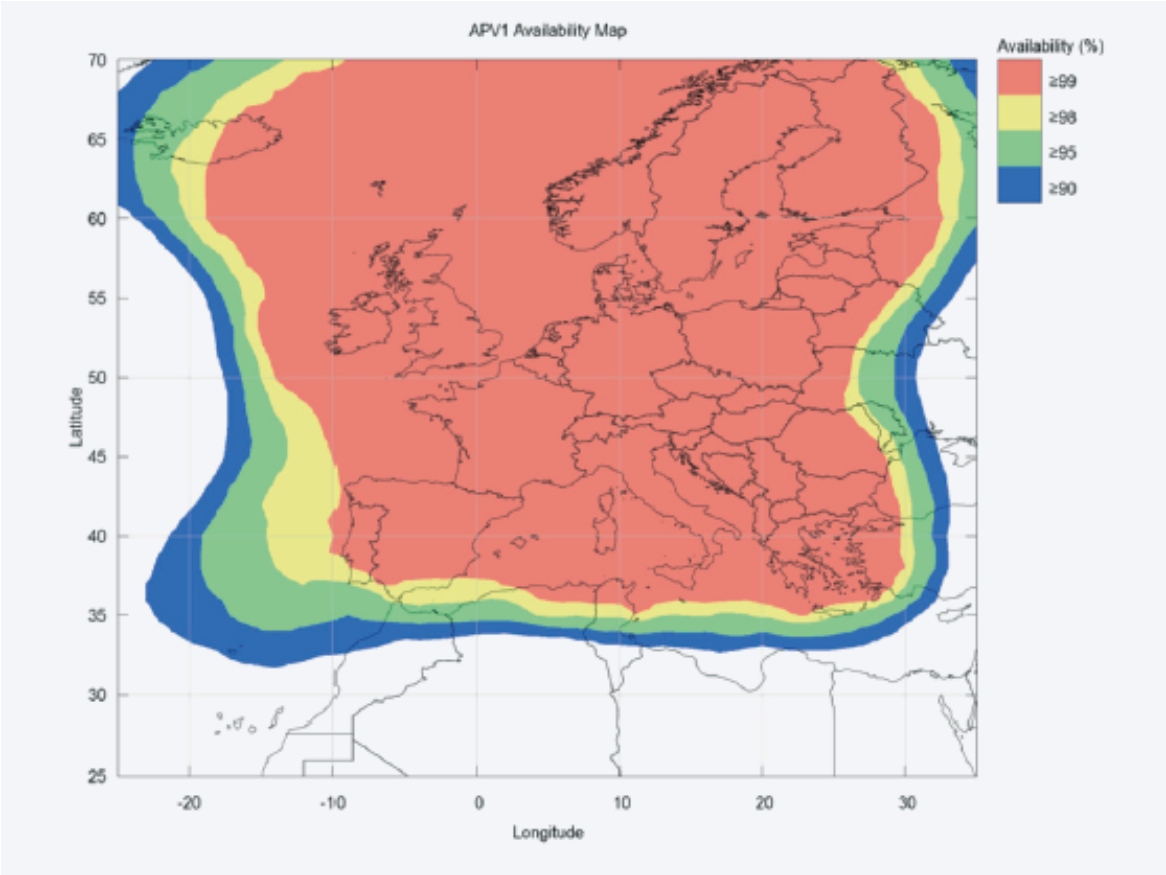
EGNOS Architecture



CURRENT EGNOS STATUS (1/2)

- Current EGNOS Release: **ESR 2.3.2** (since 7.11.2013).
- System status highlights:
  - 2 Operational GEOs (PRN120 – Inmarsat 3F2, PRN126 – Inmarsat 4F2).
  - 1 GEO in TEST (PRN136 – Astra 4B).
  - 39 RIMS (Ranging and Integrity Monitoring Stations).
  - 4 MCC (Master Control Station). Rome (It), Swanick (Uk), Torrejon (Es), Langen(De)
  - 6 NLES (Navigation Land Earth Station).
- New ESR **v2.4.1M** qualified and deployment under preparation.

CURRENT EGNOS STATUS (2/2)



APV-1 Availability Performances

Source : EGNOS Service Definition Document
http://www.essp-sas.eu/service_definition_documents

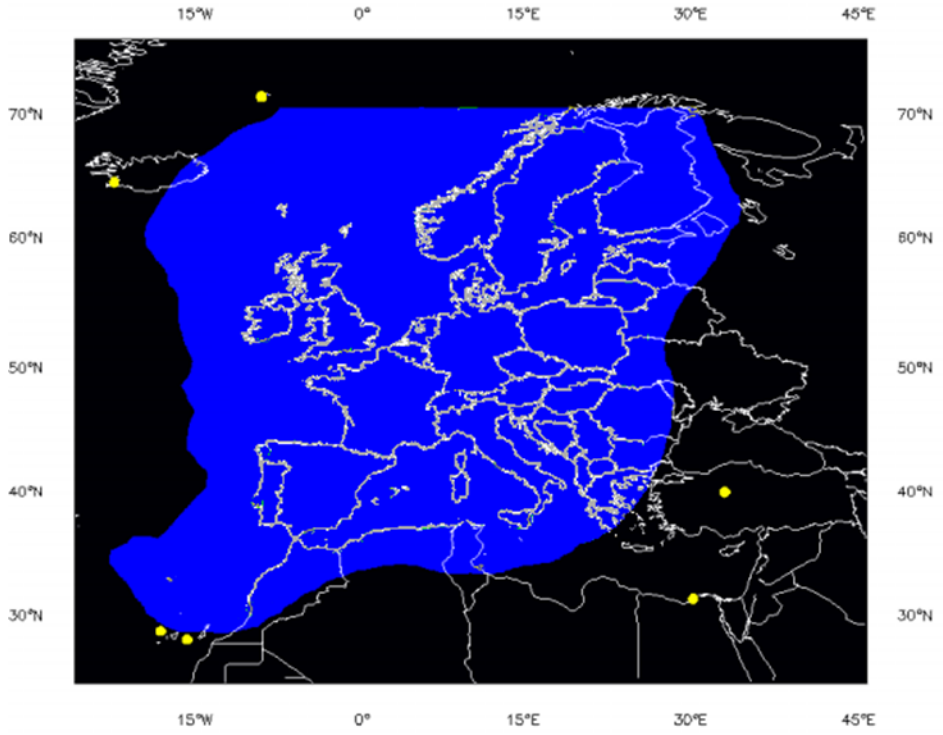
System release Plan – update

ID	PCIP signature	Contract signature	QR	Ops entry	New features
V2.3.1i	N/A	Mar 2012	Jul 2012	Aug 2012	▪ Performance improvement under severe ionosphere conditions
V2.3.2	Jul 2011 PCIP-3	Mar 2012	Jul 2013	Oct 2013	▪ Robustness against "PRN25 clock drift" feared event (Bergen) ▪ Ionosphere performance improvement step 2 ▪ Obsolescence resolution: CPF IRIG time generator, CPF switch ▪ VSAT Ku-band obsolescence resolution ▪ Network IPLC lines obsolescence resolution ▪ Compliance to EC-482 and EC-552 ▪ New RIMS: Agadir, Abu Simbel
V2.4.1M	Feb 2010 PCIP-2	Apr 2011 Mar 2012	Jul 2014	Aug 2015	▪ Obsolescence resolution: RIMS A, CCF HW, NLES, SF HW ▪ Qualification of SES-5 (ex Astra-4B) ▪ Improvement to MRD 2.0 compliance: iono algorithms ▪ New RIMS: Haifa and Tamanrasset ▪ Mission evolutions: LPV200, MOPS D, Certification ▪ Operator requirements: OURD V1 ▪ Qualification of TWAN migration
V2.4.1N	Jul 2013 PCIP-4	Oct 2014	Dec 2015	Q3 2016	▪ Qualification of Astra-5B ▪ Factory qualification of NLES G2 for Inmarsat-4F2 ▪ Integration of RIMS Haifa
V2.4.2 phase B/Co	Feb 2010 PCIP-2	Sep 2014	PDR in Feb 2016		Elements under analysis for consolidation of need and schedule: ▪Obsolescence resolution: RIMS B, RIMS C, CPF, FEE ▪Improvement to MRD 2.1 compliance: algorithms improvement ▪Coverage extension study (according to EC input scenarios) ▪GEO Ranging ▪Operator requirements: SPRD V2

V2.4.1M – Major achievement – first LPV200 qualification - July 2014

Service Level	HAL	VAL	Integrity	Continuity	HNSE 95%	VNSE 95%
APV-I	40 m	50 m	10^{-7}/150s	$8 \cdot 10^{-6}$/15s	16 m	20 m
LPV200	**40 m**	**35 m**	10^{-7}/150s	$8 \cdot 10^{-6}$/15s	**16 m**	**4 m**

Table 1: LPV service level horizontal and vertical performances



Observed LPV200 performance used in the qualification review of V2.4.1M – July 2014

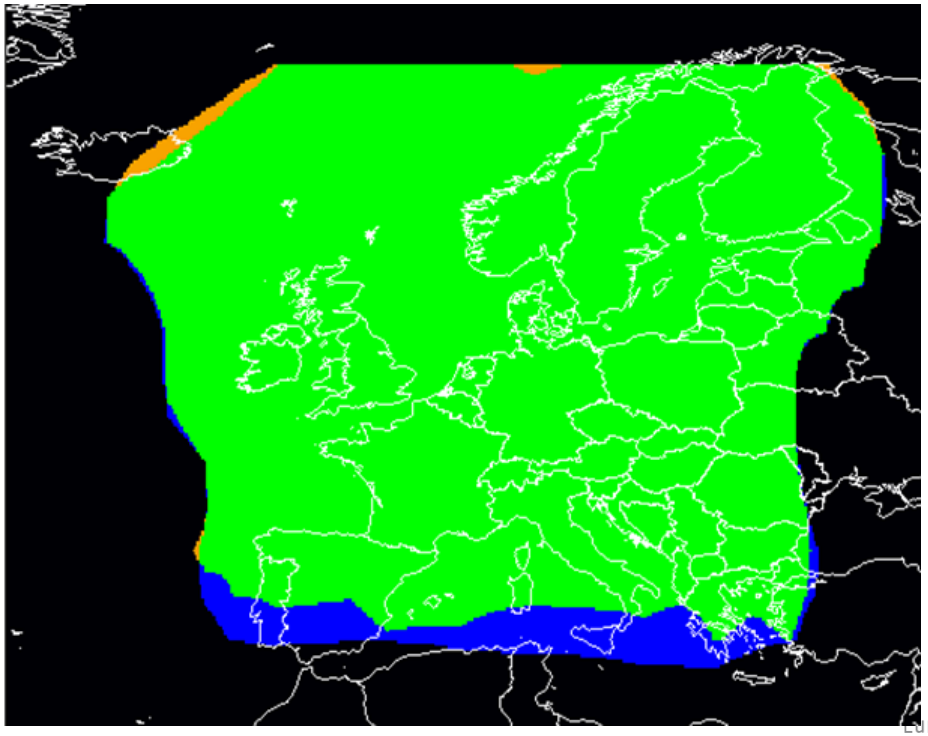
Improved Vertical Alarm Limit and Nav System Error

Service Declaration Document in 2015 (GSA)

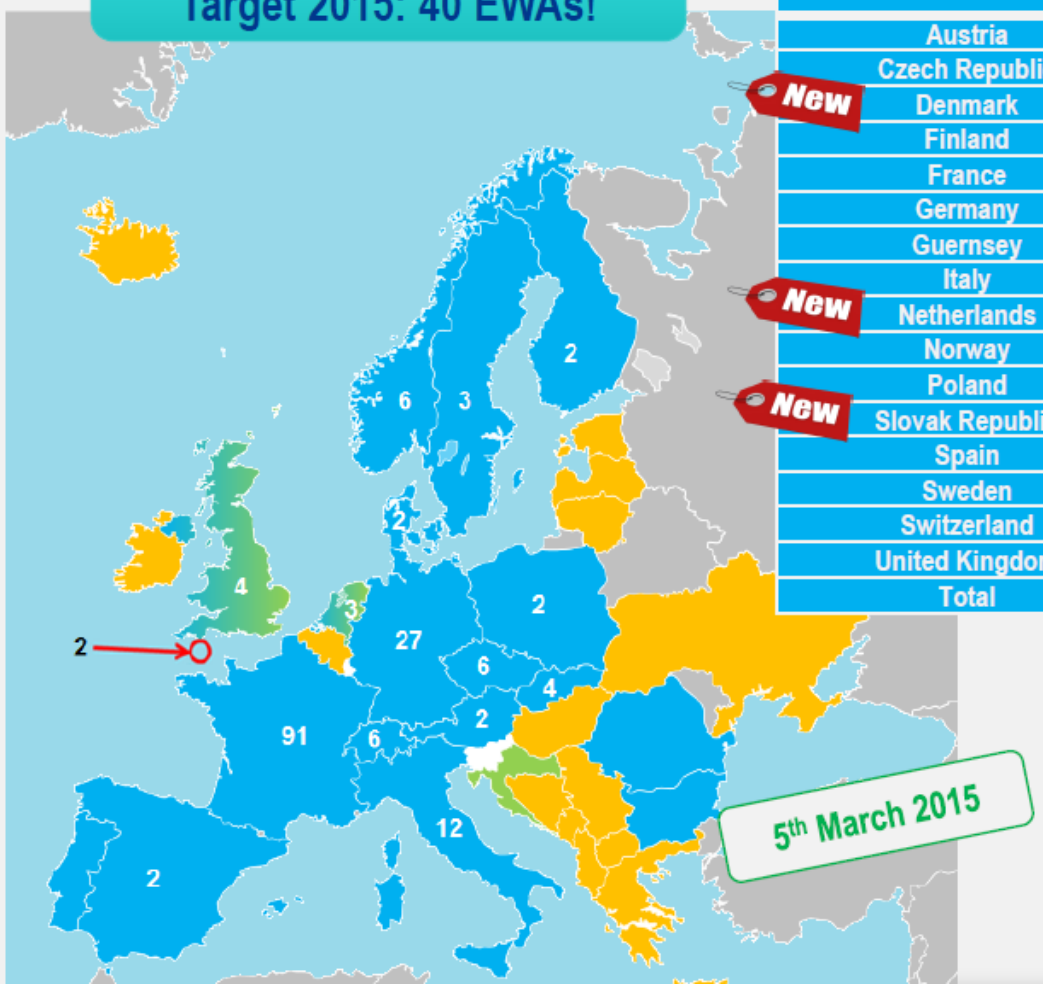
LPV : Localiser Performance with Vertical Guidance to 200ft

V241M – further improvement of APV-1 to IONO event robustness

Finally, the following figure shows the comparison for the perturbed period of April 2014 that impacted the APV-I Availability performances in the South of ECAC with the current EGNOS v2.3.2 operational release The blue area represents the improved Availability with future v2.4.1M release showing a better robustness against the high temporal and spatial ionosphere gradients.



EGNOS Procedures Implementation Status (1/2)



COUNTRY	Airports	LPV Procedures	APV baro Procedures (EGNOS enabled)
Austria	2	2	0
Czech Republic	3	6	4
Denmark	1	2	0
Finland	1	2	0
France	63	91	1
Germany	17	29	71
Guernsey	1	2	0
Italy	6	12	0
Netherlands	2	3	0
Norway	2	6	0
Poland	1	2	0
Slovak Republic	2	4	0
Spain	1	2	0
Sweden	2	3	0
Switzerland	6	6	0
United Kingdom	2	4	0
Total	113	176	76

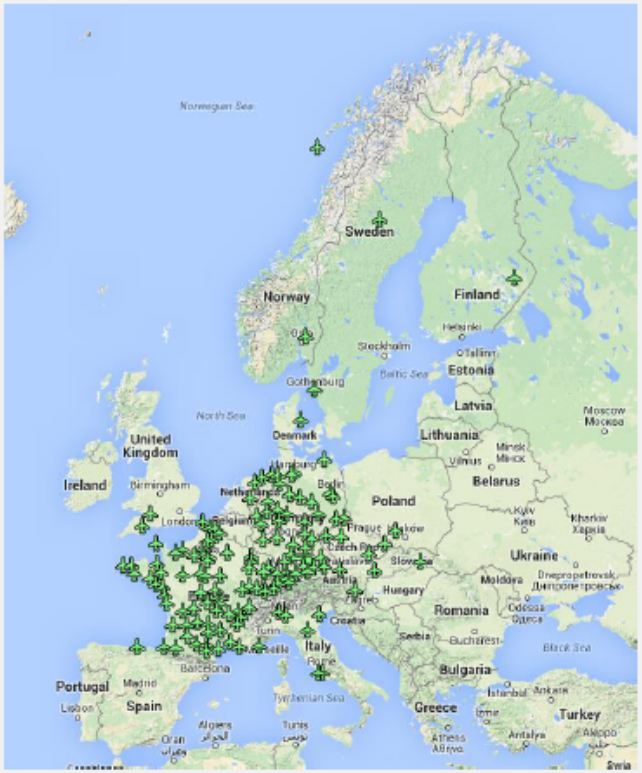
	Discussions paused
	Discussions on going
	EWA signed
3	Number of published LPV procedures
	No feedback

EWA : EGNOS Working Agreement

EGNOS Procedures Implementation Status (2/2)

As of 5th March 2015

176 LPV serving 113 airports
76 runways served by EGNOS enabled APV Baro



Plans by end 2016

Target: 280 procedures for 2015
~320 more LPV planned by end 2016

Check link: http://egnos-user-support.essp-sas.eu/egnos_ops/lpv_map/map.php

We certify you're there.

New Work Order #1 : V2.4.2 Definition Phase B and C0 (pre-devpts) started in 2014

- Obsolescence resolution: RIMS B, RIMS C, CPF, FEE
- Mission Improvement: new RIMS deployment for full ECAC coverage, algorithms improvement
- Coverage extension study (according to EC input scenarios)
- New GEO Ranging Algorithms under study (implementation TBC at PDR feb 2016)
- Operator requirements: Service Provider Requirement Document V2 (SPRD)

Next activities in 2015

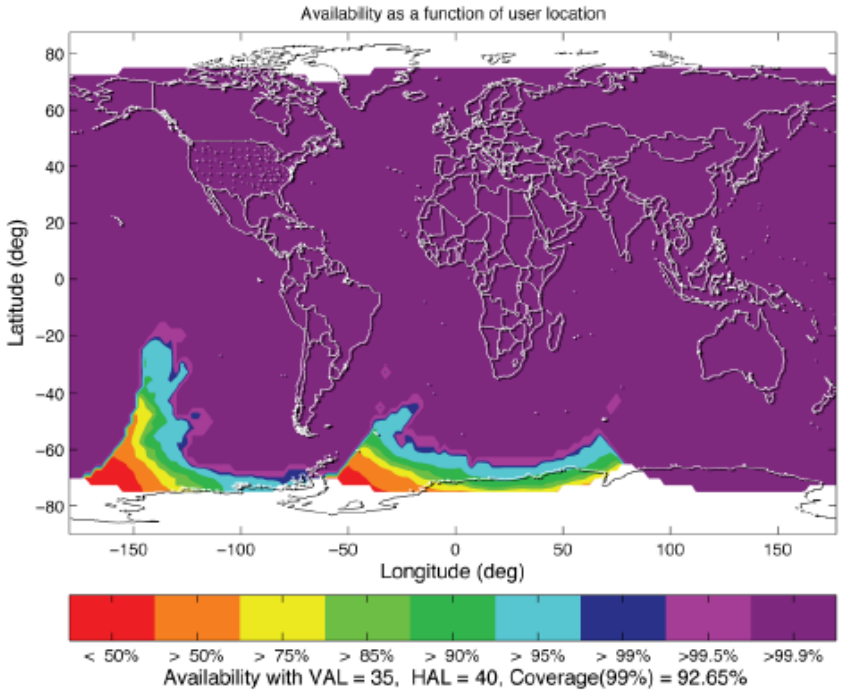
- Preparation of the V2.4.2 Implementation Phase (2016-2018)
  - HW obsolescence resolution
  - Several options to be decided at PDR (Ranging, Iono Processing, Security, SP requirement)

- Preparation of the EGNOS V3 Implementation Phase (after summer) for 2016-2023 to include Galileo Constellation and dual frequency within EGNOS resulting in better performance and accuracy targeting CAT-1 approach (10m)

DFMC Benefits with EGNOS V3

- Quasi-Global Coverage for vertical guidance navigation
- Improved Performance (availability, continuity, accuracy, integrity)
- Increased robustness against interferences and ionospheric storms
- Galileo and GPS GNSS Augmentation

Dual Frequency, Dual GNSS, Expanded Networks



LPV-200 Service Availability

DFMC : Dual Frequency, Multi-Constellation