EGNOS

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EGNOS Services Implementation Roadmaps

EGNOS Service Provision Workshop 2015

29TH SEPTEMBER 2015

European GNSS Agency

ESSP

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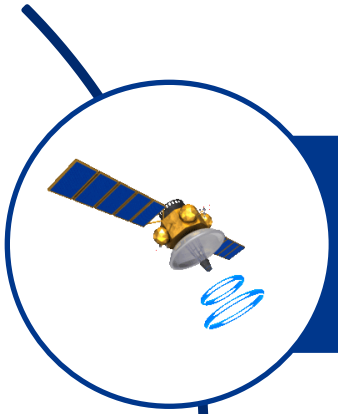
Table of Contents / Goals



EGNOS System and Services status

EGNOS Services Implementation roadmaps

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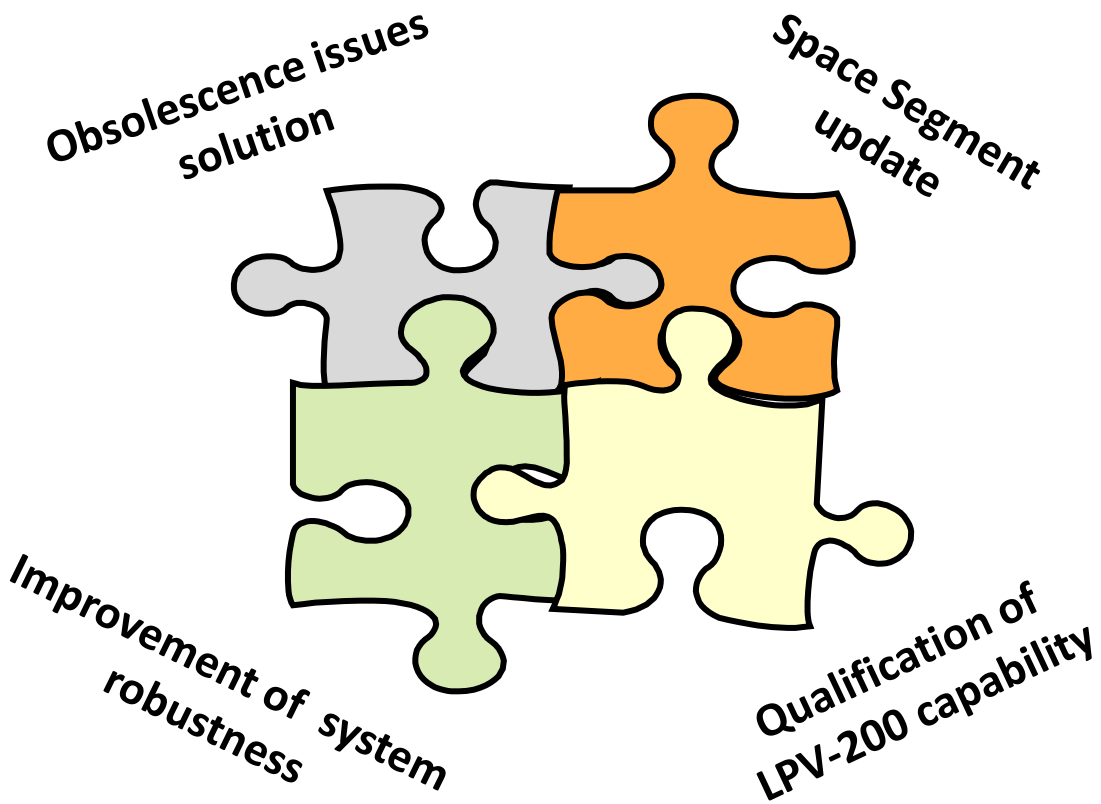
EGNOS Status

EGNOS System Release v241M

Entry in operations on 30th June 2015

EGNOS Status



EGNOS

ESR v241M

EGNOS Status

Solves some obsolescence issues in the ground segment telecommunication network

ESR v241M

NLES

Navigation
Land Earth
Stations

New NLES G2 sites deployed (Redu and Betzdorf)

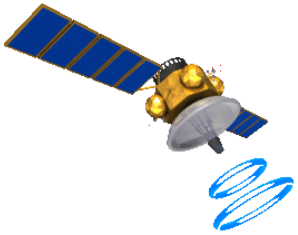
- New HW and SW to deal with legacy obsolescence issues
- Linked to GEO space segment update with GEO SES-5 (PRN 136)

EGNOS Status

EGNOS Space Segment update

ESR v241M

From 20th August 2015 ….



- **EGNOS OPS**: PRN120 &PRN136 broadcast EGNOS messages to provide the operational SIS
- **EGNOS TEST:** PRN126 is used by industry for ESR tests, operators training and qualification.

PRN120
Inmarsat 3F2 AOR-E

PRN136
SES-5 ASTRA

PRN126
Inmarsat 4F2 EMEA

Details of “EGNOS Space Segment” are given in EGNOS Service Notice #15:
http://egnos-user-support.essp-sas.eu/new_egnos_ops/content/service-notices

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EGNOS Status

Improves system robustness …

ESR v241M

… against disturbances in the behaviour of

IONOSPHERE

- *Corrections of identified problems with IONO monitoring (IGPs) in the south*
- *Adjustment of some internal IONO parameters at CS level*

General improvement of IGPs monitoring during periods with degraded IONO behavior

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EGNOS Status

Improves system robustness …

EGNOS

ESR v241M

… against disturbances in the behaviour of

IONOSPHERE

GPS CONSTELLATION

- *Corrections of identified problems with GPS SV monitoring by RIMS*

General improvement of GPS SVs monitoring

EGNOS Status

Qualified for "LPV-200 service level" capability

ESR v241M

Is compliant with **ICAO Annex 10 Category I precision approach** SiS performance requirements

Supports next NAV SPEC as of ICAO PBN Manual:
RNP APCH down to **LPV minima as low as 200 ft**

Enables **3D instrument approach operations Type A or Type B Category I**

A key milestone for EGNOS Programme

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EGNOS SoL Service Level: LPV-200

EGNOS SERVICE LEVELS UP TO NOW	ICAO ANNEX 10 Vol I – SiS PERFORMANCE REQUIREMENTS								ICAO PBN Manual (NAV SPEC)
	ACCURACY		INTEGRITY				CONTINUITY	AVAILABILITY	
	HNSE (95%)	VNSE (95%)	Integrity	Time To Alert	*Horizontal Alert Limit*	*Vertical Alert Limit*			
NPA	*En-route (oceanic/cont low density)*	*3.7 km (2.0 NM)*	*N/A*	*1 – 1x10^{-7}/h*	*5 min*	*7.4 km (4 NM)*	*N/A*	*1 – 1x10^{-4}/h to 1 – 1x10^{-8}/h*	*0.99 to 0.99999*	*RNAV 10* RNP 4* (*non sbas receivers)*
	En-route, continental					*3.7 km (2 NM)*	*N/A*			RNP 2
	En-route, Terminal	*0.74 km (0.4 NM)*	*N/A*	*1 – 1x10^{-7}/h*	*15 s*	*1.85 km (1 NM)*	*N/A*	*1 – 1x10^{-4}/h to 1 – 1x10^{-8}/h*	*0.99 to 0.99999*	RNAV 5, 2, 1 RNP 0,3
	Initial/Intermediate App / NPA / Departure	*220 m (720 ft)*	*N/A*	*1 – 1x10^{-7}/h*	*10 s*	*556 m (0.3 NM)*	*N/A*	*1 – 1x10^{-4}/h to 1 – 1x10^{-8}/h*	*0.99 to 0.99999*	RNP 1 RNAV 1 RNP 0,3
APV-1	*APV-I*	*16.0 m (52 ft)*	*20 m (66 ft)*	*1 – 2x10^{-7} in any approach*	*10 s*	*40 m (130 ft)*	*50 m (164 ft)*	*1 – 8x10^{-6} per 15 s*	*0.99 to 0.99999*	RNP APCH down to LP / LPV (DH >250')

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EGNOS SoL Service Level: LPV-200

CURRENT EGNOS SERVICE LEVELS

	ICAO ANNEX 10 Vol I – SiS PERFORMANCE REQUIREMENTS								ICAO PBN Manual (NAV SPEC)
	ACCURACY		INTEGRITY				CONTINUITY	AVAILABILITY	
	HNSE (95%)	VNSE (95%)	Integrity	Time To Alert	*Horizontal Alert Limit*	*Vertical Alert Limit*			
NPA	*En-route (oceanic/cont low density)*	*3.7 km (2.0 NM)*	*N/A*	*1 – 1x10⁻⁷/h*	*5 min*	*7.4 km (4 NM)*	*N/A*	*1 – 1x10⁻⁴/h to 1 – 1x10⁻⁸/h*	*0.99 to 0.99999*	*RNAV 10* RNP 4* (*non sbas receivers)*
	En-route, continental					*3.7 km (2 NM)*	*N/A*			RNP 2
	En-route, Terminal	*0.74 km (0.4 NM)*	*N/A*	*1 – 1x10⁻⁷/h*	*15 s*	*1.85 km (1 NM)*	*N/A*	*1 – 1x10⁻⁴/h to 1 – 1x10⁻⁸/h*	*0.99 to 0.99999*	RNAV 5, 2, 1 RNP 0,3
	Initial/Intermediate App / NPA / Departure	*220 m (720 ft)*	*N/A*	*1 – 1x10⁻⁷/h*	*10*	*(0.3 NM)*	*N/A*	*1 – 1x10⁻⁸/h*	*0.99999*	RNP 1 / RNAV 1 RNP 0,3
APV-1	*APV-I*	*16.0 m (52 ft)*	*20 m (66 ft)*	*1 – 2x10⁻⁷ in any approach*	*10 s*	*40 m (130 ft)*	*50 m (164 ft)*	*1 – 8x10⁻⁶ per 15 s*	*0.99 to 0.99999*	RNP APCH down to LP / LPV (DH >250')
	Category I precission approach	*16.0 m (52 ft)*	*6.0 to 4.0 m (52 ft)*	*1 – 2x10⁻⁷ in any approach*	*6 s*	*40 m (130 ft)*	*35.0 to 10.0 m (115 -33 ft)*	*1 – 8x10⁻⁶ per 15 s*	*0.99 to 0.99999*	RNP APCH down to LPV (DH >200')

LPV-200 service level

EGNOS SoL Service Level: LPV-200

CURRENT EGNOS SERVICE LEVELS

ICAO ANNEX 10 Vol I – SiS PERFORMANCE REQUIREMENTS									ICAO PBN Manual (NAV SPEC)
	ACCURACY		INTEGRITY				CONTINUITY	AVAILABILITY	
	HNSE (95%)	VNSE (95%)	Integrity	Time To Alert	*Horizontal Alert Limit*	*Vertical Alert Limit*			
NPA	*En-route (oceanic/cont low density)*	*3.7 km (2.0 NM)*	*N/A*	*1 – 1x10⁻⁷/h*	*5 min*	*7.4 km (4 NM)*	*N/A*	*1 – 1x10⁻⁴/h to 1 – 1x10⁻⁸/h*	*0.99 to 0.99999*	*RNAV 10* RNP 4* (*non sbas receivers)*
	En-route, continental					*3.7 km (2 NM)*	*N/A*			RNP 2
	En-route, Terminal	*0.74 km (0.4 NM)*	*N/A*	*1 – 1x10⁻⁷/h*	*15 s*	*1.85 km (1 NM)*	*N/A*	*1 – 1x10⁻⁴/h to 1 – 1x10⁻⁸/h*	*0.99 to 0.99999*	RNAV 5, 2, 1 RNP 0,3
	Initial/Intermediate App / NP[illegible]	*220 m (720 ft)*	*N/A*	*1 – 1x10⁻⁷/h*	*10 s*	*0.3 NM*	*N/A*	*1 – 1x10⁻⁴/h to 1 – 1x10⁻⁸/h*	*0.99 to 0.99999*	RNP 1 RNAV 1 RNP 0,3
APV	*APV-I*	*20 m (66 ft)*	*1 – 2x10⁻⁷ in any approach*	*10 s*	*40 m (130 ft)*	*50 m (164 ft)*	*1 – 8x10⁻⁶ per 15 s*	*0.99 to 0.99999*	RNP APCH down to LP / LPV (DH >250')
	Category I precission approach	*6.0 to 4.0 m (52 ft)*	*1 – 2x10⁻⁷ in any approach*	*6 s*	*40 m (130 ft)*	*35.0 to 10.0 m (115 -33 ft)*	*1 – 8x10⁻⁶ per 15 s*	*0.99 to 0.99999*	RNP APCH down to LPV (DH >200')

LPV-200 service level

EGNOS SoL Service Level: LPV-200

LPV-200 and APV-I service levels share some requirements

LPV-200 vertical performance requirements more stringent than APV-I

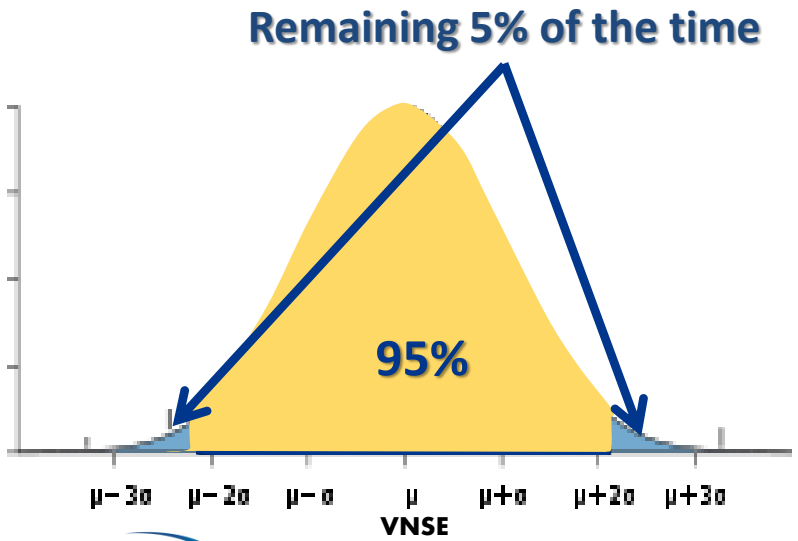
	ACCURACY (95%)		INTEGRITY				CONTINUITY	AVAILABILITY
	HNSE	VNSE	Integrity	TTA	*HAL*	*VAL*		
APV-I	*16.0 m (52 ft)*	*20 m (66 ft)*	*1 – 2x10^{-7} in any approach*	*6 s (in ICAO Doc 9613)*	*40 m (130 ft)*	*50 m (164 ft)*	*1 – 8x10^{-6} per 15 s*	*0.99 to 0.99999*
Category I precission approach	*16.0 m (52 ft)*	*6.0 to 4.0 m (52 ft)*	*1 – 2x10^{-7} in any approach*	*6 s*	*40 m (130 ft)*	*35.0 to 10.0 m (115 -33 ft)*	*1 – 8x10^{-6} per 15 s*	*0.99 to 0.99999*

EGNOS SoL Service Level: LPV-200

LPV-200 and APV-I service levels share some requirements

Vertical performance requirements more stringent in LPV-200 than APV-I

LPV-200 based approaches impose **novel requirements on Accuracy tail distribution**



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EGNOS SoL Service Level: LPV-200

LPV-200 and APV-I service levels share some requirements

Vertical performance requirements more stringent in LPV-200 than APV-I

LPV-200 based approaches impose **novel requirements on Accuracy tail distribution**

Accuracy tail Requirements

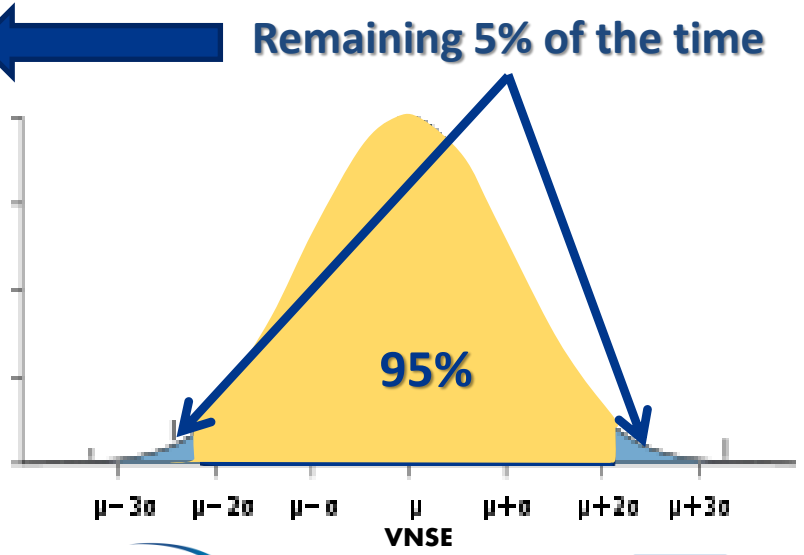
ICAO SARPS – Acceptable Means for Category I precision approach with VAL >10m

In nominal conditions:

Probability (VNSE > 10m) < 10^{-7}/150s

In degraded conditions:

Probability (VNSE > 15m) < 10^{-5}/150s



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EGNOS SoL Service Level: LPV-200

LPV-200 benefits:

- ✓ Provides angular lateral and vertical guidance without any visual contact to the ground until a Decision Height down to 200 ft
- ✓ Enables RNP APCH down to LPV minima as low as 200 feet and supporting 3D approach procedures Type A and B Category I
- ✓ Enables Precision approaches where today it is not possible
- ✓ Equivalent to a Category I ILS approach
- ✓ Lower DH minima than with APV-Baro
- ✓ With low operational impact keeping safety levels
- ✓ Brings additional direct and indirect benefits

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EGNOS system is ready to support
RNP APCH down to LPV minima as low as 200 feet

As part of the EGNOS SoL service provision, LPV-200 service level is currently available for operational use

1. Press Release on LPV-200

2. New version of the SoL SDD for LPV-200

http://egnos-user-support.essp-sas.eu/new_egnos_ops/sites/default/files/library/official_docs/egnos_sol_sdd_in_force.pdf

EGNOS Status

EGNOS SoL Service Definition Document (SDD) describes characteristics, commitments and liabilities of and access conditions to EGNOS SoL service

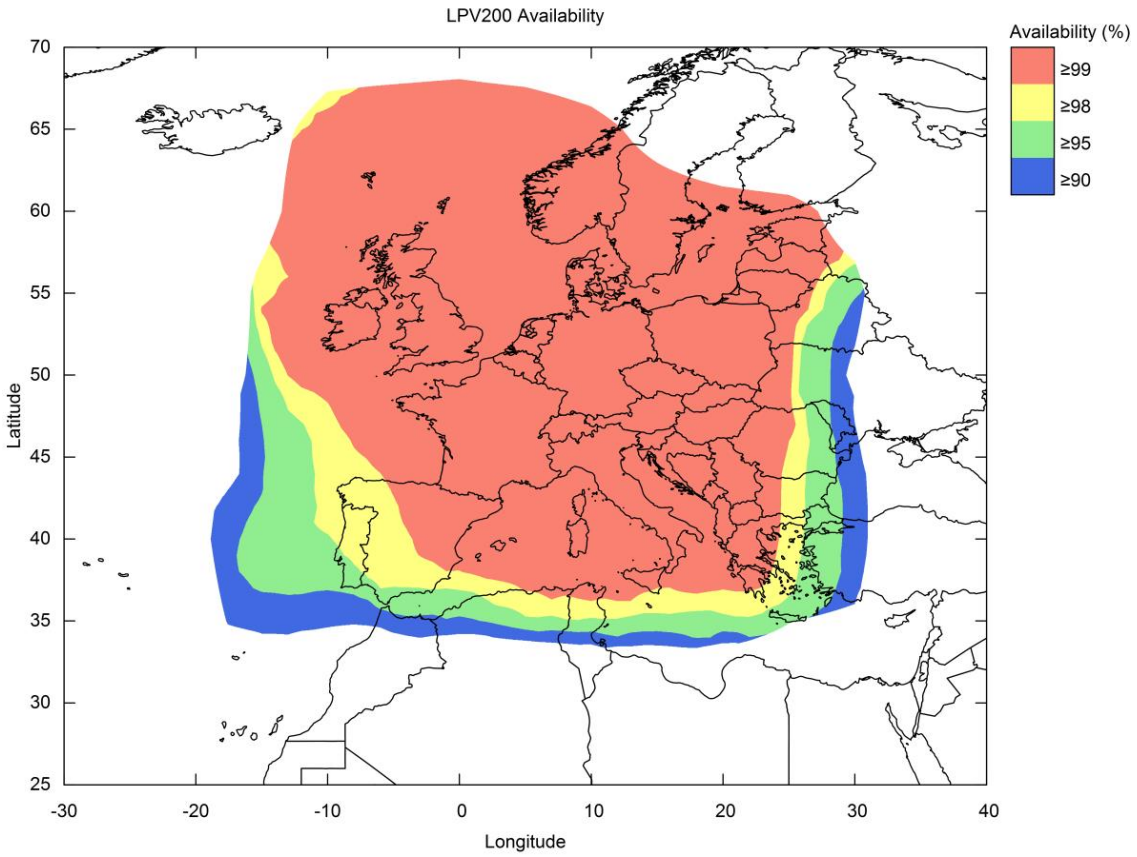
EGNOS Status

EGNOS LPV-200 availability commitment map

For the computation of LPV-200 AVAILABILITY, two new requirements in addition to xPL < xAL are defined regarding the probability that the VNSE exceeds.

a) 10m in nominal system operation conditions, set to 10-7/per approach, and

b) 15m in degraded system operation conditions, set to 10-5/per approach.



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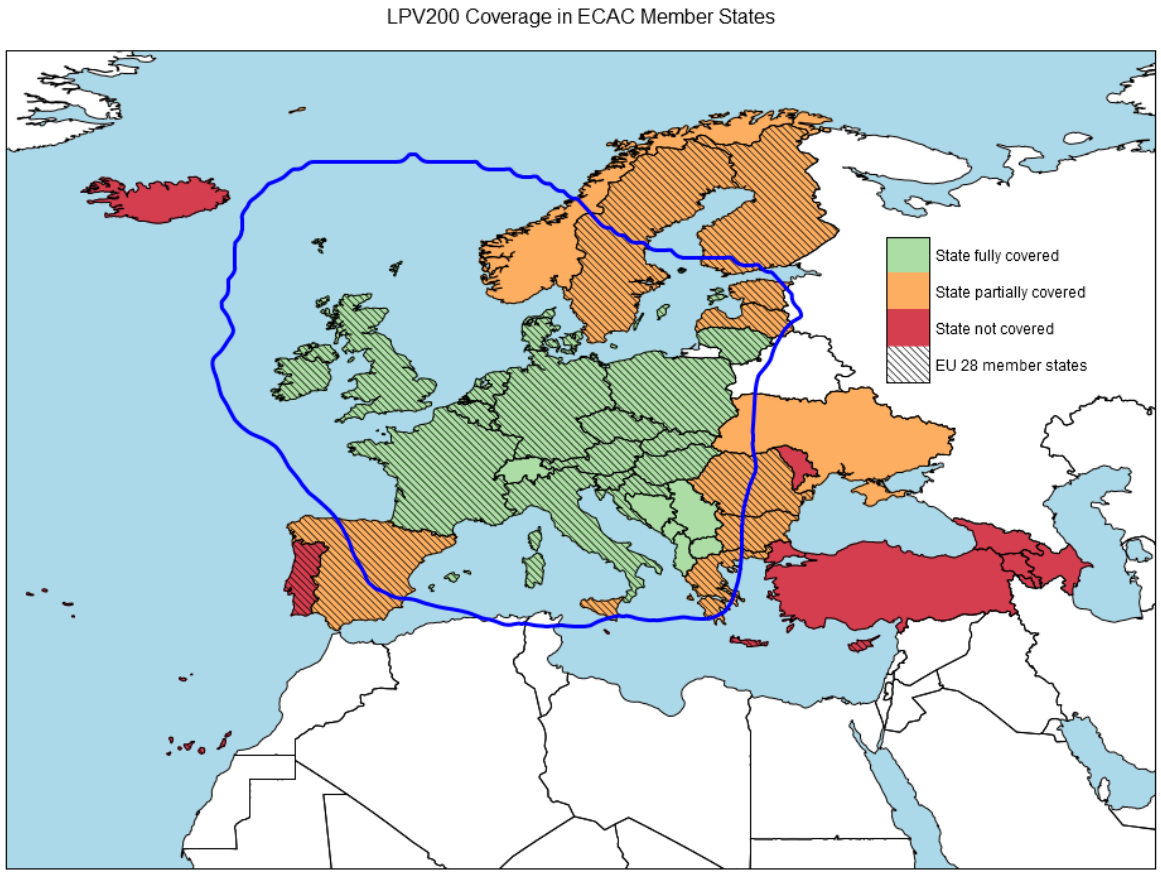
EGNOS Status

LPV-200 coverage in ECAC Member States

(LPV-200 availability 99% isoline)



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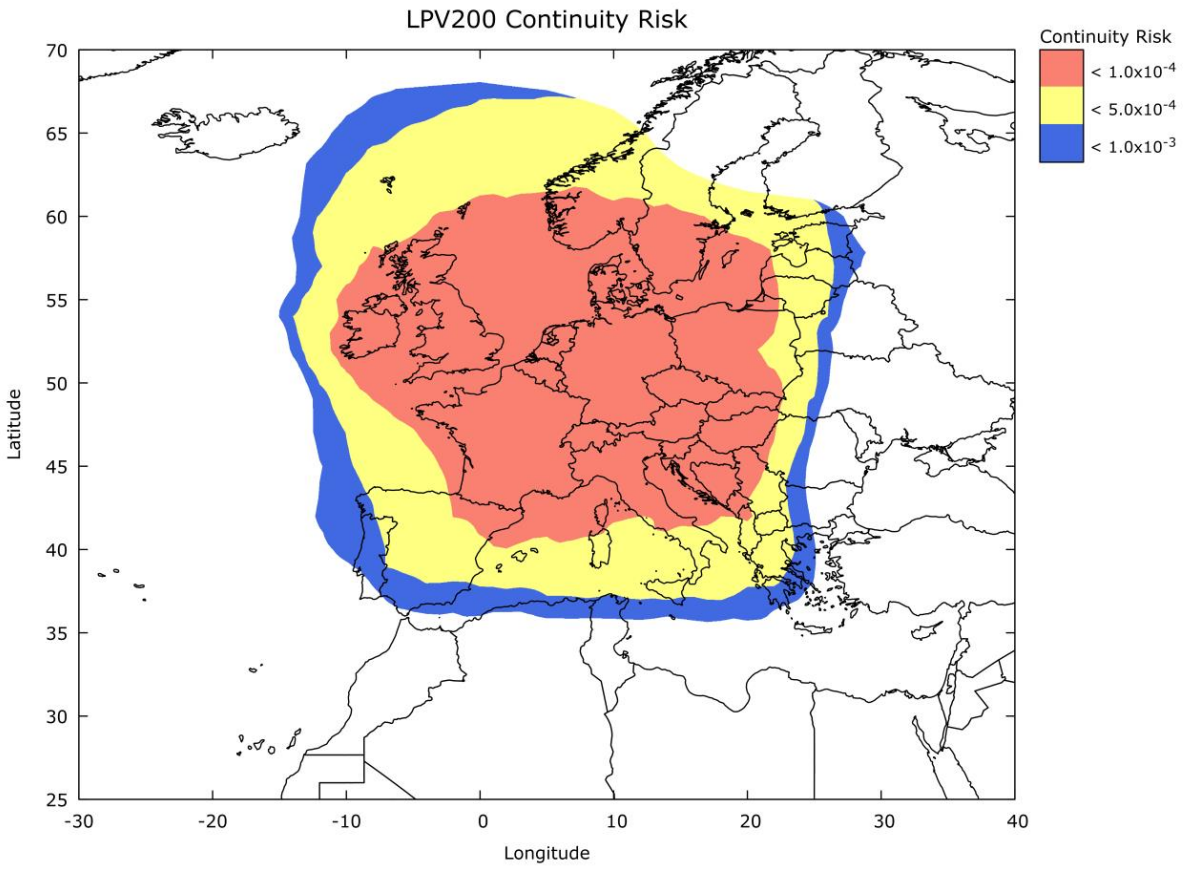
EGNOS Status

EGNOS LPV-200 continuity commitment map

For the computation of LPV-200 CONTINUITY, the same new two requirements as in LPV-200 AVAILABILITY are applied



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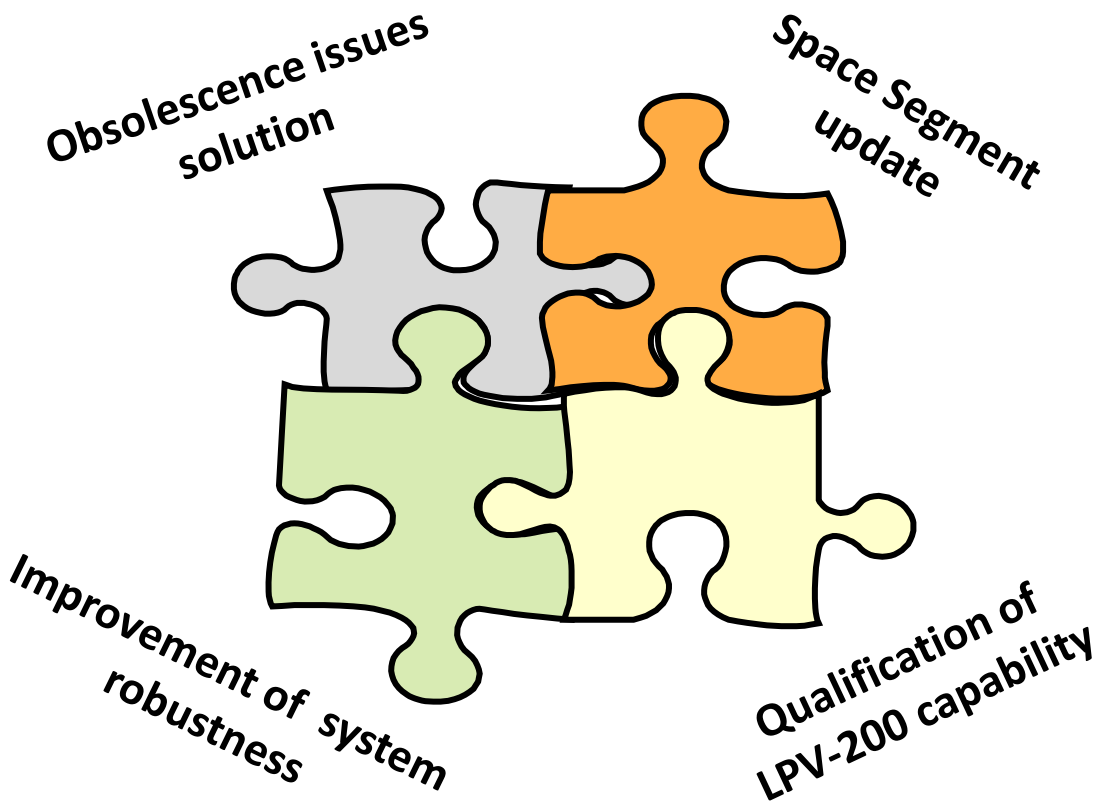


EGNOS

ESR v241M

EGNOS Status

2x MCC

Mission Control Centers

39x RIMS

Ranging & Integrity Monitoring Stations

GPS signal

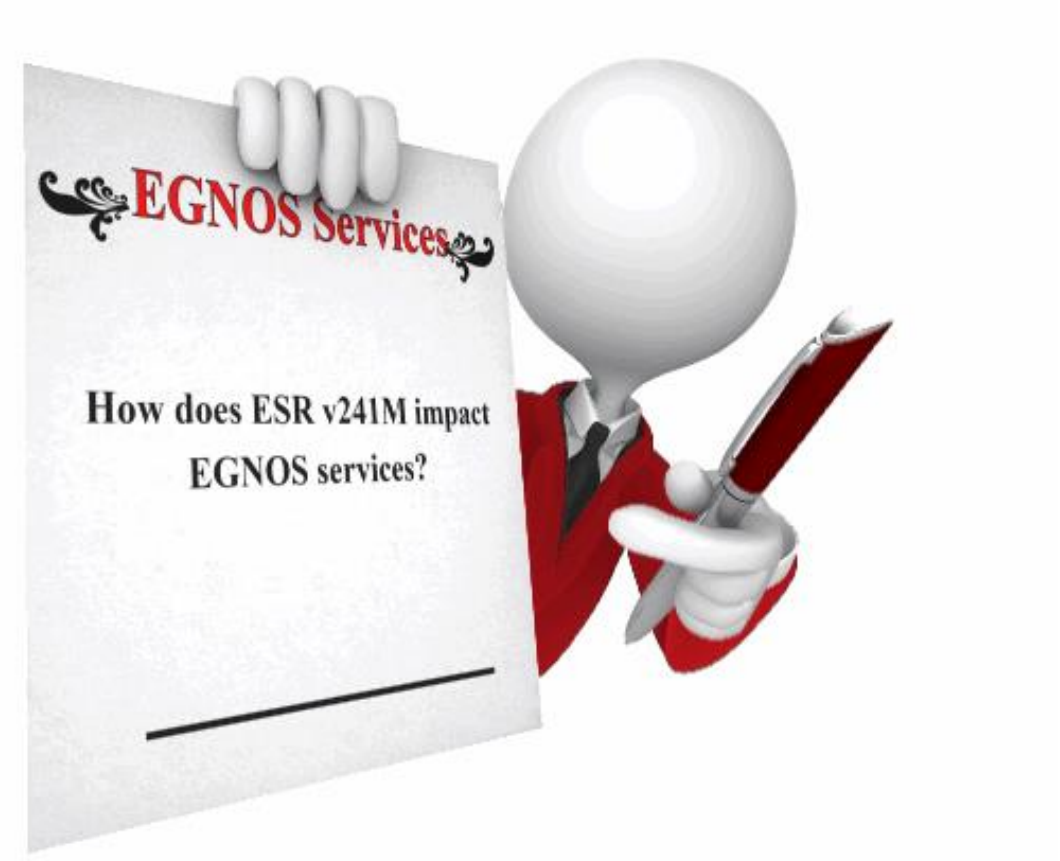
EGNOS

3 GEO satellites

6x NLES

Navigation Land Earth Stations

EGNOS Status



EGNOS Status

- Improvement of OS performances specially in terms of better continuity values.
- Improvement of OS service area in the south

- SBAS messages from SES-5 (PRN 136) are available

- Improvement of SoL performances specially in terms of better continuity values.
- General improvement of SoL service area (NPA and APV-1 levels) in particular in the south-west
- LPV-200 service level readiness for operational use.

EGNOS Services Implementation roadmaps

- EGNOS Services Implementation roadmaps (SIRs) provide a high-level overview of
  - EGNOS Services current status
  - EGNOS Services foreseen evolutions in a 3-year timeframe linked to
    - Consecutive EGNOS System Releases' deployments
    - Information/interfaces improvements/changes.
- These roadmaps are mainly focused on 4 different aspects:
  - Service Area (OS & SoL) or Data availability (EDAS)
  - Service Level
  - Service Robustness
  - User Interfaces
- Current version is **v3.2** covering the period: Q1 2015 – Q4 2017

  http://egnos-user-support.essp-sas.eu/new_egnos_ops/content/service-implementation-roadmaps
- **Next update foreseen in Q4 2015** (updated in a 6 months-basis)

EGNOS Services Implementation roadmaps

Service Area

ESR v2.4.1M:

- **Deployment timeline:** In operation
- **Service Areas Improved:** SoL, OS

- General improvement of OS and SoL service (NPA and APV-1 levels) areas specially in south-west of Europe
- Full NPA coverage area in ENI countries
- LPV-200 coverage area defined in the SoL SDD

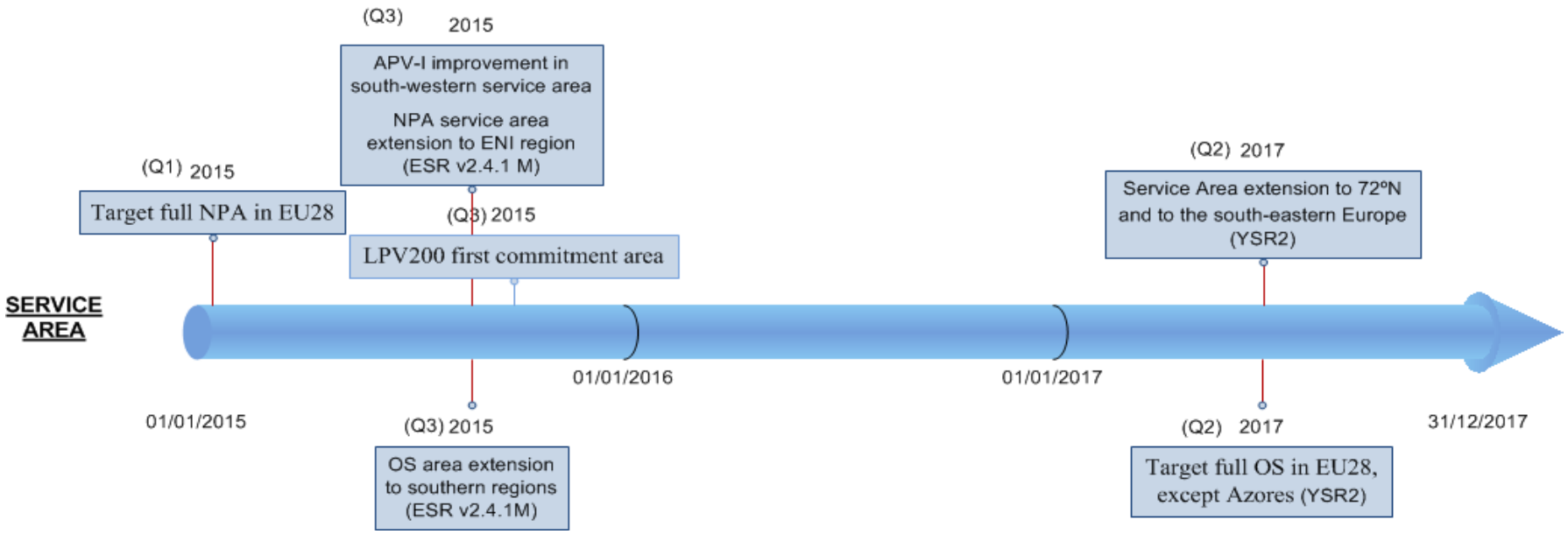
YSR #2:

- **Deployment timeline:** Q2 2017
- **Service Areas Improved:** SoL, OS

- Inclusion of RIMS Haïfa improving SoL coverage in the south-east of Europe
- Full OS coverage in EU 28 (excluding Azores)
- MT27 extension to 72ºN for SoL service

EGNOS Services Implementation roadmaps

Service Area



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EGNOS Services Implementation roadmaps

Data Availability

ESR v2.4.1M:

- **Deployment timeline:** Q3 2015
- **Service :** EDAS

- SES-5 (PRN 136) replacing INMARSAT 4F2 EMEA (PRN 126). From then on, SBAS messages will be available from SES-5 (PRN 136) through EDAS

ESR v2.4.1N:

- **Deployment timeline:** Q2 2016
- **Service :** EDAS

- ASTRA-5B (PRN 123) replacing INMARSAT 3F2 AOR-E (PRN 120). From then on, SBAS messages will be available from ASTRA-5B (PRN 123) through EDAS service.

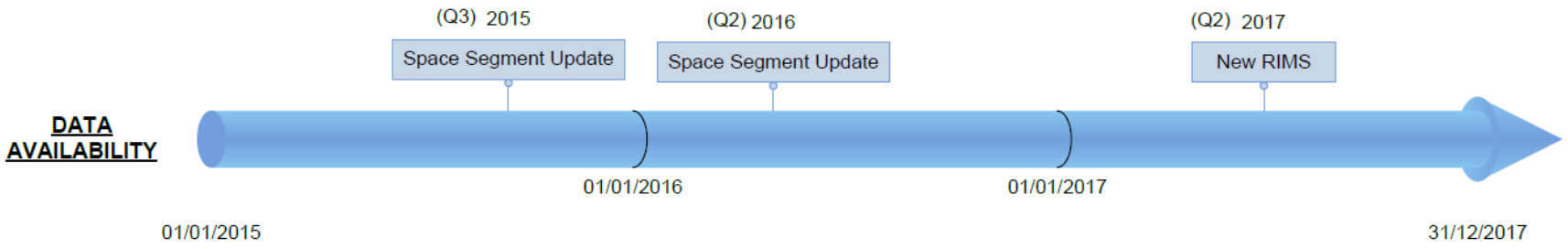
YSR #2:

- **Deployment timeline:** Q2 2017
- **Service :** EDAS

- Inclusion of RIMS Haïfa leading to more information to be available through EDAS service.

EGNOS Services Implementation roadmaps

Data Availability

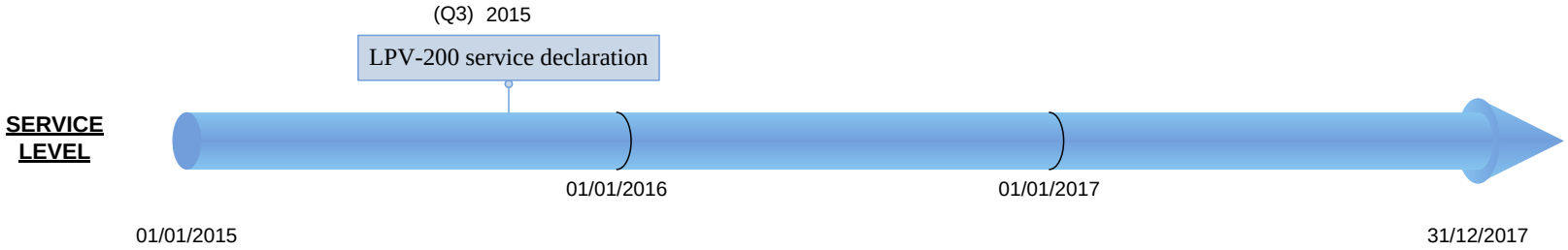


EGNOS Services Implementation roadmaps

Service Level

New SoL service level "LPV-200":

- **Service Declaration:** 29th Sep. 2015



EGNOS Services Implementation roadmaps

Service Robustness

ESR v2.4.1M:

- **Deployment timeline:** In operation
- **Robustness improved in:** SoL, OS

- PRN 126 replacement by new SES-5 (PRN136) to improve GEO orbital stability.
- Increased robustness against IONO disturbances
- Improvement in SV monitoring
- Deployment of two new NLES G2 sites

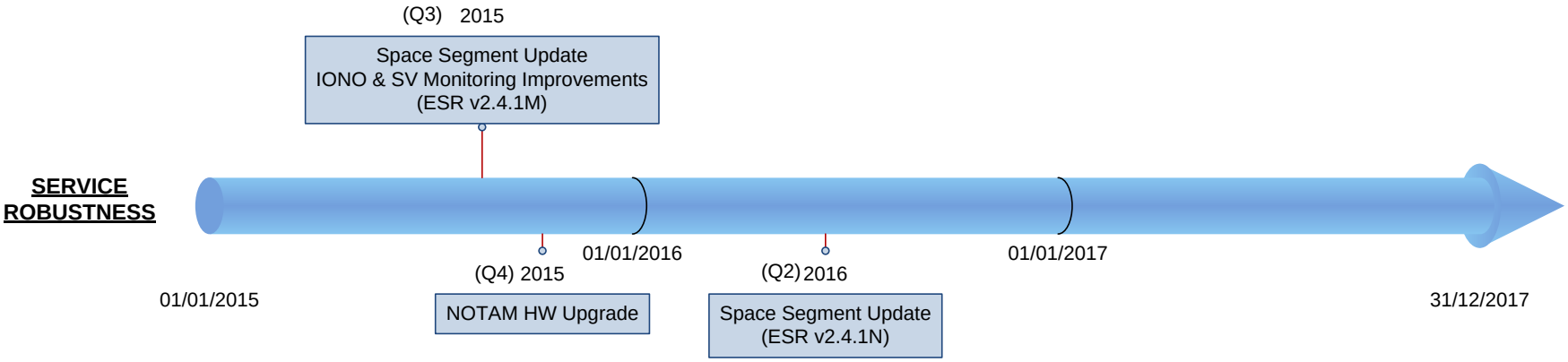
ESR v2.4.1N:

- **Deployment timeline:** Q2 2016
- **Robustness improved in:** SoL, OS

- ASTRA-5B (PRN 123) replacing INMARSAT 3F2 AOR-E (PRN 120) so as to ensure the level of robustness and GEO orbital stability

EGNOS Services Implementation roadmaps

Service Robustness



EGNOS Services Implementation roadmaps

Interfaces with Users

EGNOS Services Generic I/Fs:

- **User Support Website (http://egnos-user-support.essp-sas.eu/): Q2 2015**
  - New upgrade with improved usability, availability and robustness
  - Contents improvement in order to increase usability, user experience, friendly-user interfaces

EGNOS Services Implementation roadmaps

Interfaces with Users

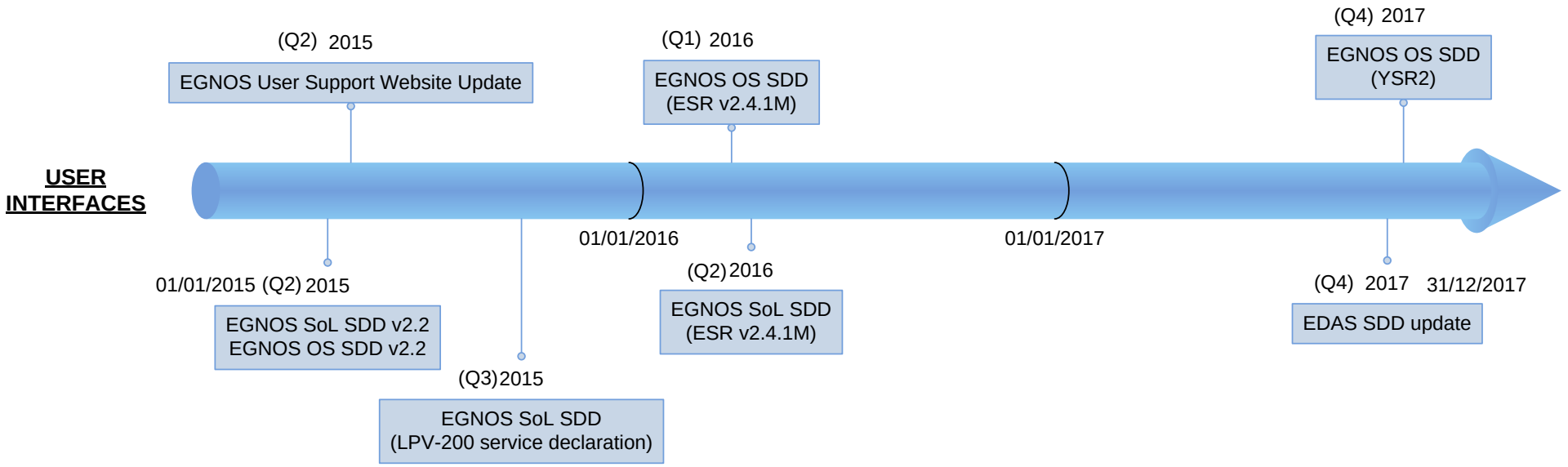
EGNOS Services Generic I/Fs:

- **EGNOS Service Definition Documents (SDD):**
  - New SoL SDD for LPV-200 declaration published TODAY
  - OS SDD update in Q1 2016 (ESR v2.4.1M): Service area extension to the southern regions
  - SoL SDD update in Q2 2016 (ESR v2.4.1M):
    - NPA coverage extension to fully ENI with 99.9% availability
    - APV-I coverage extension in the south- west of the service area
    - LPV-200 coverage extension is foreseen in line with the APV-I coverage trend
  - OS SDD update (YSR2) in Q4 2017: Target full OS availability in EU28 (except Azores)
  - SoL SDD update (YSR2) in Q2 2018: Extension to 72ºN + Improve availability in the south-east Mediterranean due to Haïfa RIMS
  - EDAS SDD update (YSR2) in Q4 2017: New RIMS in Haïfa and new GEO constellation

EGNOS Services Implementation roadmaps

Interfaces with Users

EGNOS Services Generic I/Fs:



Thanks for your attention …

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It´s time for

Carlos Joaquín Hernando

carlos-joaquin.hernando@essp-sas.eu

We certify you´re there.