



EGNOS, it's there. Use it.

EDAS (EGNOS Data Access Service) for Added Value Applications

E. Lacarra, *ESSP SAS*



European
Global Navigation
Satellite Systems
Agency



Precise navigation,
powered by Europe



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- **EDAS overview**
- **EDAS description**
- **DGNSS navigation using EDAS NTRIP Service.**
- **Applications based on EDAS Services.**
- **Conclusions**

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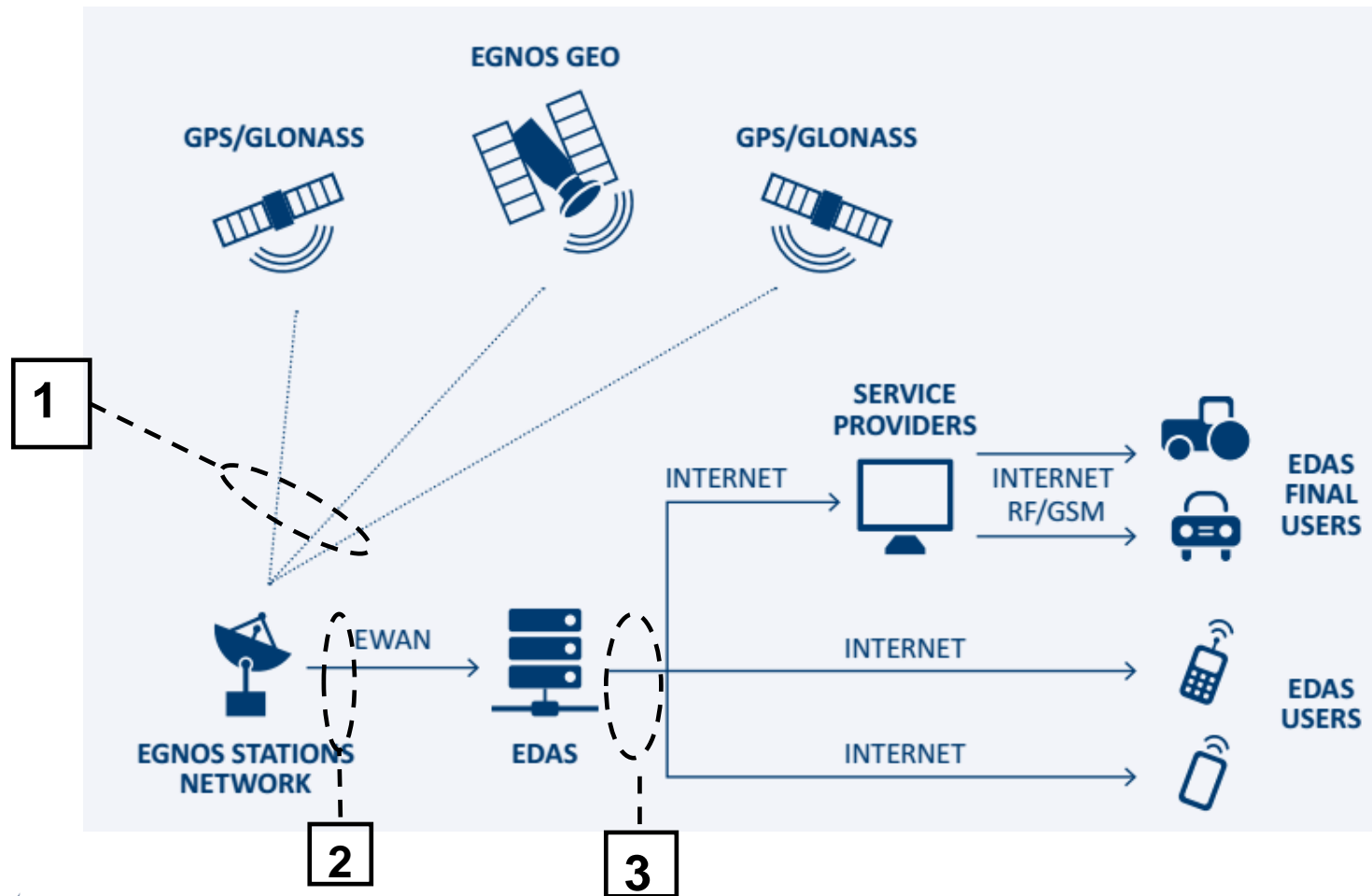
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What is EDAS?

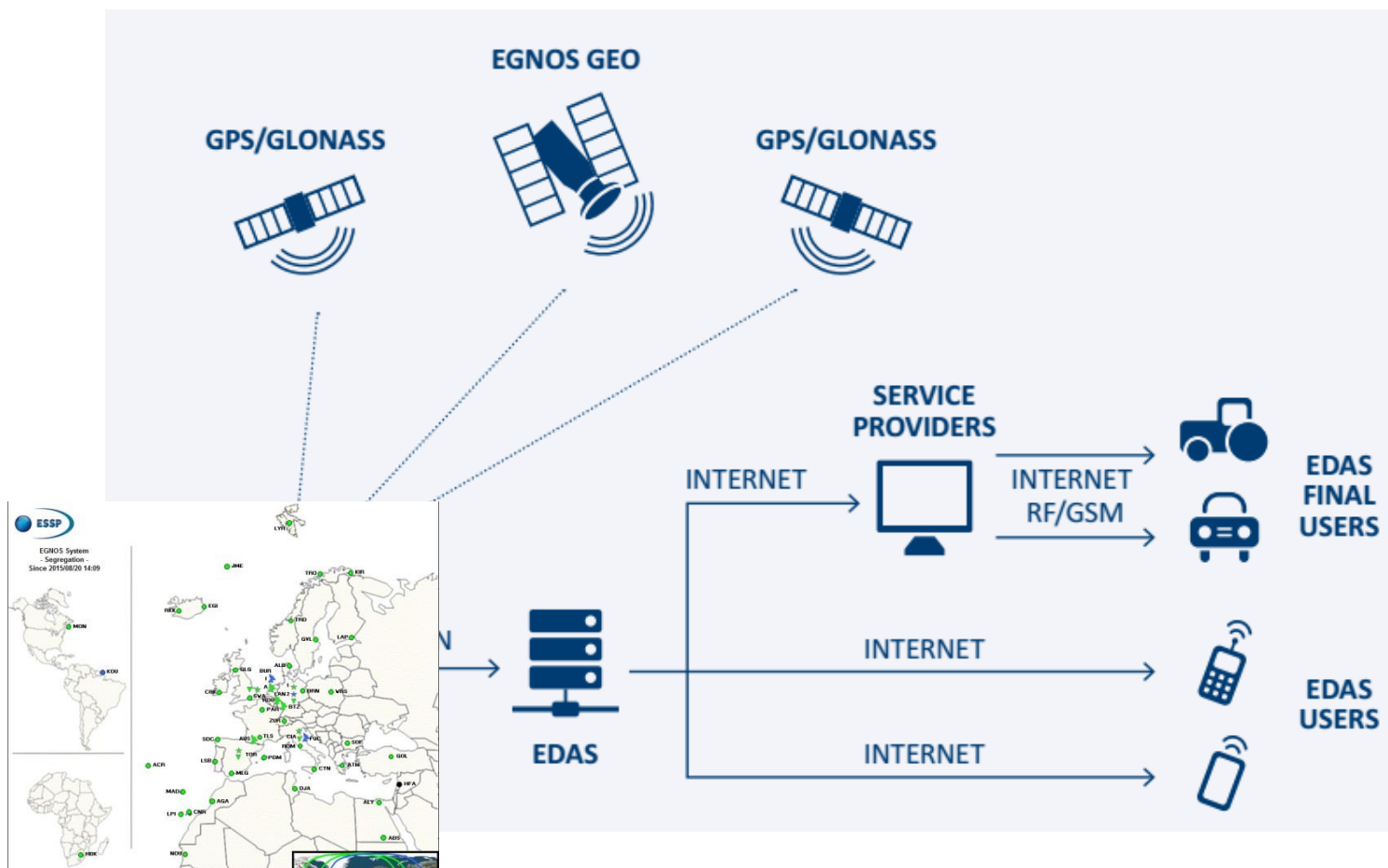
EDAS (EGNOS Data Access Service)

is a free of charge service (owned by EC) that provides access to the data gathered by the EGNOS infrastructure through the Internet.

EDAS overview



EDAS overview



EGNOS System

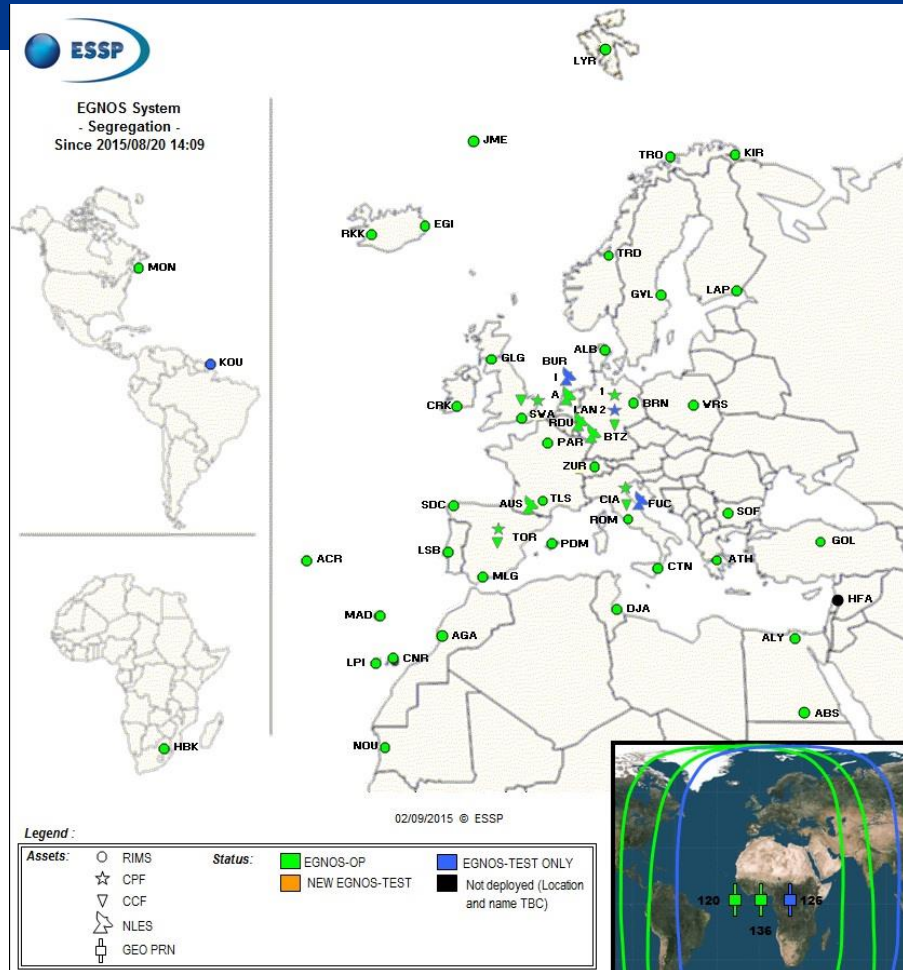


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EDAS Services

EDAS Service	Type of Data			Service Description		
	OBS & NAV	EGNOS MSG	RTK MSG	DGNSS COR	FORMAT	PROTOCOL

- GPS and GLONASS observations and navigation data collected by the entire network of EGNOS ground stations

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- ❑ GPS and GLONASS observations and navigation data collected by the entire network of EGNOS ground stations
- ❑ EGNOS augmentation messages.

EDAS Services

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- EGNOS augmentation messages.
- RTK (Real-Time Kinematic) messages.

EDAS Services

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- GPS and GLONASS observations and navigation data collected by the entire network of EGNOS ground stations
- EGNOS augmentation messages.
- RTK (Real-Time Kinematic) messages.
- Differential GNSS (DGNSS) corrections.

EDAS Services

	EDAS Service	Type of Data				Service Description	
		OBS & NAV	EGNOS MSG	RTK MSG	DGNSS COR	FORMAT	PROTOCOL
Real Time	Service Level 0 Data Filtering SL0	✘	✘			ASN.1	EDAS
	Service Level 2 Data Filtering SL2	✘	✘			RTCM3.1	EDAS
	SISNET					RTCA	SISNeT
	Ntrip					RTCM 2.x RTCM 3.1	Ntrip
	FTP					RINEX, EMS, IONEX...	FTP

EDAS Services

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		OBS & NAV	EGNOS MSG	RTK MSG	DGNSS COR	FORMAT	PROTOCOL					
Real Time	Service Level 0 Data Filtering SL0	✕	✕			ASN.1	EDAS					
	Service Level 2 Data Filtering SL2											
	SISNET										RTCA	SISNeT
	Ntrip										RTCM 2.x RTCM 3.1	Ntrip
	FTP										RINEX, EMS, IONEX...	FTP

EDAS Client SW

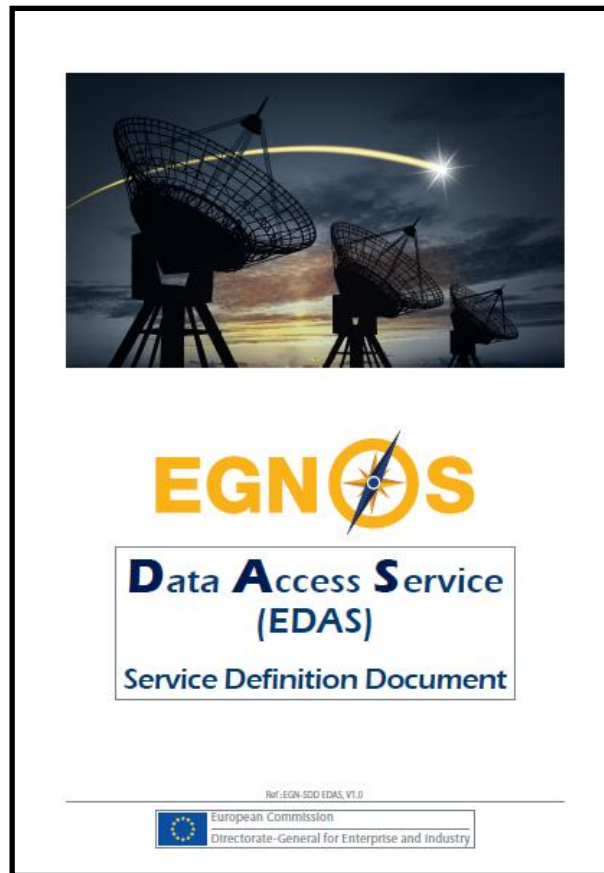
EDAS Services

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Real Time	Service Level 0 Data Filtering SL0	✗	✗			ASN.1	EDAS
	Service Level 2 Data Filtering SL2	✗	✗			RTCM3.1	EDAS
	SISNET		✗			RTCA	SISNeT
	Ntrip	✗		✗	✗	RTCM 2.x RTCM 3.1	Ntrip
Archive	FTP	✗	✗			RINEX, EMS, IONEX...	FTP

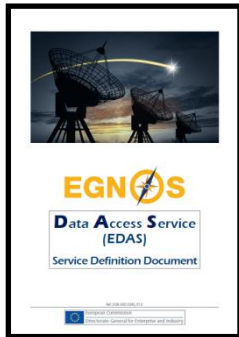
EDAS Services

	EDAS Service	Type of Data				Service Description	
		OBS & NAV	EGNOS MSG	RTK MSG	DGNSS COR	FORMAT	PROTOCOL
Real Time	Service Level 0	✗	✗			ASN.1	EDAS
	Data Filtering SL0						
	Service Level 2	✗	✗	REAL-TIME		RTCM3.1	EDAS
	Data Filtering SL2			Nominal latency < 1 second			
	SISNET		✗			RTCA	SISNeT
	Ntrip	✗		✗	✗	RTCM 2.x RTCM 3.1	Ntrip
Archive	FTP	✗	✗	ARCHIVE		RINEX, EMS, IONEX	FTP

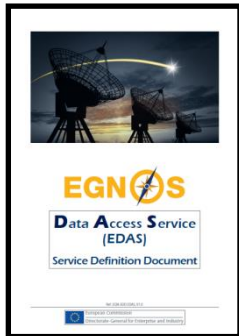
EDAS Information



EDAS Information



<http://egnos-user-support.essp-sas.eu/>



The **EGNOS** Service Provider



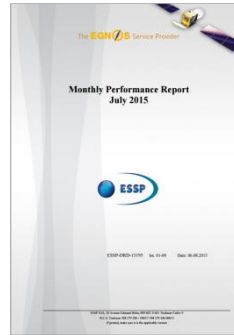
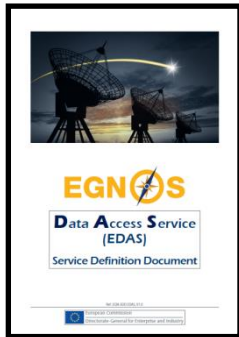
Monthly Performance Report July 2015



ESSP-DRD-15195 Iss. 01-00 Date: 06.08.2015

ESSP SAS, 18 Avenue Edouard Belin, BP1 602 31401 Toulouse Cedex 9
R.C.S. Toulouse 508 275 286 - SIRET 508 275 286 00013
If printed, make sure it is the applicable version

EDAS Information




<http://egnos-user-support.essp-sas.eu/>


REALTIME


HOME / EDAS SERVICE

SIGNAL IN SPACE

The section shows the real time status of all EDAS Services (SL0, SL2, Data Filtering, NTRIP, SISNeT and FTP).

 **PRN 120** Active SoL Mode

 **PRN 136** Active SoL Mode

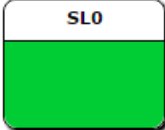
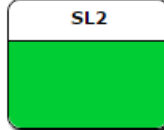
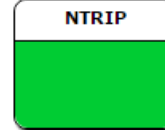
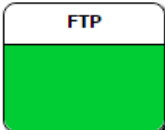
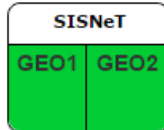
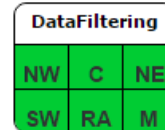
 **PRN 126** Active Test mode

LPV Procedures

Map



Resume Status Services

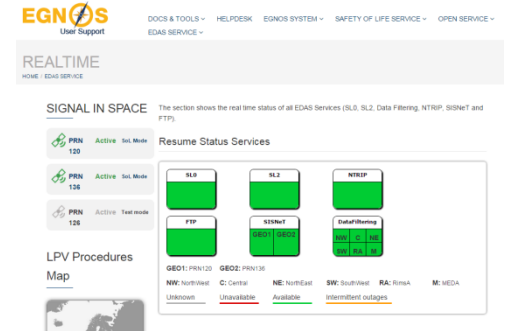
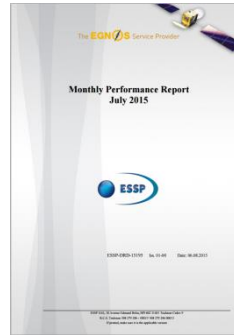
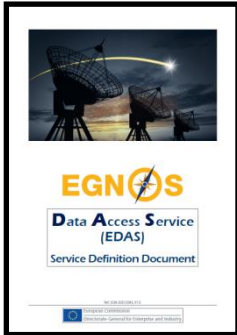
SL0 	SL2 	NTRIP 
FTP 	SISNeT GEO1 GEO2 	DataFiltering NW C NE SW RA M 

GEO1: PRN120 **GEO2:** PRN136

NW: NorthWest **C:** Central **NE:** NorthEast **SW:** SouthWest **RA:** RimsA **M:** MEDA

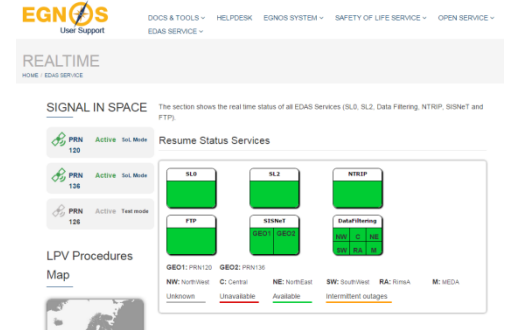
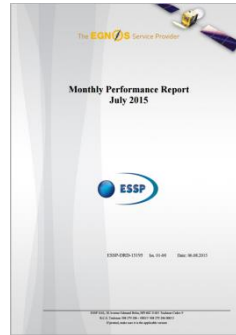
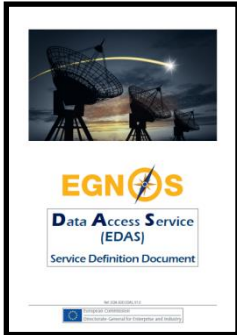
Unknown Unavailable Available Intermittent outages

EDAS Information



<http://egnos-user-support.essp-sas.eu/>

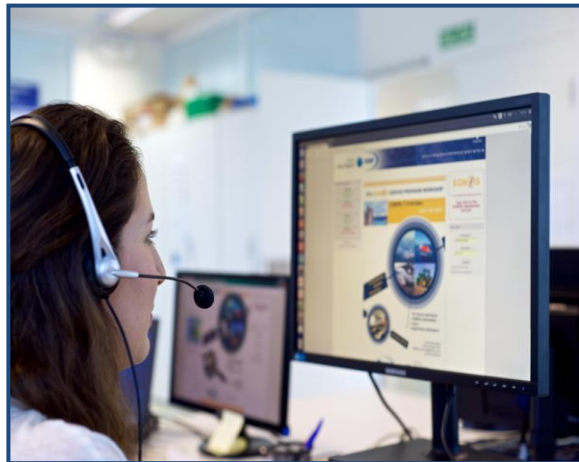
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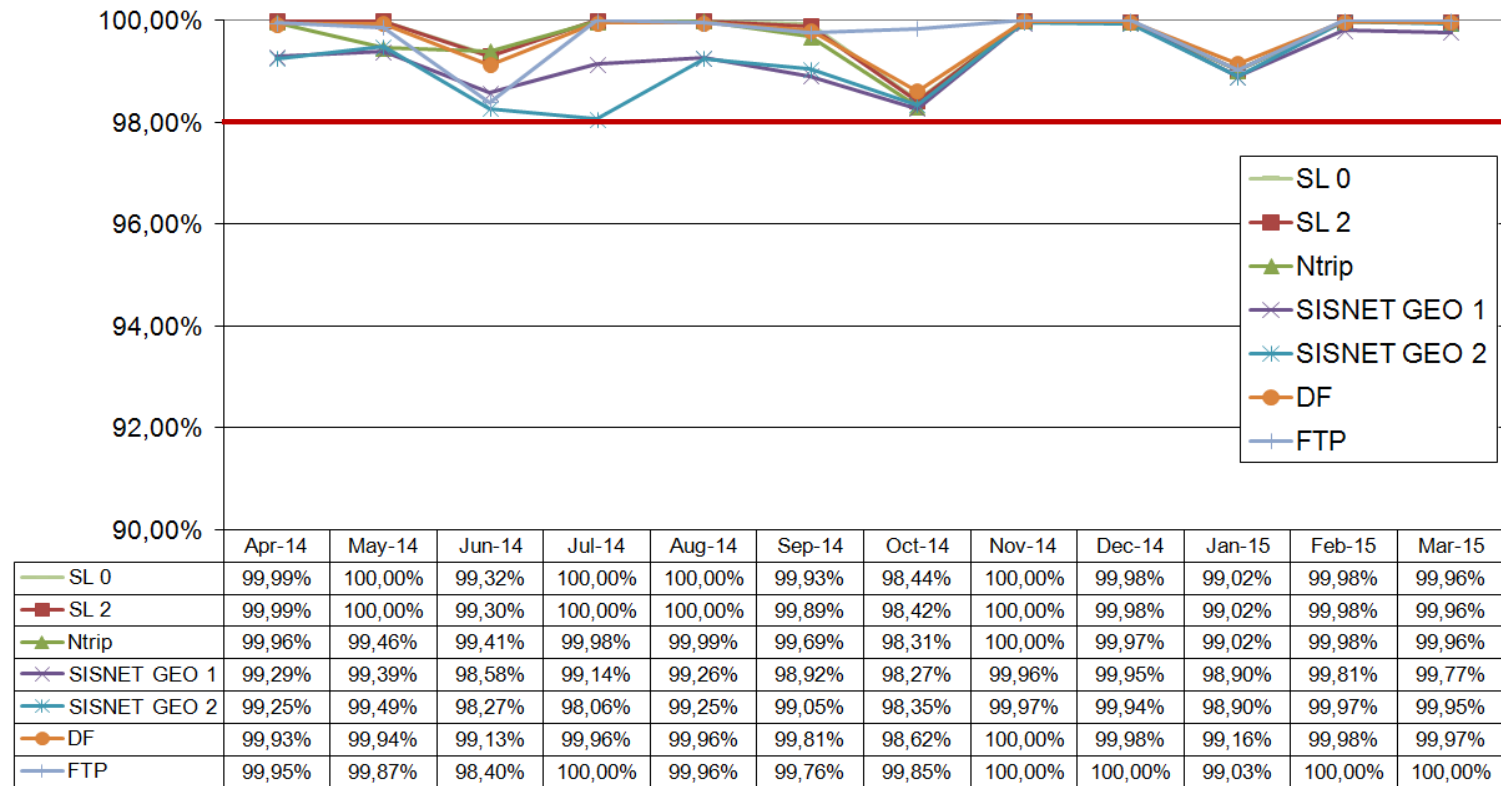
EDAS Registration Website



EGNOS Helpdesk
EGNOS-Helpdesk@essp-sas.eu
+34 91 236 554

EDAS Services Availability

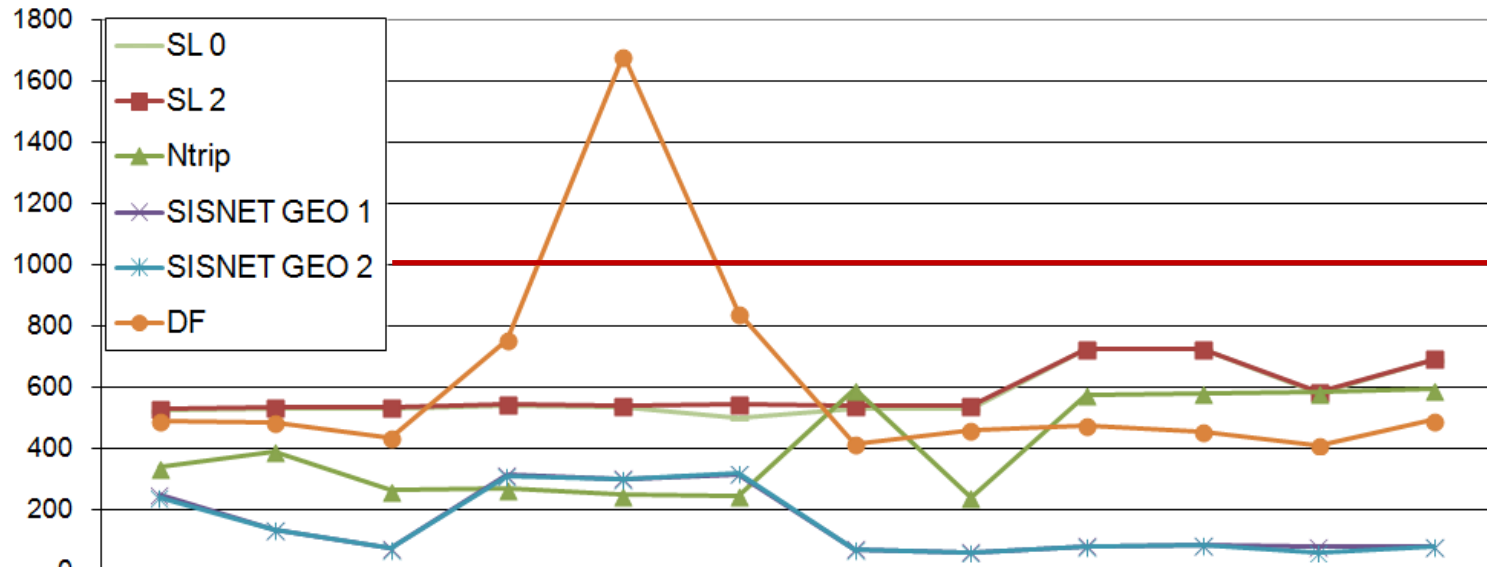
EDAS Services Availability Trending



EDAS Services Latency

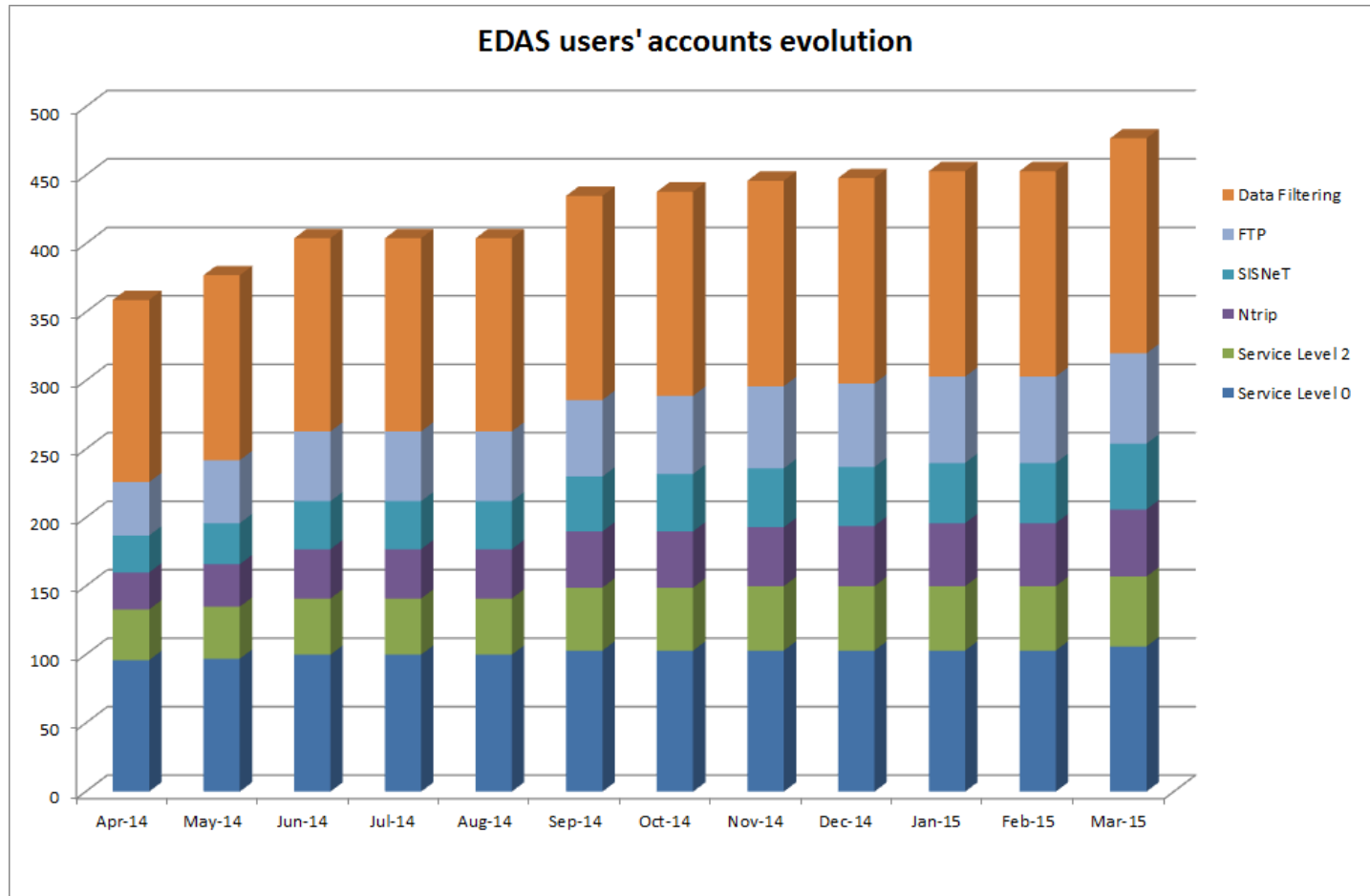


EDAS Services Latency (ms)



	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15
SL 0	525,53	531,1	529,17	539,77	532,87	501,01	530,32	528,9	722,48	722,94	581,21	689,71
SL 2	529,63	534,77	533,83	544,58	539,77	542,43	538,13	538,17	723,68	724,65	581,96	690,39
Ntrip	336,83	391,23	262,23	267,84	246,97	246,57	593,84	240,4	576	579,19	583,32	592,1
SISNET GEO 1	249,37	133,32	72,5	314,68	300,71	315,77	70,53	60,97	80,23	84,74	79,5	79,81
SISNET GEO 2	241,17	135,58	72,53	308,74	301,52	318,1	71,062	61,07	80,48	84,74	59,5	79,9
DF	488,30	483,27	435,15	754,44	1680,76	841,26	416,24	459,04	472,22	453,05	410,40	491,47

EDAS user' accounts evolution



EDAS user distribution

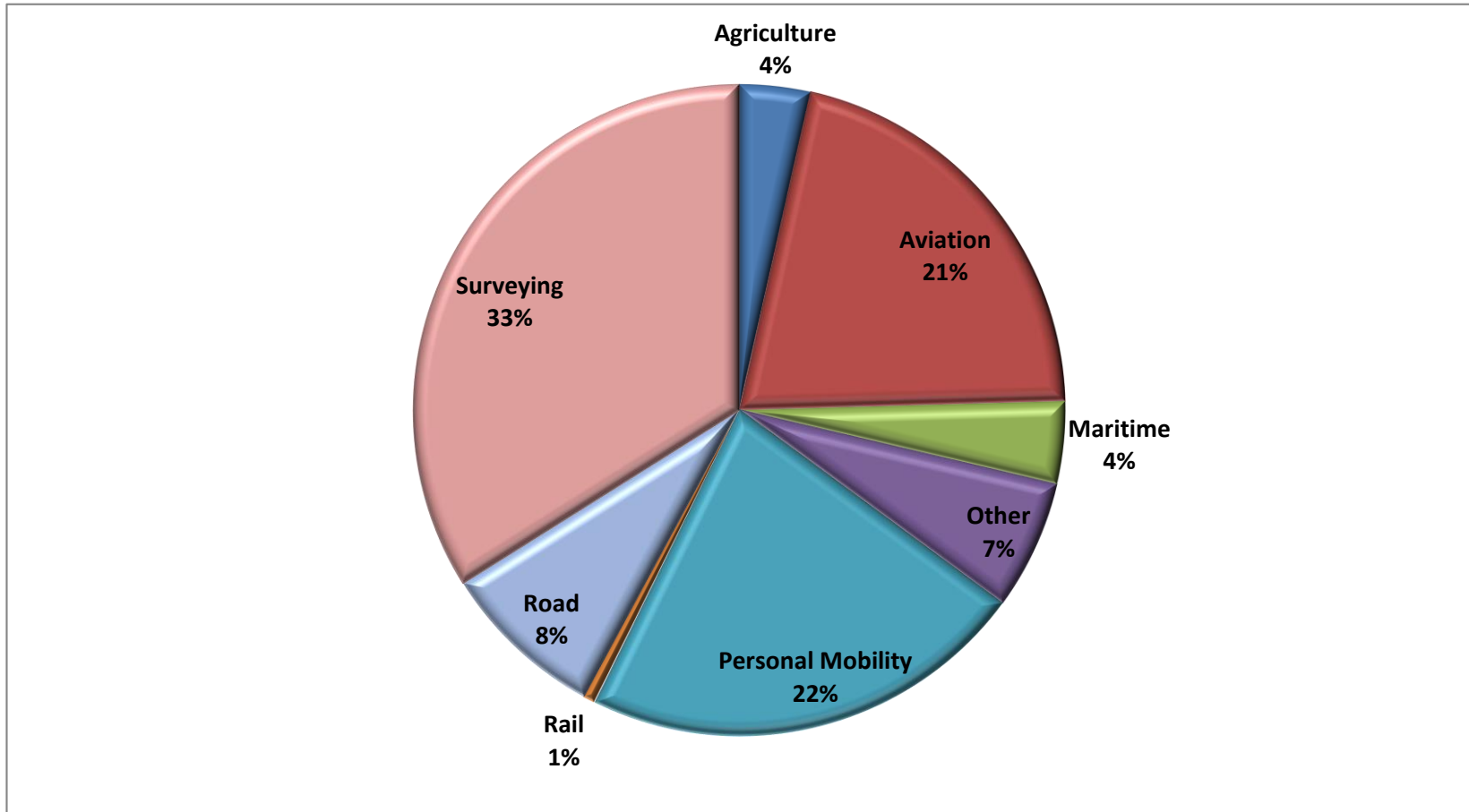


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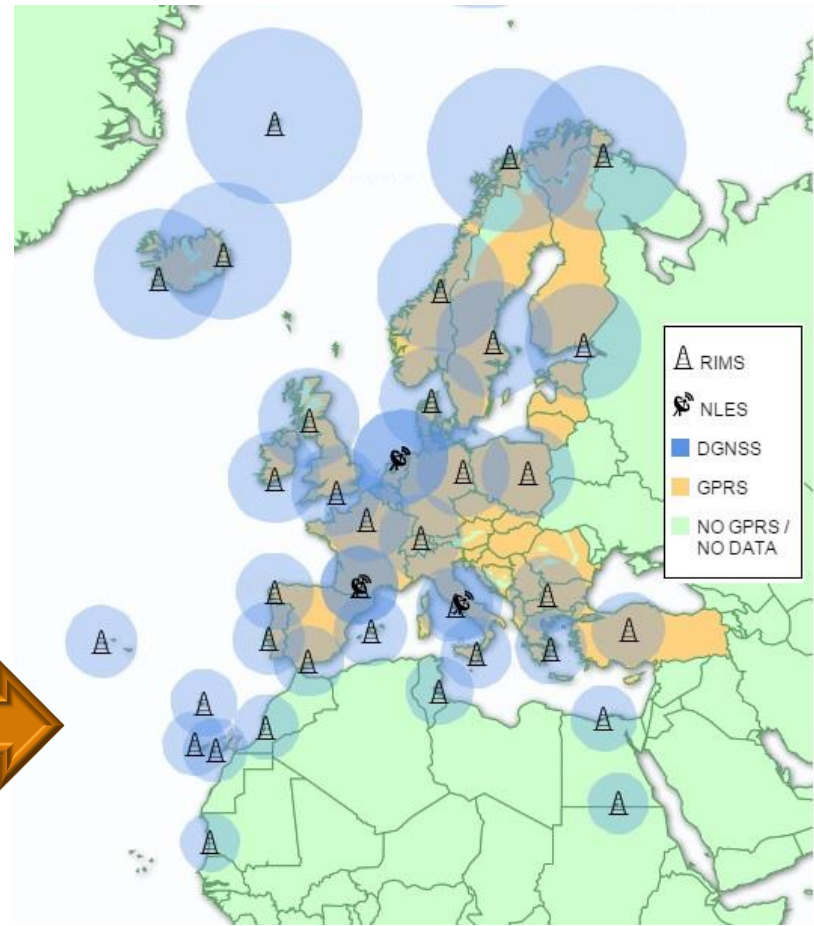
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		OBS & NAV	EGNOS MSG	RTK MSG	DGNSS COR	FORMAT	PROTOCOL
	Service Level 0	✗	✗			ASN.1	EDAS
DGNSS corrections for EGNOS stations provided by EDAS NTRIP Service							
Real Time	Data Filtering SL2	✗	✗			RTCM 2.x	EDAS
	SISNET		✗			RTCA	SISNeT
	Ntrip	✗		✗	✗	RTCM 2.x RTCM 3.1	Ntrip
Archive	FTP	✗	✗			RINEX, EMS, IONEX...	FTP

DGNSS Navigation using EDAS Ntrip Service (0)

- **IALA radio-beacon DGNSS** is the internationally accepted method of providing differential GNSS corrections and integrity information to **maritime users**.
- **DGNSS corrections (GPS & GLONASS) for EGNOS stations are sent through the EDAS Ntrip Service** via the Internet

Estimated GPRS & EDAS DGNSS Coverage in Europe (baseline: 200 nm = 370 km)

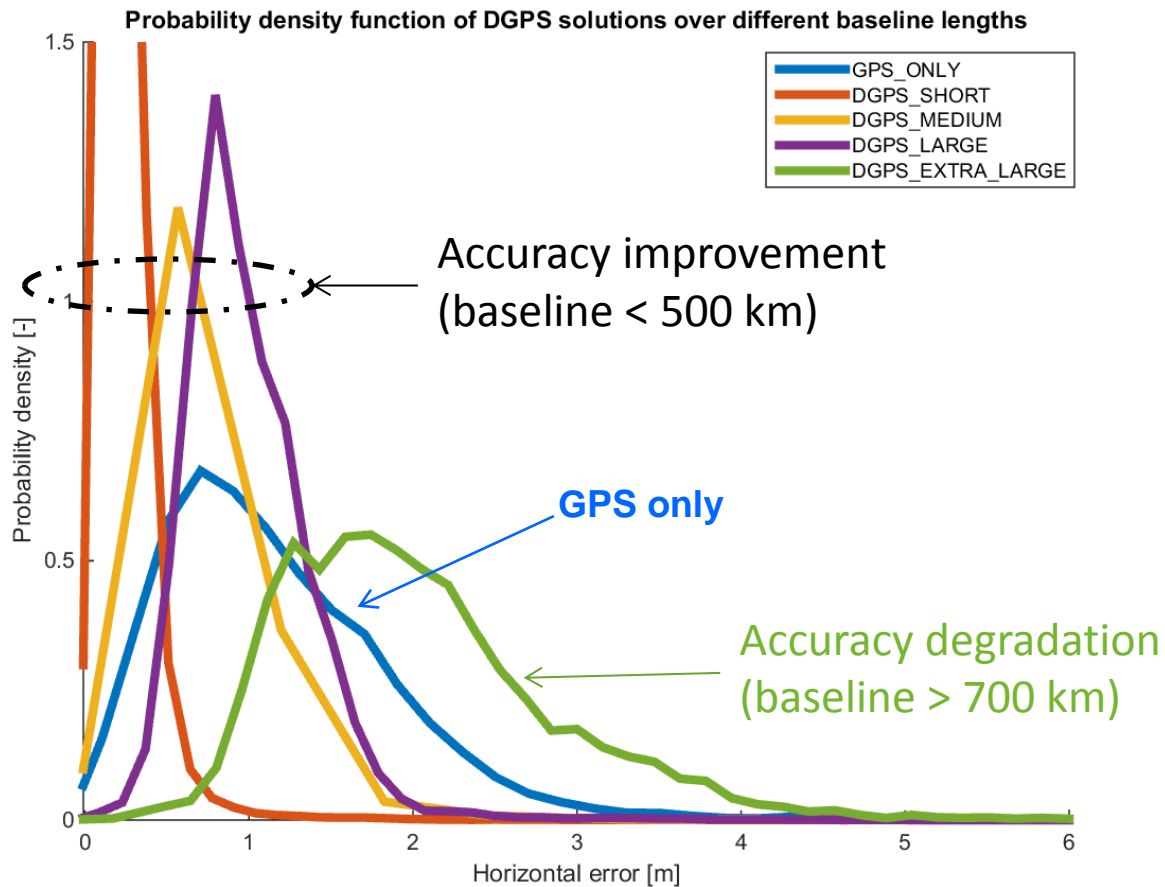


EDAS DGPS: Performance analysis (1)

- **Time period used:** full GPS week 1856
02/08/2015 00:00:00 - 08/08/2015 23:59:59
- Multiple combinations of rover and reference station locations to obtain different baseline length scenarios:
 - short (<50km),
 - medium (200-350km)
 - large (350-500km)
 - extra-large (700-1000 km)

Area	DGPS Solution		Distance type (Km)
	Rover receiver (EPN)	Reference station (EDAS)	
Mediterranean	MALA	MLGA	Short (≈ 12 km)
	MELI		Medium (≈ 210 km)
	LAGO		Large (≈ 372 km)
	BELL		Extra-large (≈ 747 km)
	AJAC	ROMA	Medium (≈ 305 km)
		DJAA	Extra-large (≈ 1000 km)
Scandinavian	MAR6	GVLA	Short (≈ 10 km)
	VISO		Medium (≈ 342 km)
	SUR4		Large (≈ 423 km)

EDAS DGPS: Performance analysis (2)



short (<50km),
medium (200-350km)
large (350-500km)
extra-large (700-1000 km)

EDAS DGPS: Performance analysis (3)



Solution Type	North error (m)		East Error (m)		Horizontal Error (m)	
	Mean	2 σ	Mean	2 σ	Mean	2 σ
GPS only Rover rec.	0.746	1.912	-0.131	1.170	1.165	1.375
DGPS Short	-0.052	0.517	-0.122	0.319	0.241	0.456
DGPS Medium	-0.352	1.037	-0.249	1.111	0.733	0.951
DGPS Large	-0.182	0.972	-0.186	1.855	0.993	0.844
DGPS Extralarge	1.689	1.828	0.330	1.951	2.019	1.643

For baselines < 500 km:

- Enhancement of GPS accuracy
- Mean & 2 σ < 1 meter

Accuracy meets:

- 10 meter for general maritime navigation (ocean, inland waterways...)

EDAS DGPS: Performance analysis (4)

Solution Type	North error (m)		East Error (m)		Horizontal Error (m)	
	Mean	2 σ	Mean	2 σ	Mean	2 σ
GPS only Rover rec.	0.746	1.912	-0.131	1.170	1.165	1.375
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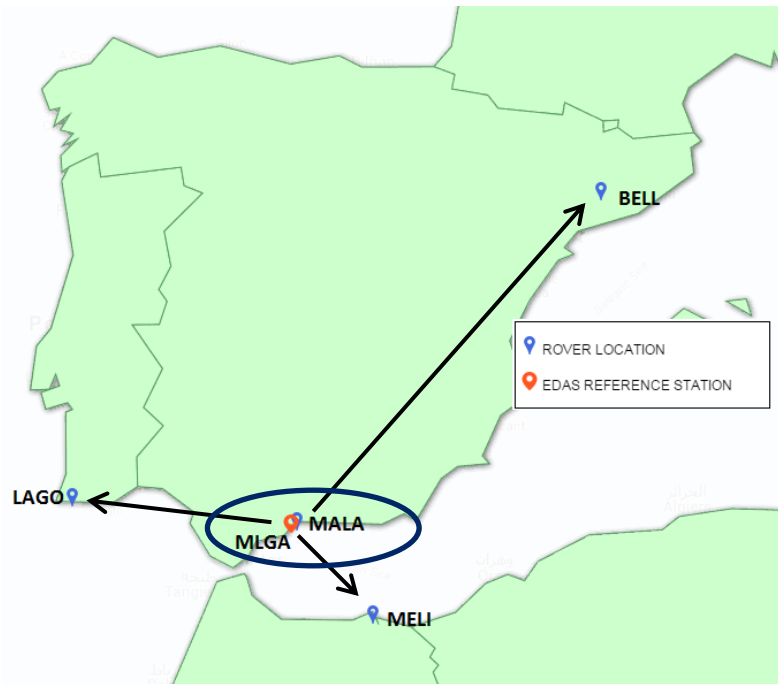
- For baselines > 700 km:
- Degradation of GPS accuracy
 - Mean & 2 σ > 1 meter

EDAS DGPS: Performance analysis (5)

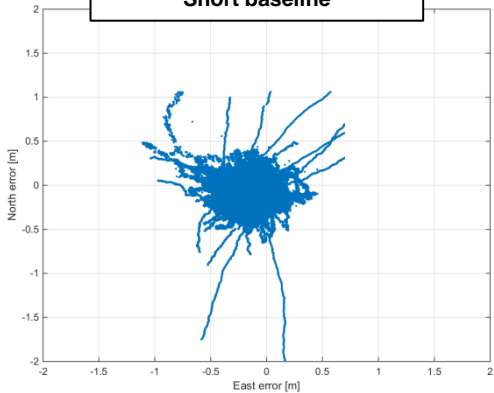
DGPS: LAGO-MLGA
Large baseline

DGPS: BELL-MLGA
Extra-long baseline

DGPS: MALA-MLGA
Short baseline



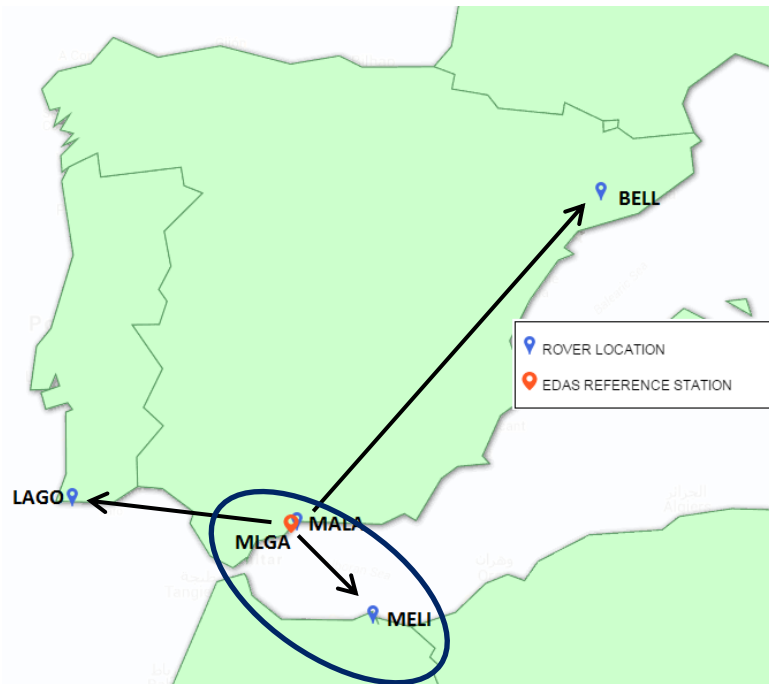
DGPS: MELI-MLGA
Medium baseline



EDAS DGPS: Performance analysis (5)

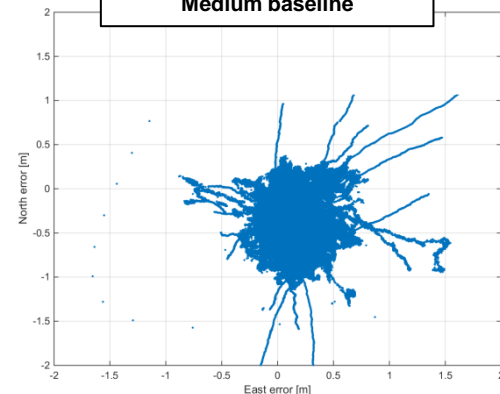
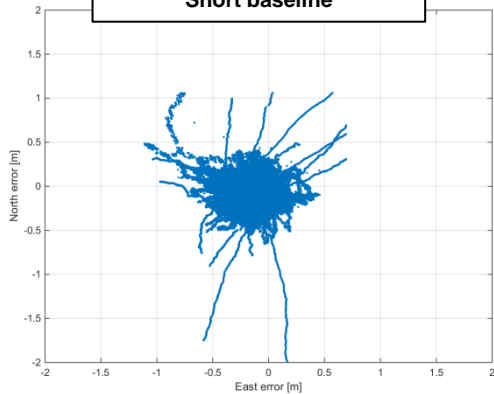
DGPS: LAGO-MLGA
Large baseline

DGPS: BELL-MLGA
Extra-long baseline



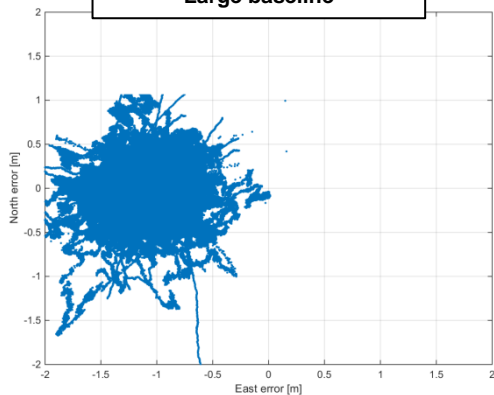
DGPS: MALA-MLGA
Short baseline

DGPS: MELI-MLGA
Medium baseline

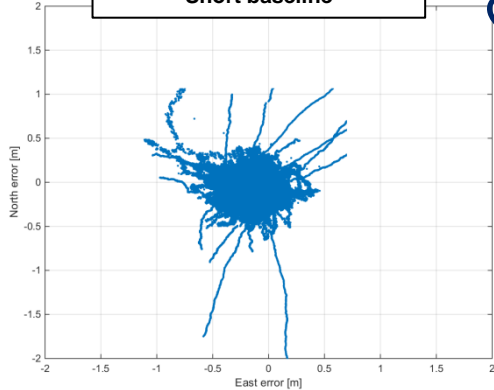


EDAS DGPS: Performance analysis (5)

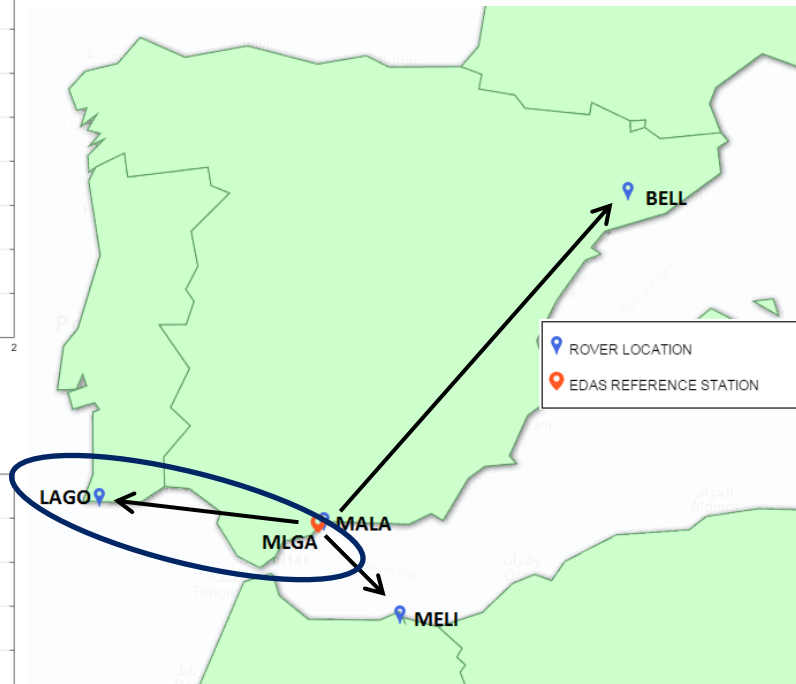
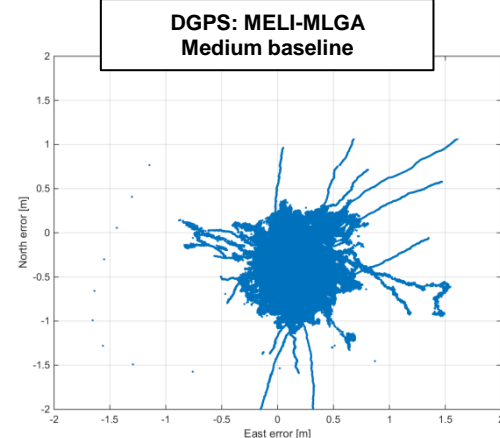
DGPS: LAGO-MLGA
Large baseline



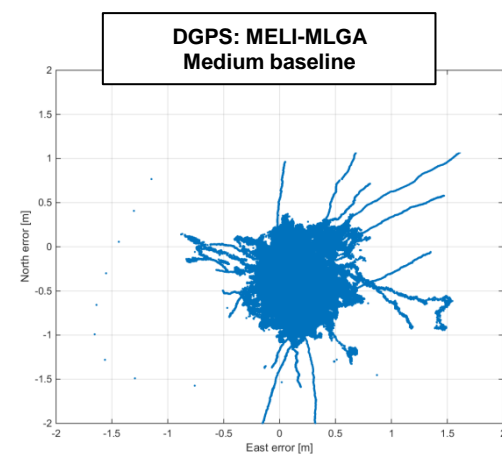
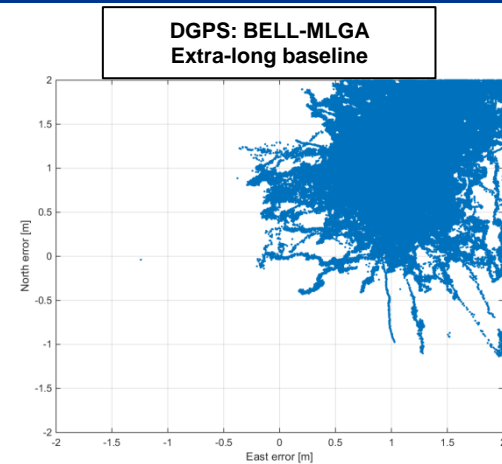
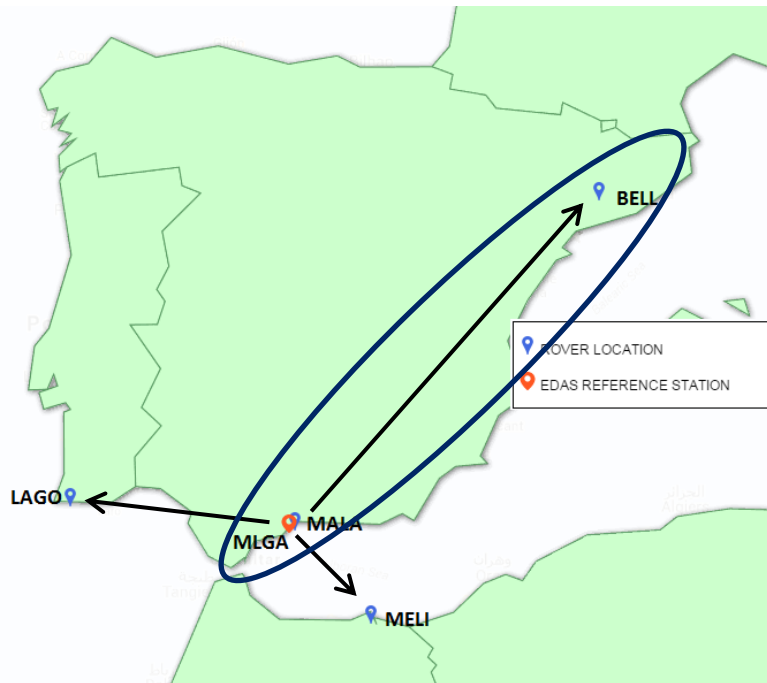
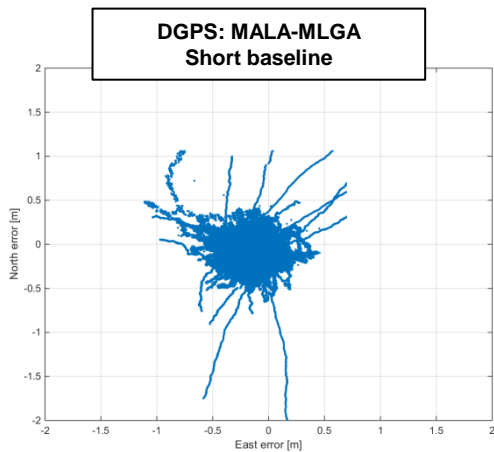
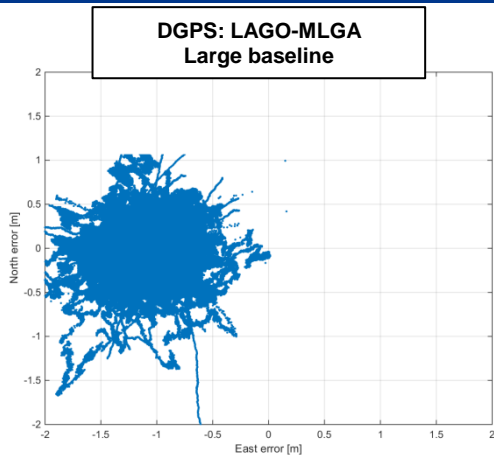
DGPS: MALA-MLGA
Short baseline



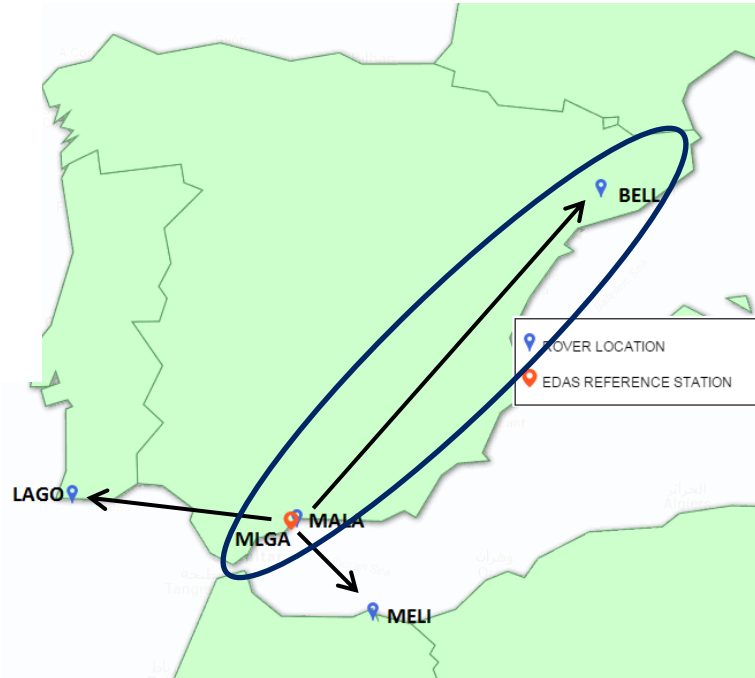
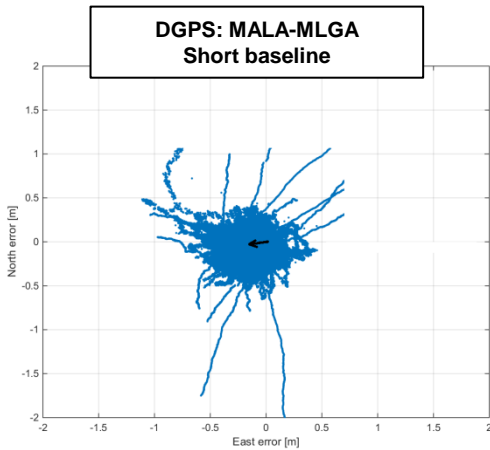
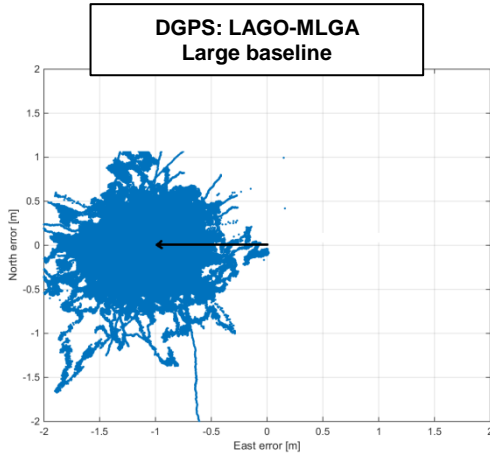
DGPS: BELL-MLGA
Extra-long baseline



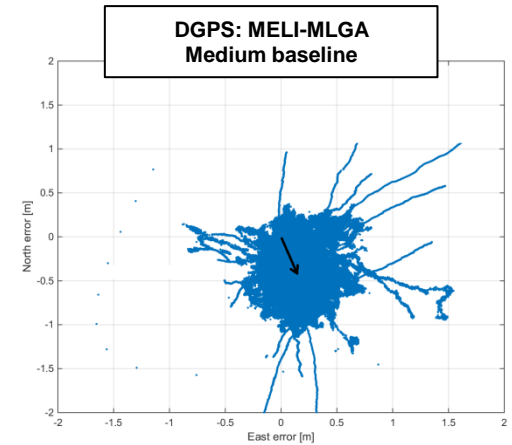
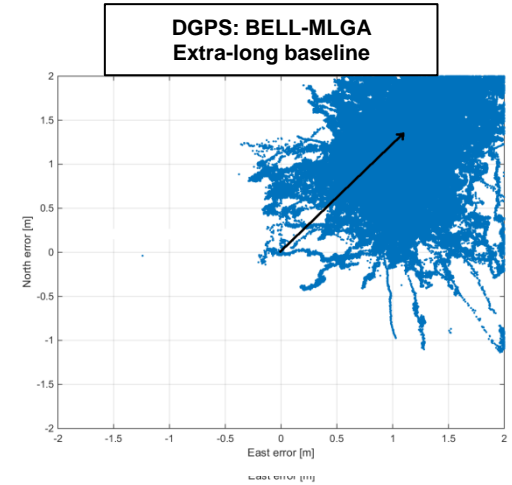
EDAS DGPS: Performance analysis (5)



EDAS DGPS: Performance analysis (6)

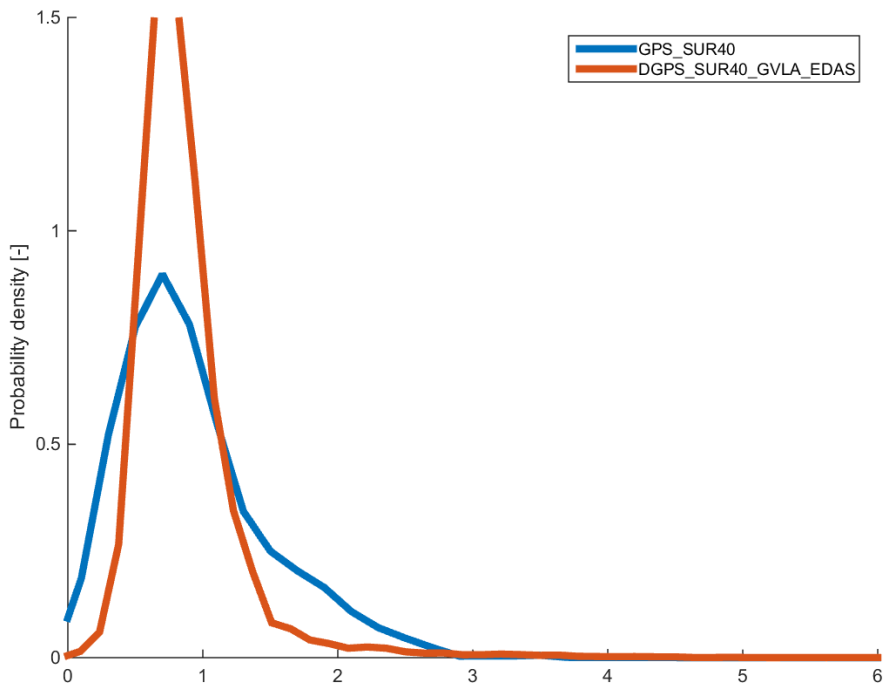


The farther the reference station is, the higher the position offset is



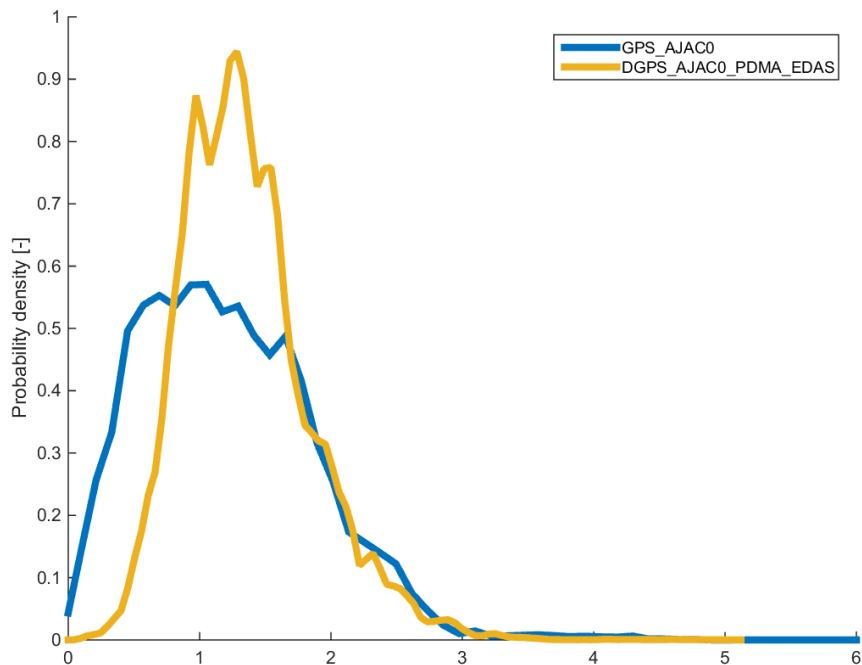
EDAS DGPS: Revised coverage (1)

Probability density function.



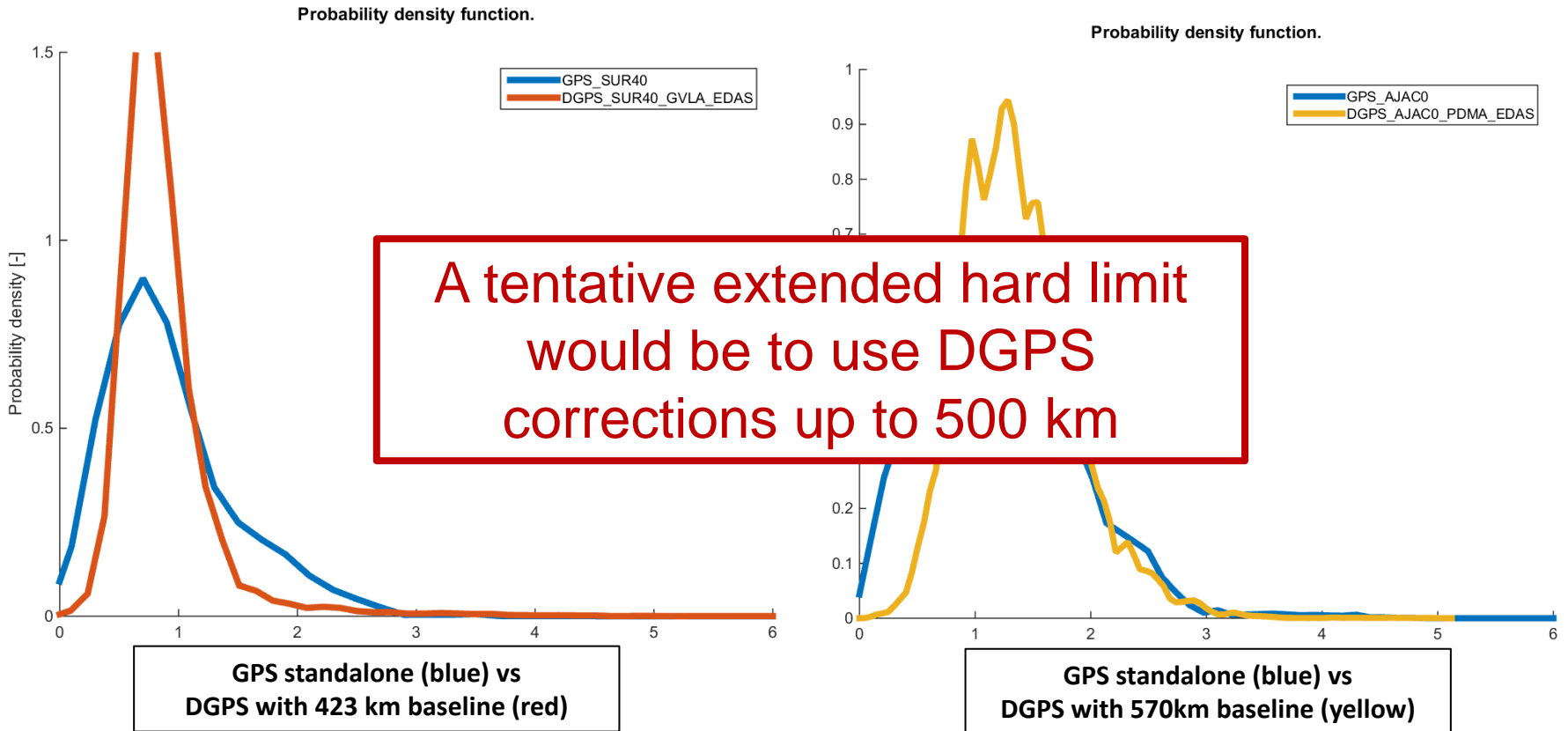
GPS standalone (blue) vs DGPS with 423 km baseline (red)

Probability density function.



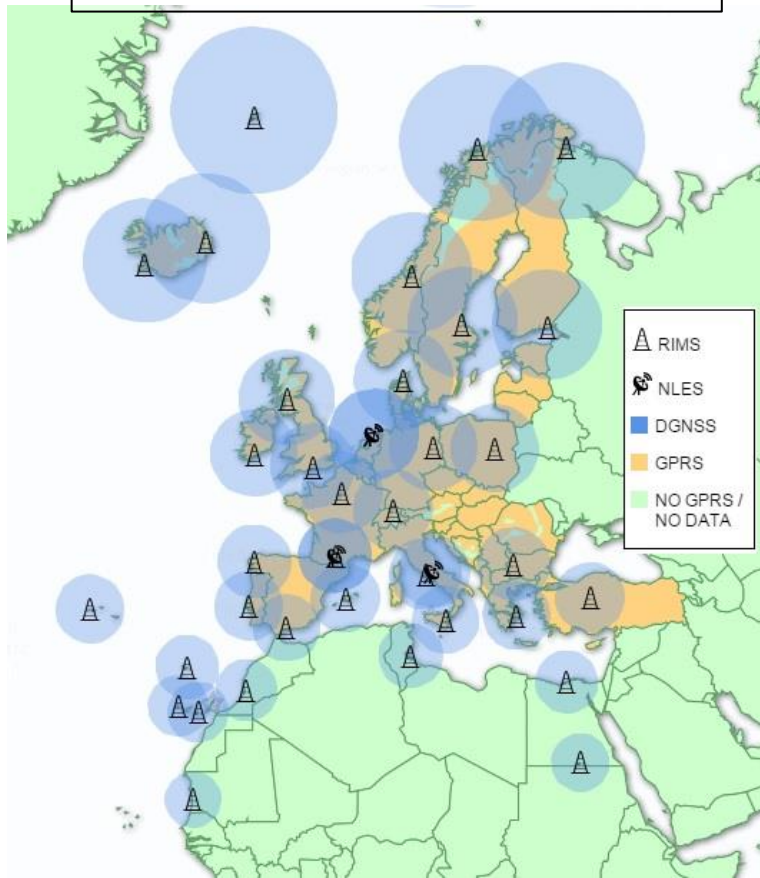
GPS standalone (blue) vs DGPS with 570km baseline (yellow)

EDAS DGPS: Revised coverage (1)

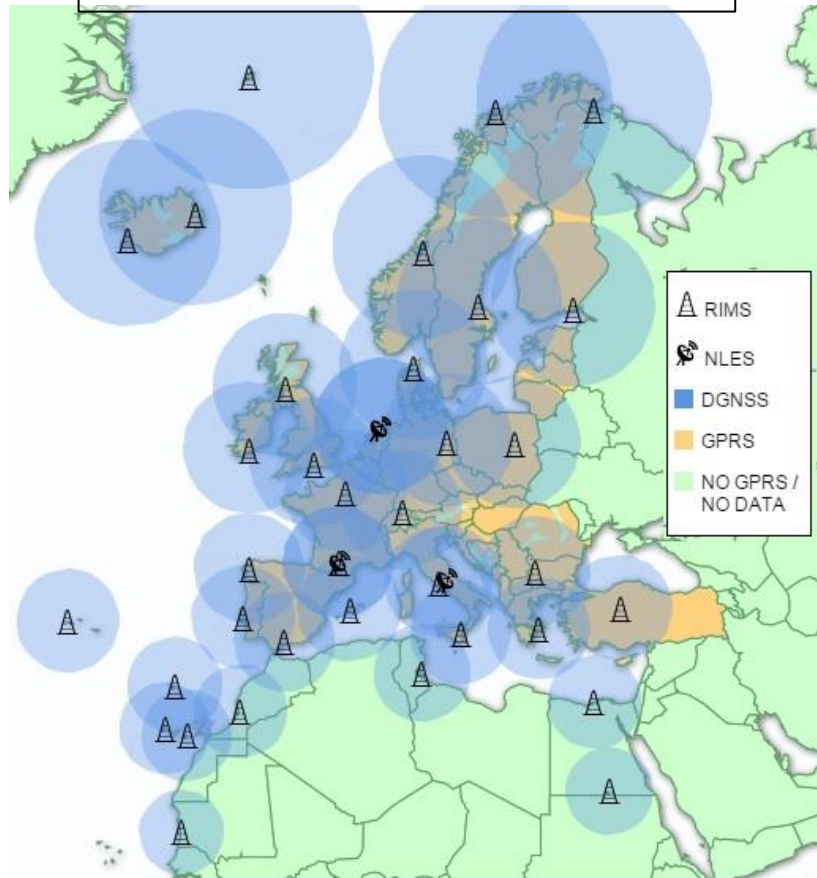


EDAS DGPS: Revised coverage (2)

Estimated EDAS DGNSS coverage considering a maximum baseline of 370 km (Europe)

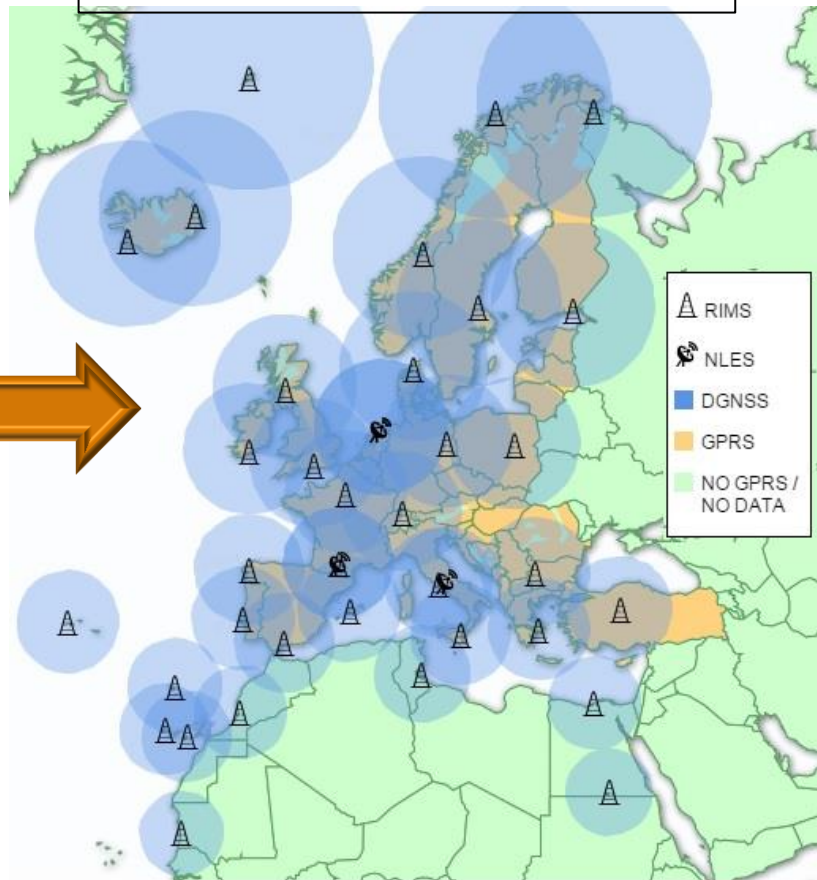


Estimated EDAS DGNSS coverage considering a maximum baseline of 500 km (Europe)



EDAS DGPS: Revised coverage (2)

Estimated EDAS DGNSS coverage considering a maximum baseline of 500 km (Europe)

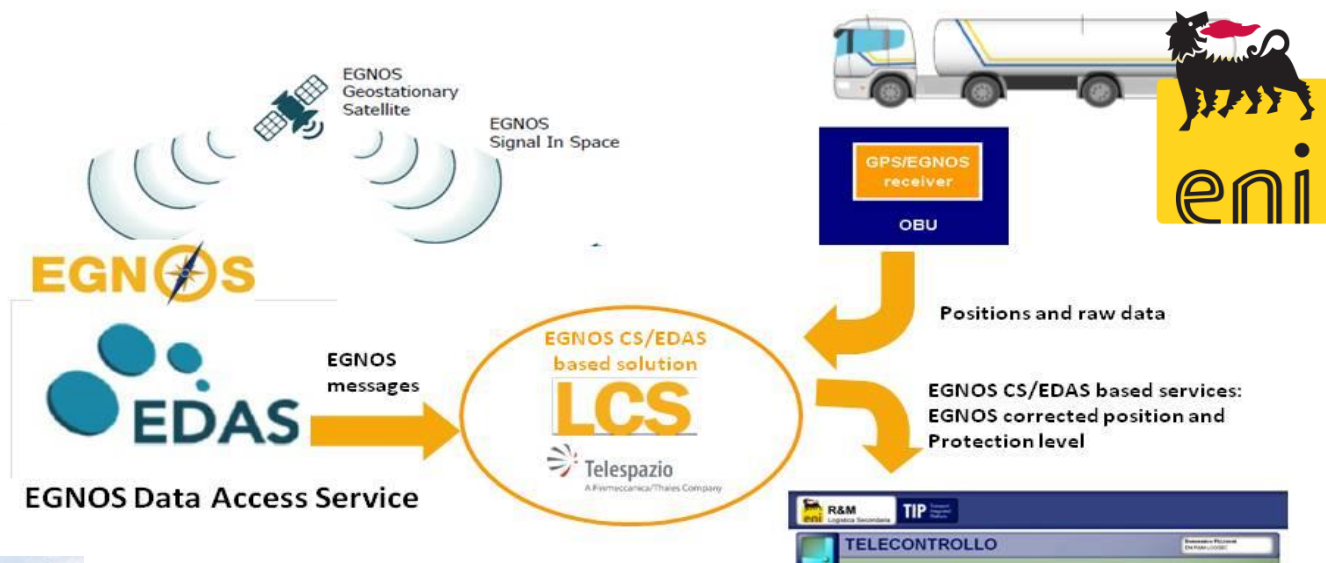


Estimated EDAS DGNSS coverage considering a range of 500 km would cover most of the EU land masses, with the exception of some regions of Eastern Europe

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- **EDAS description**
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EDAS for Tracking dangerous goods



**1200 tankers equipped in Italy
Compliant with CWA 16390**



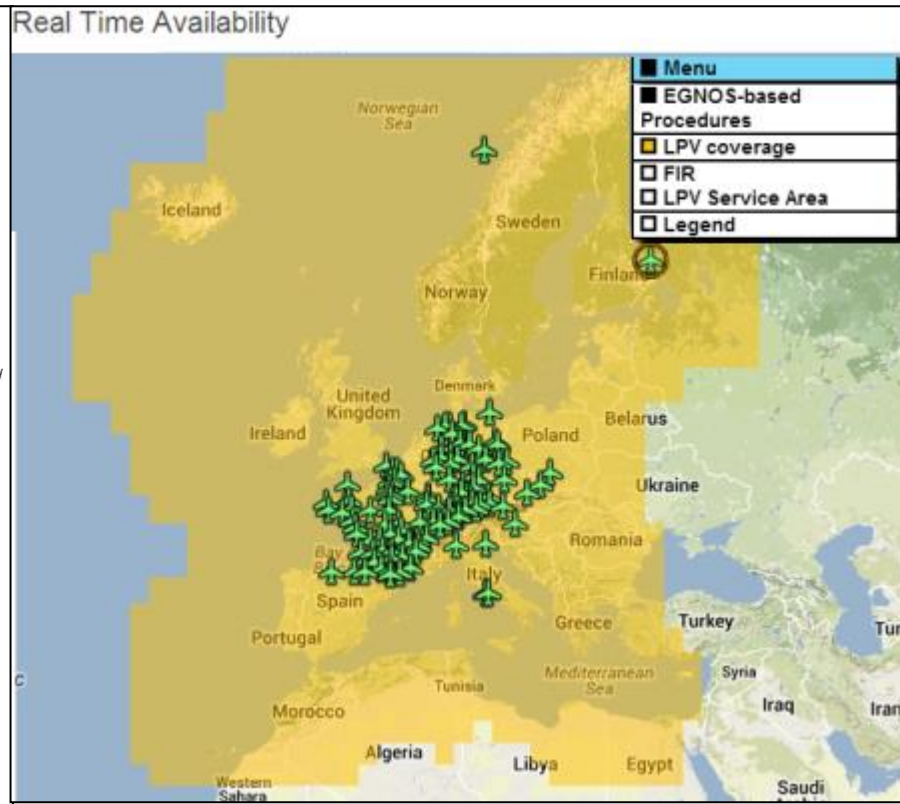
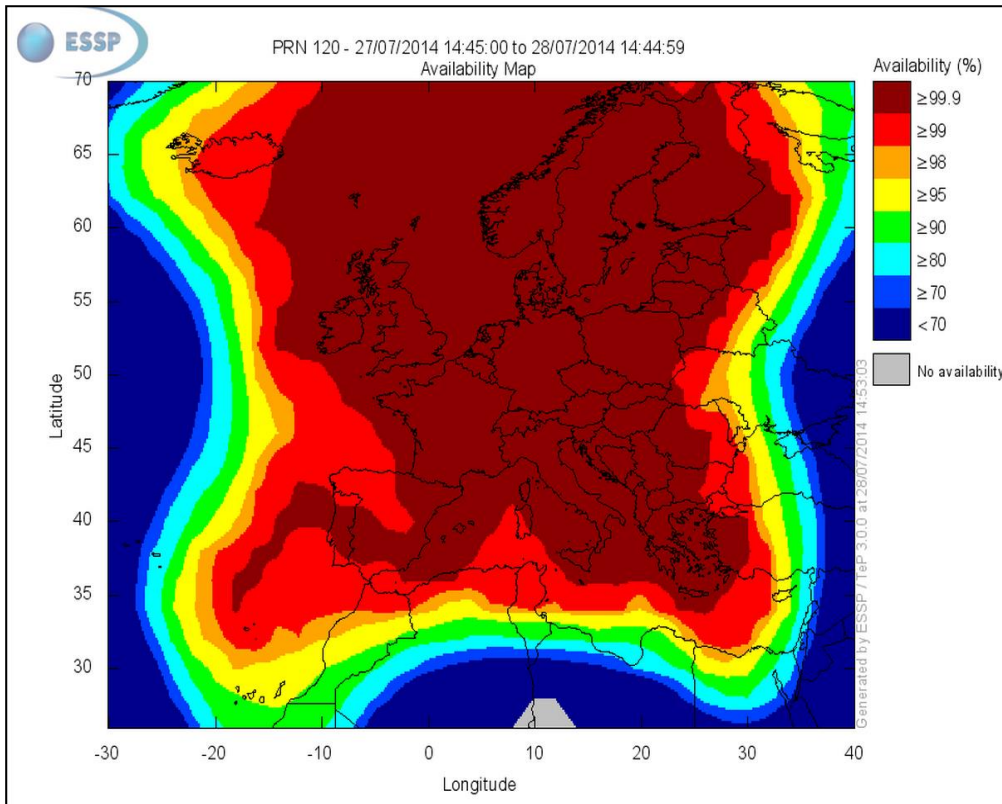
EDAS for Tracking dangerous goods



- True path
- True position
- GPS
- GPS + EGNOS Open Service
- GPS + EDAS
- Protection level

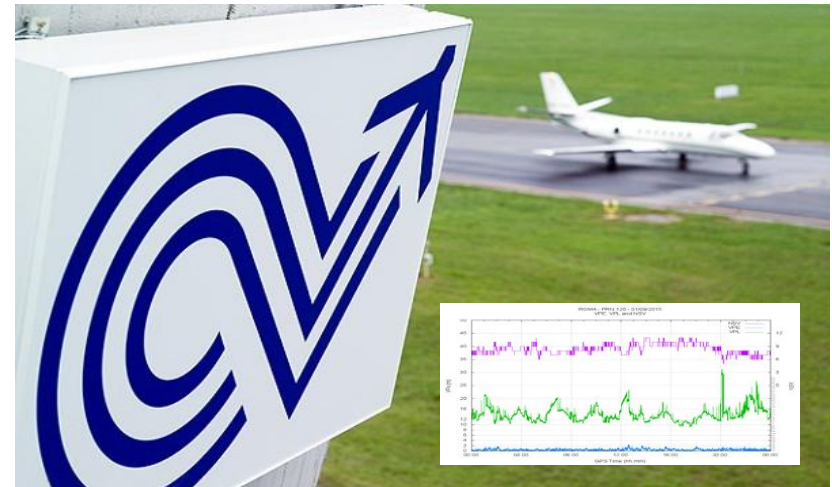
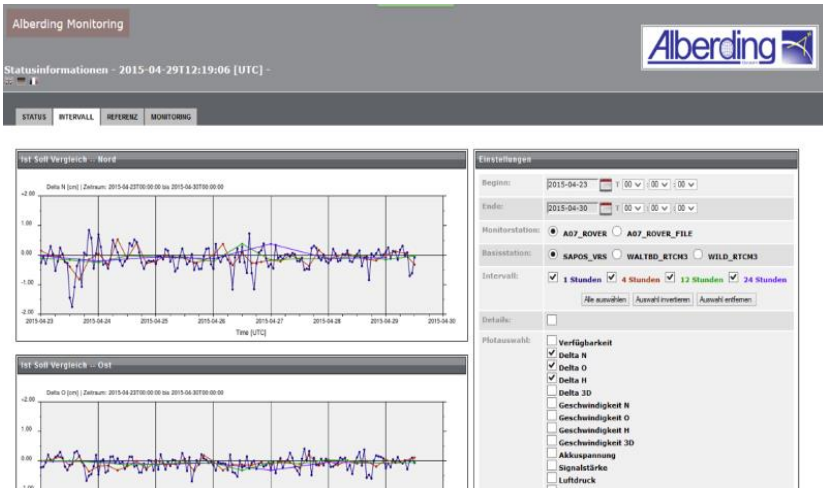


Real-time EGNOS performance monitoring




<http://egnos-user-support.essp-sas.eu/>

EDAS for GNSS performance monitoring



Alberding Monitoring SW monitors GNSS performances in real time providing solutions: GPS, GPS+GLO, RTK & DGNSS.

www.alberding.eu/en/alb_mon.html


 ENAV has assessed the feasibility to use GPS raw data provided by EDAS for Rome and Catania sites in order to compute GPS performances with Pegasus. EDAS data will be used in other GNSS Monitoring projects.

EDAS for Multi-purpose testbeds

DATA SHEET	
Operating modes	Real-time Post-processing
Input formats	NTRIP (RTCM through the internet) RINEX 2.X/3.X EGNOS EDAS Proprietary raw format
Supported GNSS constellations	GPS, GLONASS, Galileo, Compass
Supported frequencies	Single-frequency E11 augmentation Dual-frequency L1/L2 or L1/L5 augmentation
Special messages support	MT-27 and MT-28 Dynamic mask in multi-constellation mode
Output formats	RTCA DO-229D / ICAO SBAs for SBAS RTCM SC-104 v2.3 for virtual DGPS simulation SBAS-T for message dissemination through the internet
Accuracy	1-1.5 m (95%) horizontal accuracy 1-2 m (95%) vertical accuracy

Product demos at:
www.gmv.com/en/space/magicSBAS/Testbeds/

STATE-OF-THE-ART MULTI-CONSTELLATION OPERATIONAL SBAS TESTBED



magic SBAS

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CONTACT
magicbas@gmv.com

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magicSBAS


magicSBAS is a SBAS testbed to offer SBAS regional differential corrections for non-safety critical applications like mapping, precision agriculture or multi-modal transport

www.gmv.com/en/space/magicSBAS

DATA SHEET	
Operating Modes	Real Time Post Processing
Supported GNSS Systems	GPS
Supported GNSS augmentations	magicSBAS SBAS (EGNOS, WAAS)
Supported Standards	RTCA DO-229 (GPS MOPS) RTCA DO-229C (SBAS MOPS)
Supported Flight Phases (PBN specifications)	Intermediate and final segments of the approach (RNP APCH down to LP and LPV minima)
System Components	Ground transmitter Onboard rock Pilot display
Guidance Display	CDWDR
Engineering Displays	Visible Sensible Dilation of Precision Navigation solution Protection Levels Flight Technical Error Histograms

For more info:
<http://www.gmv.com/en/aeronautics/products/magicLPV>
magicLPV@gmv.com

THE LPV APPROACH DEMONSTRATOR FLY SBAS EVERYWHERE



magicLPV

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magicLPV@gmv.com

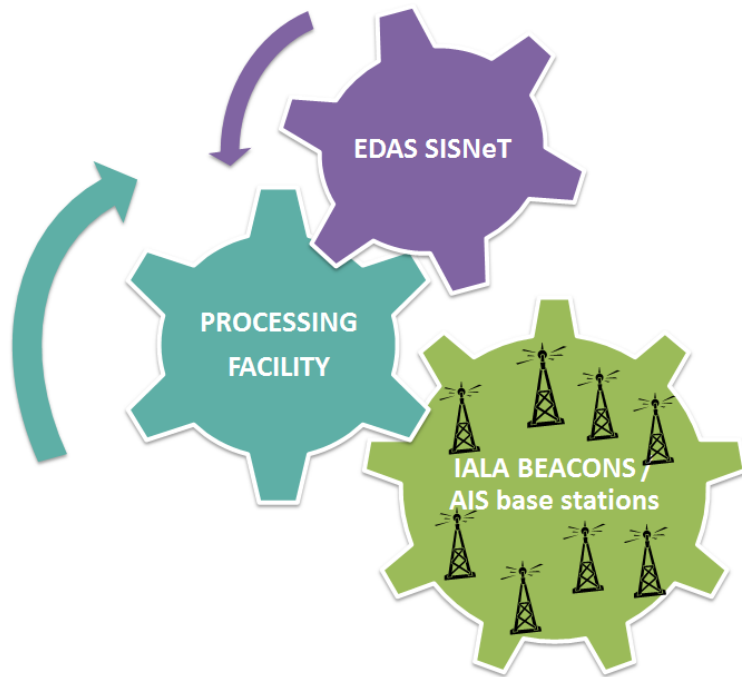
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magicLPV

magicLPV allows test pilots to fly SBAS augmented GPS APV approach procedures, down to LPV minima, using the navigation signal generated magicSBAS.

www.gmv.com/en/space/products/magicLPV

EDAS for maritime navigation



Alberding Monitor SW



based on EDAS Services for generation and monitoring of EGNOS-based virtual reference stations that provide DGNSS corrections.

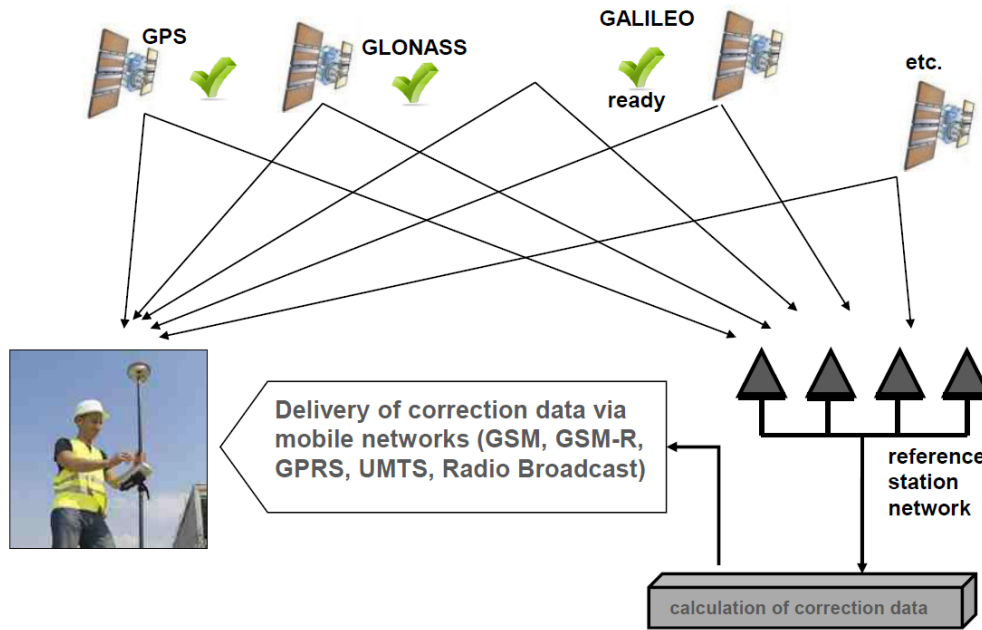
http://www.alberding.eu/en/alb_mon.html

General Lighthouse **RESEARCH & RADIONAVIGATION**
GENERAL LIGHTHOUSE AUTHORITIES
Authorities of the UK and Ireland

Is using this SW to assess EGNOS performance at selected locations within the GLA service area.

GNSS Network : Higher density with EDAS

Network RTK / DGNSS



Usage of > 400 GNSS reference stations
(including EGNOS RIMS via EDAS)

AXIO-NET comprises more than 20 years of experience in the field of precise satellite positioning and is a leading European reference network services supplier of satellite-based surveying and navigation for all kind of applications.

www.axio-net.eu



EDAS benefits for GNSS networks

- Redundancy of ground stations & robustness
- Higher network density
- Save of costs
- Extension of coverage
- Infrastructure rationalization
- Data for new algorithms
- Data for validation
- Performance monitoring

EDAS Ntrip for High Accuracy Applications

Pass-to-pass results using EDAS NTRIP



Navigation solution based on EDAS	Date	Rover receiver	Reference station (EDAS)	Pass-to-pass
RTK with short baseline (~1 km)	14-20 June 2015	BRNB (EDAS)	BRNA	< 1 cm
DGPS with short baseline (~10 km)	2-8 August 2015	MALA (EPN)	MLGA	6 cm
DGPS with medium baseline (~210 km)	2-8 August 2015	MELI (EPN)	MLGA	8 cm
DGPS with large baseline (~372 km)	2-8 August 2015	LAGO (EPN)	MLGA	10 cm

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Conclusions

- **EDAS** provides **free-of-charge** access to the **GNSS data** generated and gathered by **EGNOS infrastructure** in real time and in form of archive.
- **EDAS DGPS corrections improve GPS standalone solution up to 500 km baseline covering most of the EU land masses**, with the exception of some regions of Eastern Europe.
- **EDAS provides an added value for a wide area of applications:** asset tracking, GNSS performance monitoring, contribution to GNSS networks, high accuracy applications, etc.

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We certify you're there.