

Galileo and EGNOS applications in High Precision

Budapest

21 March 2013 European GNSS Agency, GSA

Reinhard Blasi, Market Development Officer

GSA supports European Commission on market development and security accreditation

Political Oversight

Council and Parliament

Programme Oversight

European Commission

GNSS Programme Committee

Implementation

European Space Agency

delegation

delegation assistance

European GNSS Agency (GSA)

IOV contracts

FOC contracts

Security accreditation

Marketing of the systems

Market monitoring

Applications R&D programme

Upstream industry

Downstream industry



The European Satellite Programme: EGNOS/EDAS and Galileo



- Global Navigation Satellite System (GNSS)
- Compatible with most other GNSS
- Inter-operable with GPS
- 2 prototypes launched (GIOVE) in 2005 and 2008
- 2/4 constellation satellites were launched to validate the system on 21 October 2011
- Next 2 satellites two be launched on 12 October 2012
- Operational system planned for 2014/15
- Satellite Based Augmentation System (SBAS)
- Measures GPS performance
- Corrections to users via satellite or terrestrial links (EDAS)
- Covers most of EU
- Expansion to Africa, Middle East and Eastern Europe planned
- Officially operational since 2009
- Certified for Safety Of Life since March 2011



The European Satellite Programme: EGNOS/EDAS and Galileo



The Galileo implementation plan

In order for Galileo to be recognized by the downstream market as the second satellite navigation system of choice it is key to deliver early services as soon as 2014/2015.

Galileo System Testbed v1
Validation of critical algorithms
2003



Galileo System Testbed v2
2 initial test satellites
2005



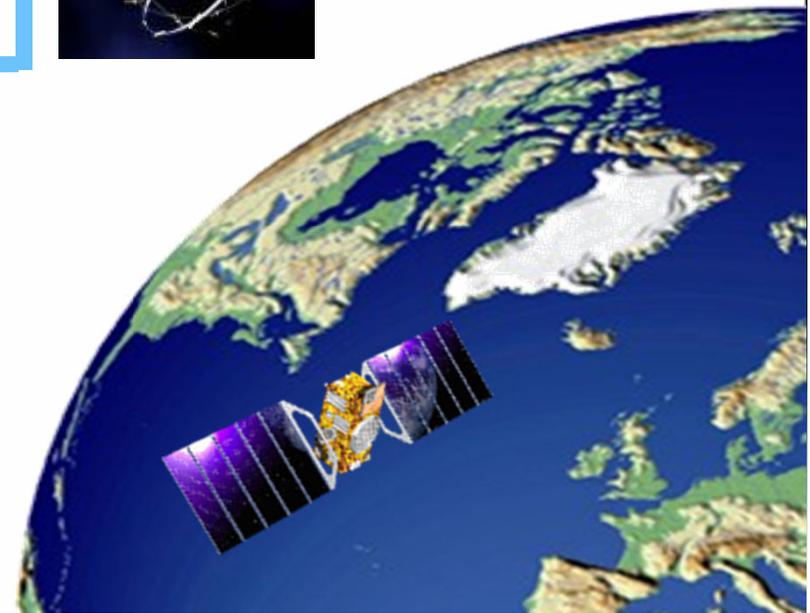
In-Orbit Validation
4 IOV satellites plus
ground segment
2011/2012



Initial Operational Capability
Early Services for OS, SAR, PRS
18 satellites
2014/2015



Full Operational Capability
All services, 30 satellites
2019/2020



GNSS market report issue 2 just published



GNSS MARKET REPORT ISSUE 2

SECTORS COVERED:

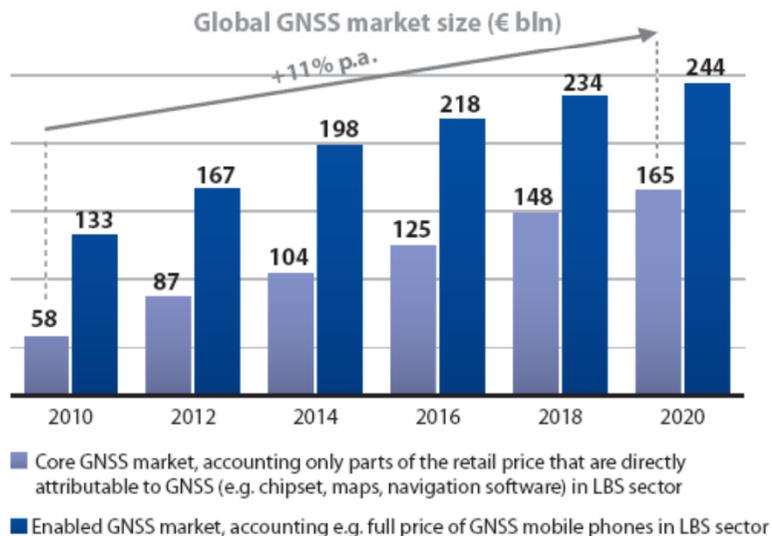
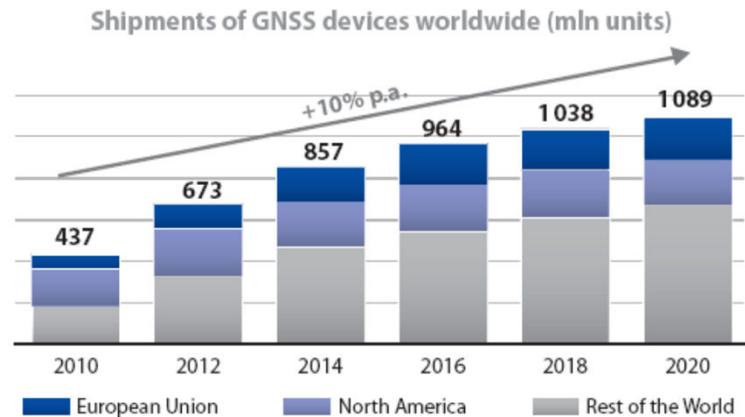
- Aviation
- Agriculture
- Road transport
- LBS
- Surveying
- Maritime (open sea)

May 2012

GSA GNSS Market Report – Issue 2



The global GNSS market is strong and growing



- GNSS device shipments will grow on average 10% per year over the next decade reaching 1.1 bln shipments by 2020.
- The overall worldwide GNSS revenues for civil applications are expected to grow on average by 11% per year reaching €165 bln in 2020 (core market), of which €32 bln is generated in the EU.



Galileo in Mapping and Surveying domain (1/3)

Benefits and impact areas of Galileo in both segments

Dual frequency signal as a standard for all civil applications will improve the precision of positioning for capable devices

Higher elevation of satellites and their number guarantee better availability of the service worldwide

Higher contingency thanks to three in-orbit spare satellites

Positioning at locations with poor sightline of the sky will become feasible as twice as many satellites will be visible

Enhanced geometry will improve the precision of positioning

Enhanced visibility, particularly in the urban areas or areas with obscured lines of sight to the current satellites

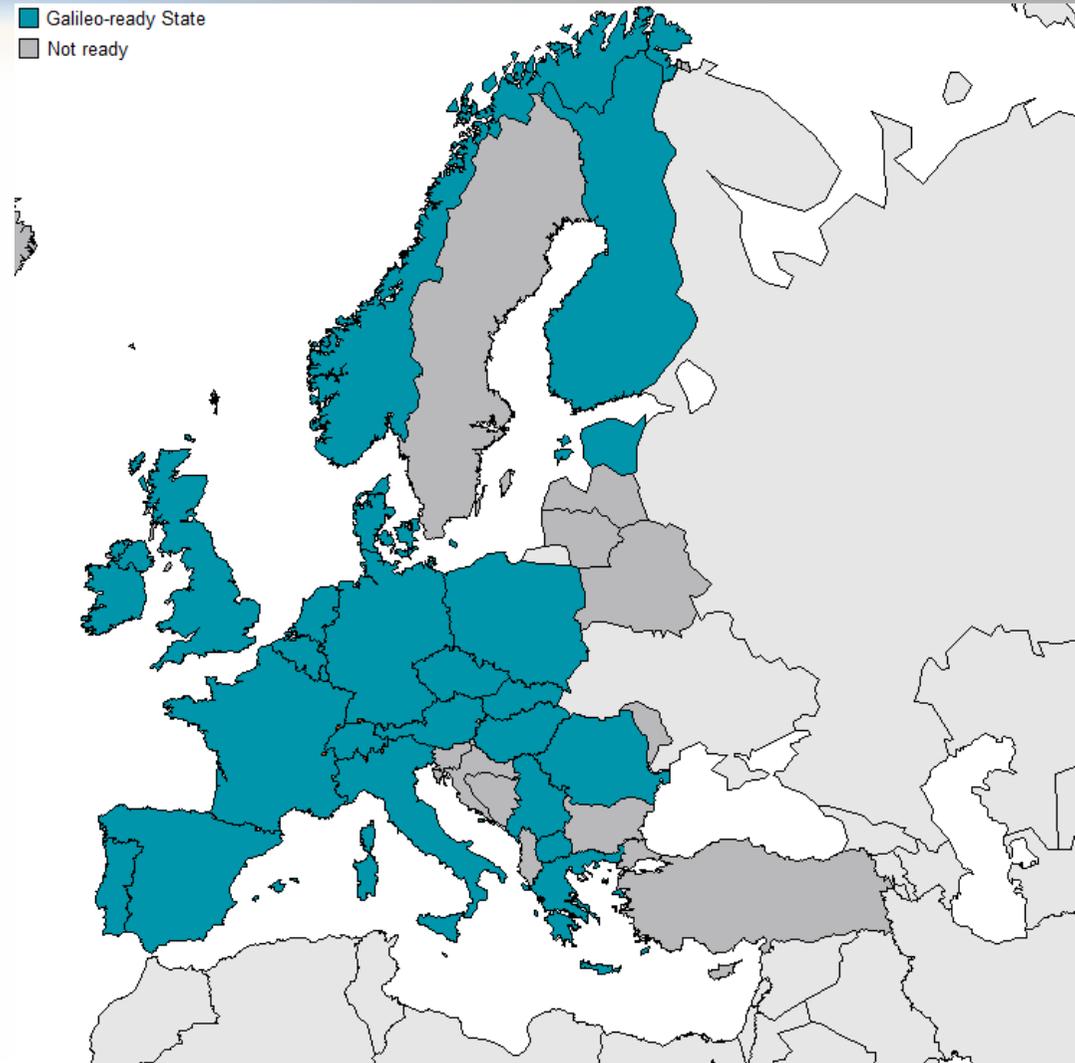
Stronger signal comparing to GPS, which would be able to pass more easily through some objects, such as tree canopy



Galileo in Mapping and Surveying domain (2/3)

Readiness of permanent GNSS networks in Europe

Permanent GNSS networks in 23 out of 35 (66%) of the researched states are ready for the Galileo signals*



* Data taken from the desk-based research



Galileo in Mapping and Surveying domain (3/3)

- Markets are highly competitive
 - ▶ New possibilities facilitated by the Galileo service will be quickly picked up by the leading manufacturers and companies
- Plans for GPS-III in 2018 earliest
 - ▶ If initial navigation services are provided already in initial operational phase, Galileo will gain advantage to establish itself in the market
- The more satellites the better
 - ▶ Even with GPS III, which by itself brings a benefit of having more satellites in orbit, Galileo will still deliver benefit associated with users seeing more satellites, which is particularly important in built up urban areas

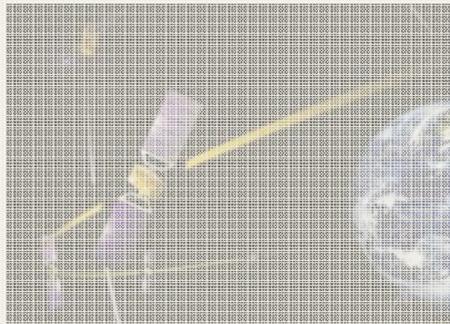


Assess impact of Galileo in mapping and surveying: *Conclusions*

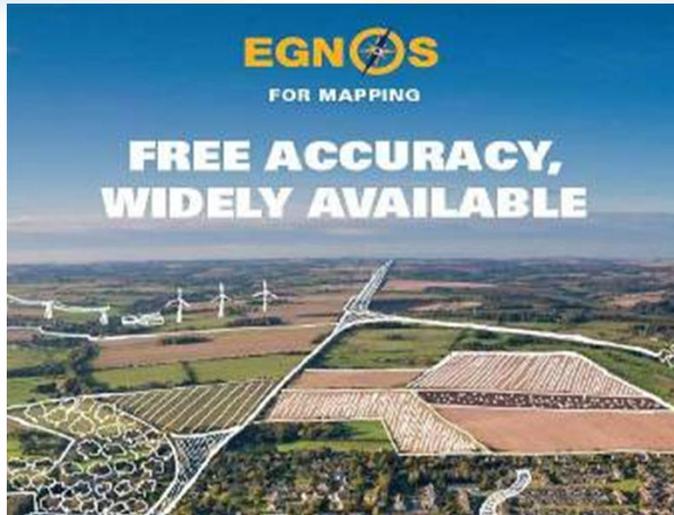
- Plans for full GPS-III deployment in 2021 earliest
If initial navigation services are provided already in initial operational phase, Galileo will gain advantage to establish itself in the market
- Combined GPS-III(IIF)/Galileo dual-constellation impact
Users using dual-frequency dual-constellation receivers will be able to start utilising the fully operational dual-frequency services by as early as 2015 (accelerated by five years); accelerated adoption of inexpensive, high-precision GNSS receivers; value of high-precision data (horizontal and vertical) is expected to reduce substantially
- The more satellites the better
Even with GPS-III Galileo will have benefit associated with users seeing more satellites, which is particular benefit in built up urban areas



The European Satellite Programme: EGNOS/EDAS and Galileo



So far the GSA Market Development is focussing on four EGNOS segments



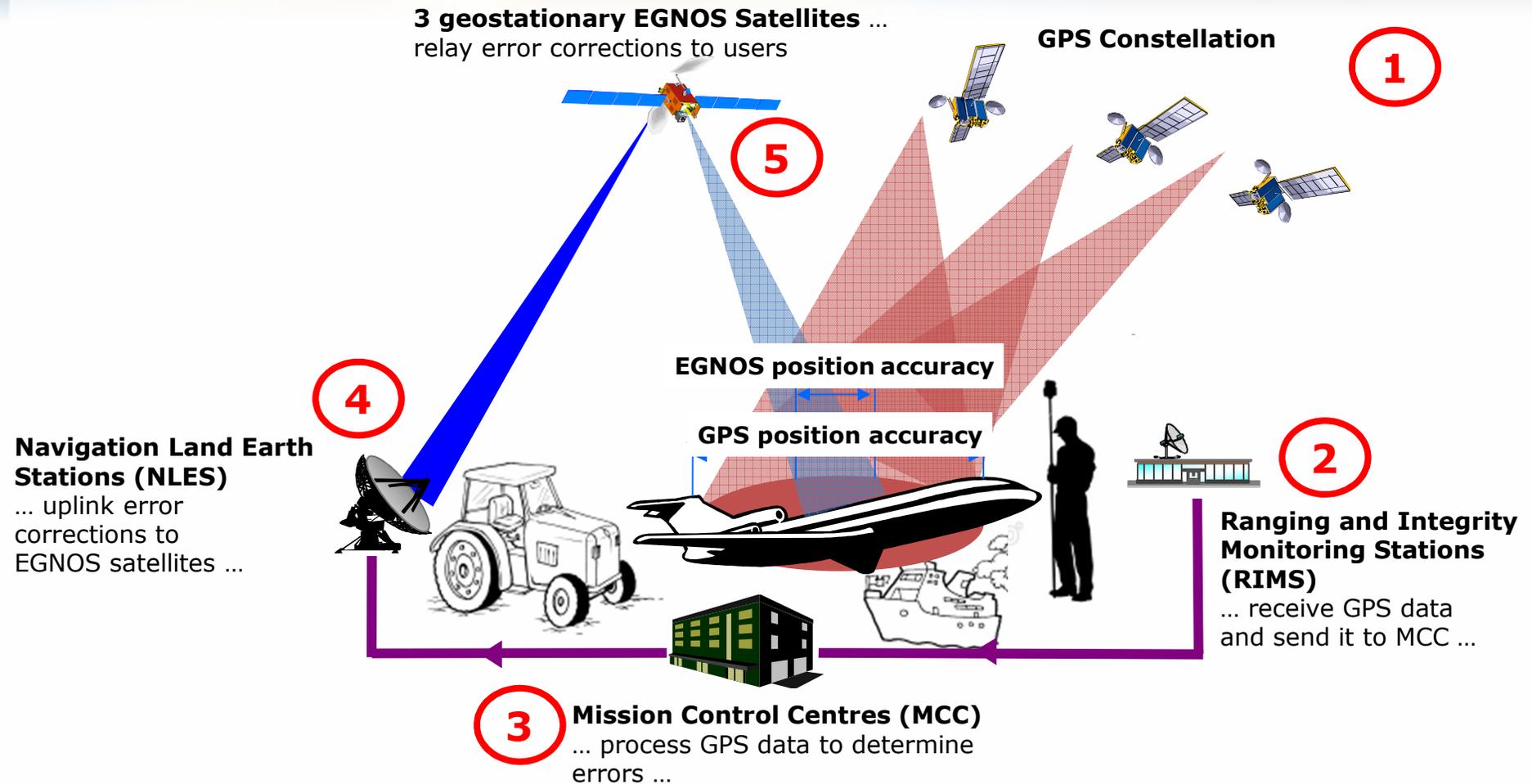
While Galileo is being built up, EGNOS is operational, certified and well performing



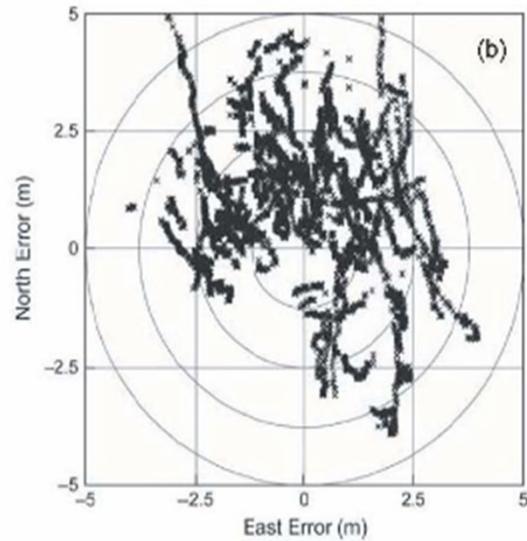
It's there. Use it.



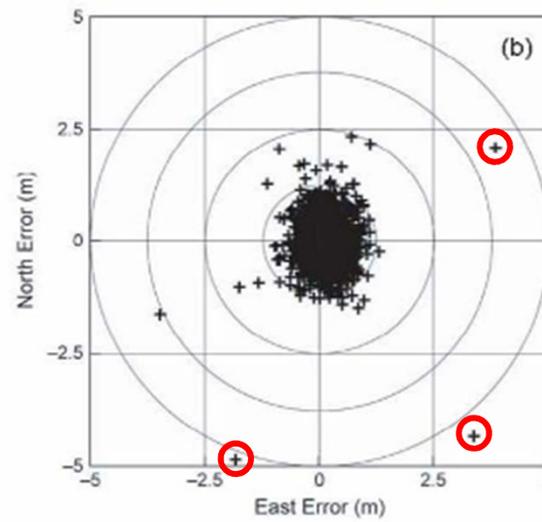
EGNOS improves GPS



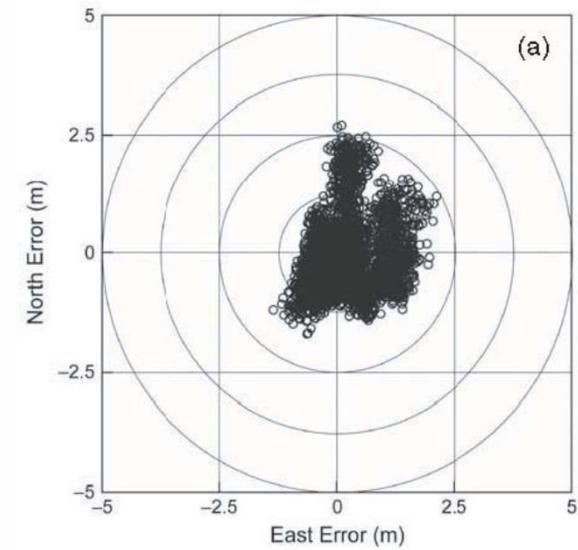
EGNOS improvement on precision



GPS



D-GPS



**SBAS
(EGNOS)**

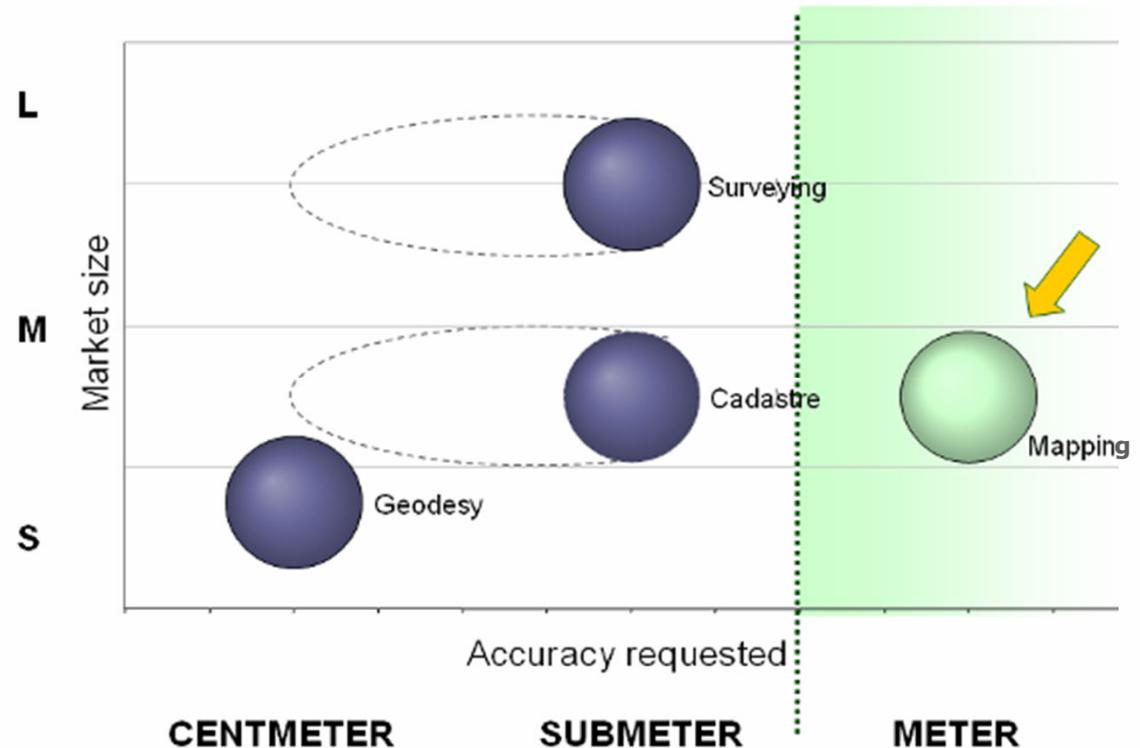


EGNOS and Mapping – providing free accuracy that is widely available

GNSS provides an efficient technology for mapping and are widely used by organisations such as utility companies as well as regional and local authorities.

The use of GNSS in mapping often means services with centimetre level accuracy and substantial costs (e.g., infrastructure, equipment, software, service)...

Now EGNOS can contribute in growing the use of GNSS in real time.

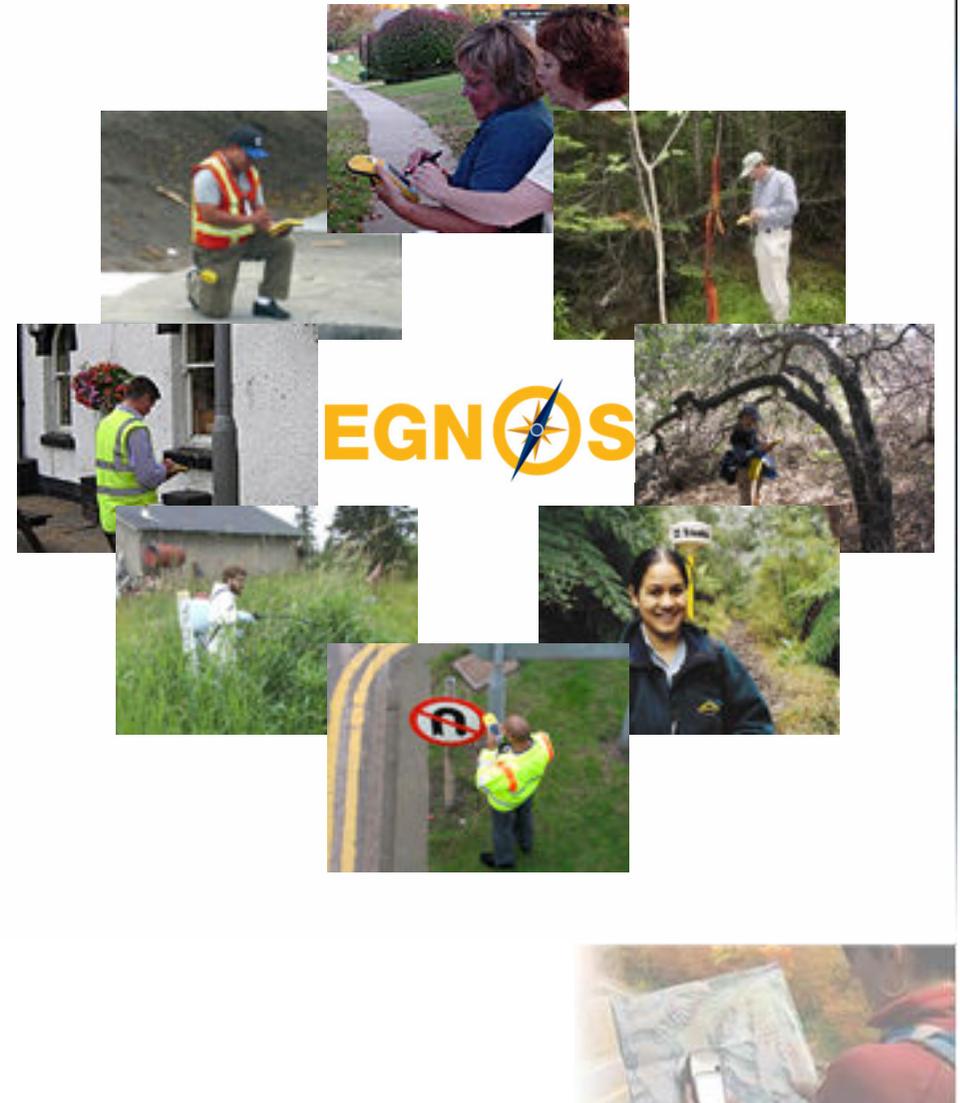


Free accuracy...

For many mapping applications meter level accuracy is sufficient

Applications such as thematic mapping for small and medium **municipalities, forestry** and **park management** as well as surveying of **utility infrastructures** can benefit from EGNOS.

Most of the devices used for Mapping are already EGNOS-ready. Thus, EGNOS also allows more and more non-professionals to access GNSS mapping technologies

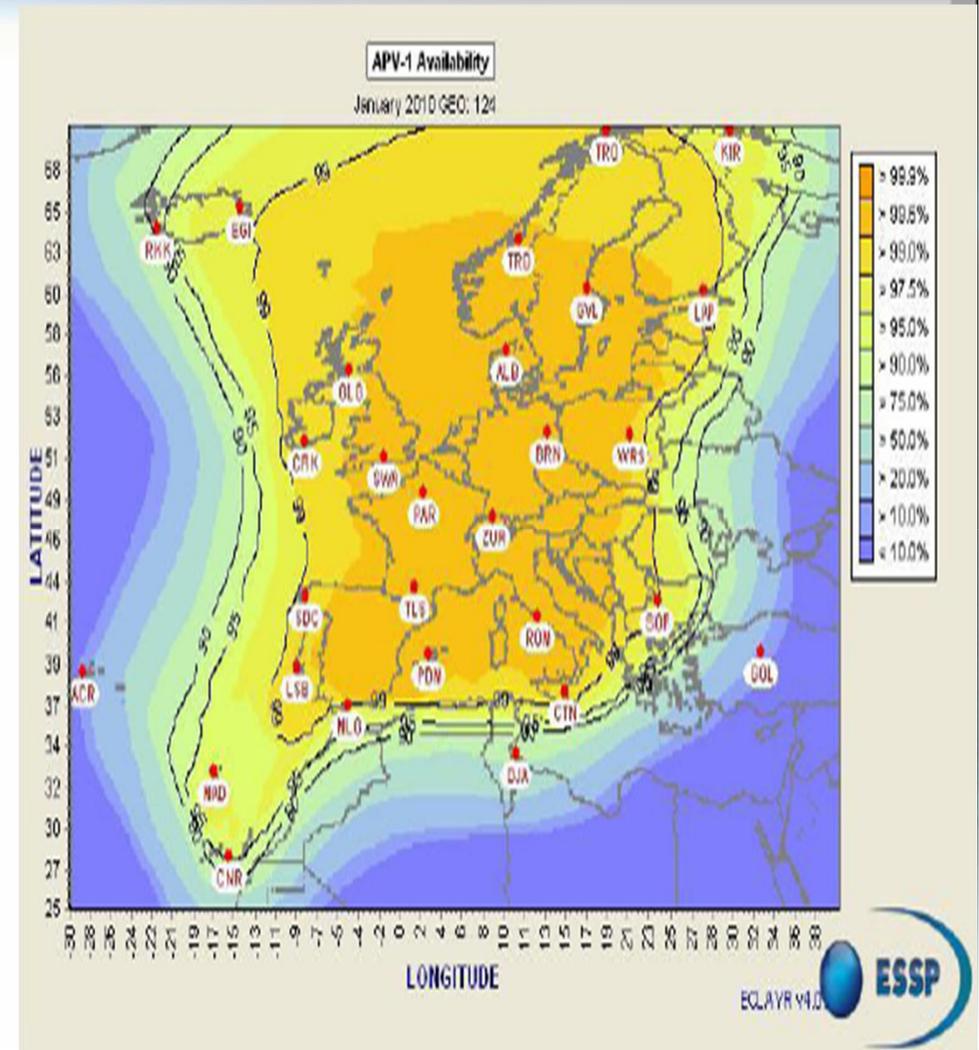


...widely available (1/3)

EGNOS provides constant level of position accuracy throughout most of Europe. EGNOS corrections can be received via different means:

- directly via EGNOS satellites without any communication costs
- via terrestrial communication means such as internet or cellular networks, thanks to **EDAS, the EGNOS Data Access Service**

EDAS is the single point of access for the data generated and collected by EGNOS. EDAS is freely available and currently in a test service phase.

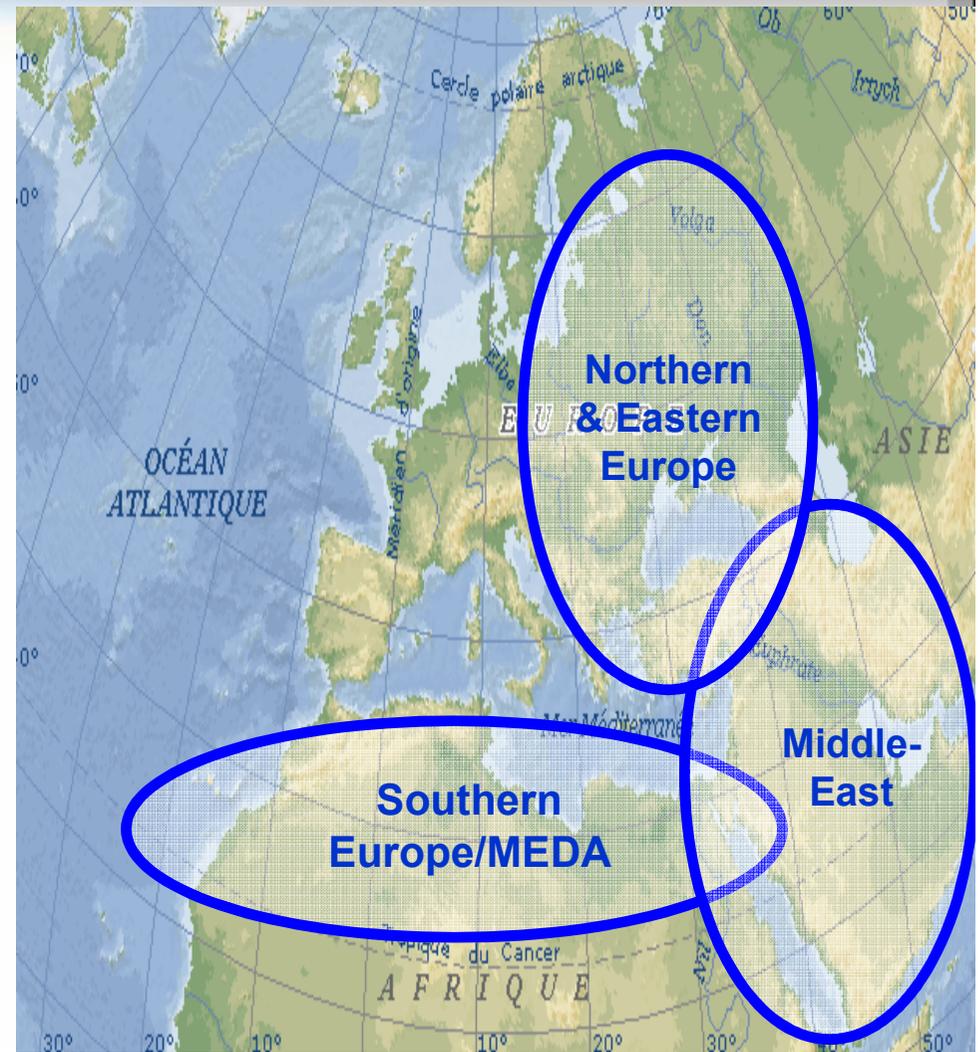


...widely available (2/3)

EGNOS provides constant level of position accuracy throughout most of Europe. EGNOS corrections can be received via different means:

- directly via EGNOS satellites without any communication costs
- via terrestrial communication means such as internet or cellular networks, thanks to **EDAS, the EGNOS Data Access Service**

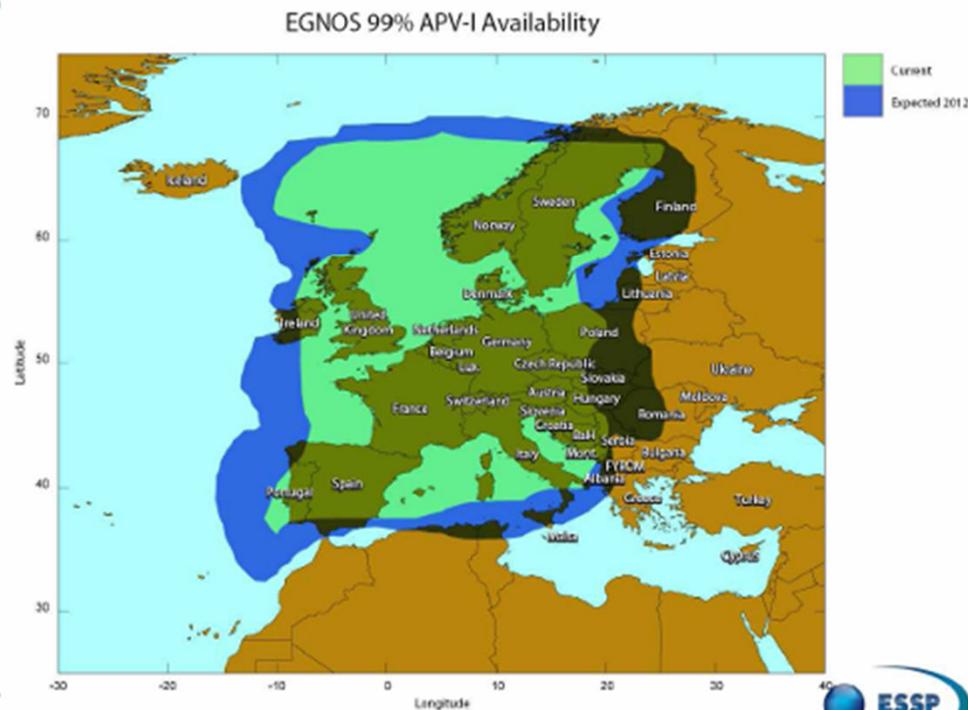
EDAS is the single point of access for the data generated and collected by EGNOS. EDAS is freely available and currently in a test service phase.



...widely available (3/3)



EGNOS Service Area Improvements



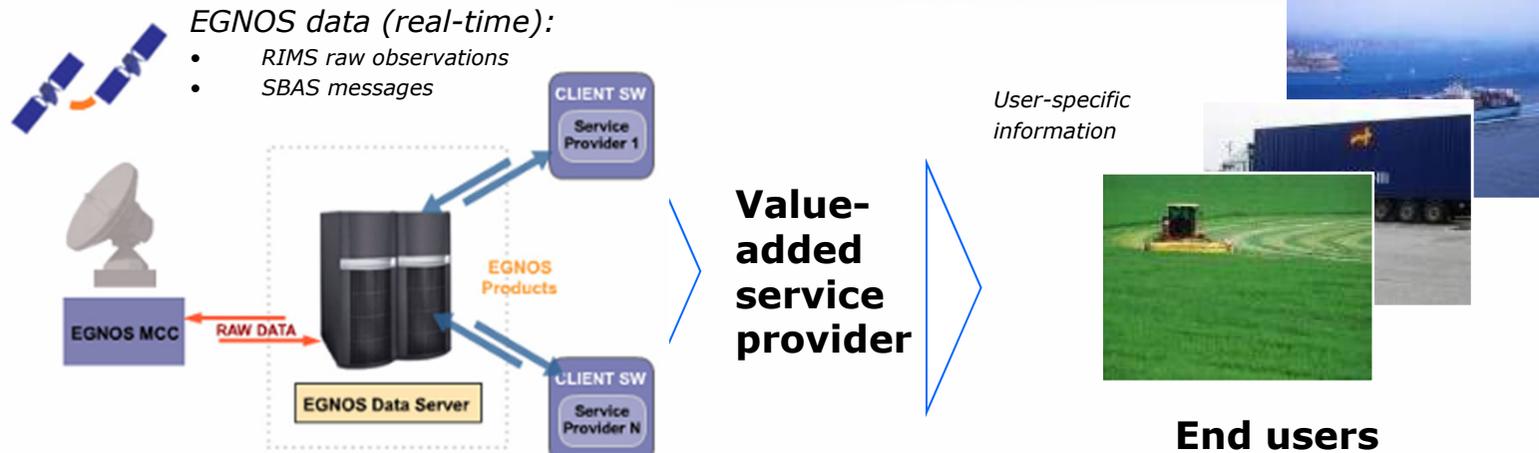
New RIMS in Athens, Alexandria, Palma

EGNOS release SR2.3.1 deployed at the end of 2011 with new RIMS and improved EGNOS functions will increase:

- the service area
- the service robustness in the service border area



The EDAS Service is free to use

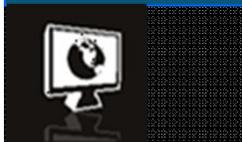


<http://www.gsa.europa.eu/go/egnos/edas>



EDAS on the way – Plug in for free

EDAS is now available. This allows any interested parties to sign-up to access EDAS for free.



During the evaluation of the free trial different market scenarios are currently assessed



Preliminary results of the CAP trials done by EGNOS/EDAS enabled device (1/4)

The Common Agricultural Policy (CAP) is a system of subsidies and support programmes for agriculture by the European Union. The reform of 2003 introduced new area-based subsidies.



Article 34 of the Regulation N° 1122/2009 requires that EU Member States use tools of a proven quality to measure agricultural parcels that are eligible for area-based subsidies under the CAP. This requirement applies to the GNSS devices used during the on-the-spot controls.



Preliminary results of the CAP trials done by EGNOS/EDAS enabled device (2/4)

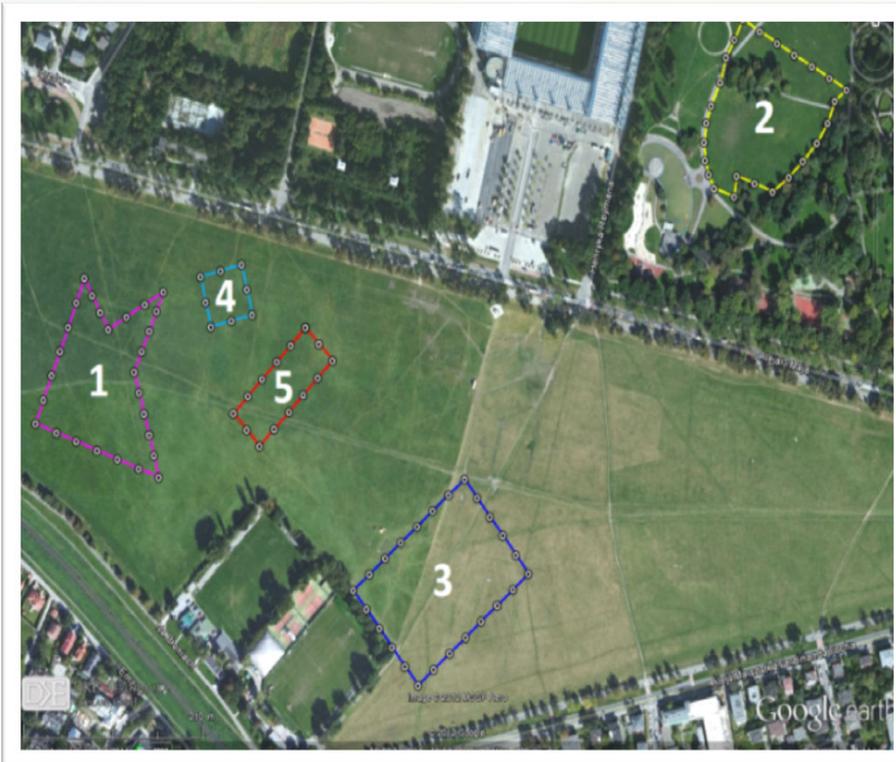
GNSS technologies are the second most popular method for performing field measurements within the CAP applications after Control with Remote Sensing (CwRS)

Validation

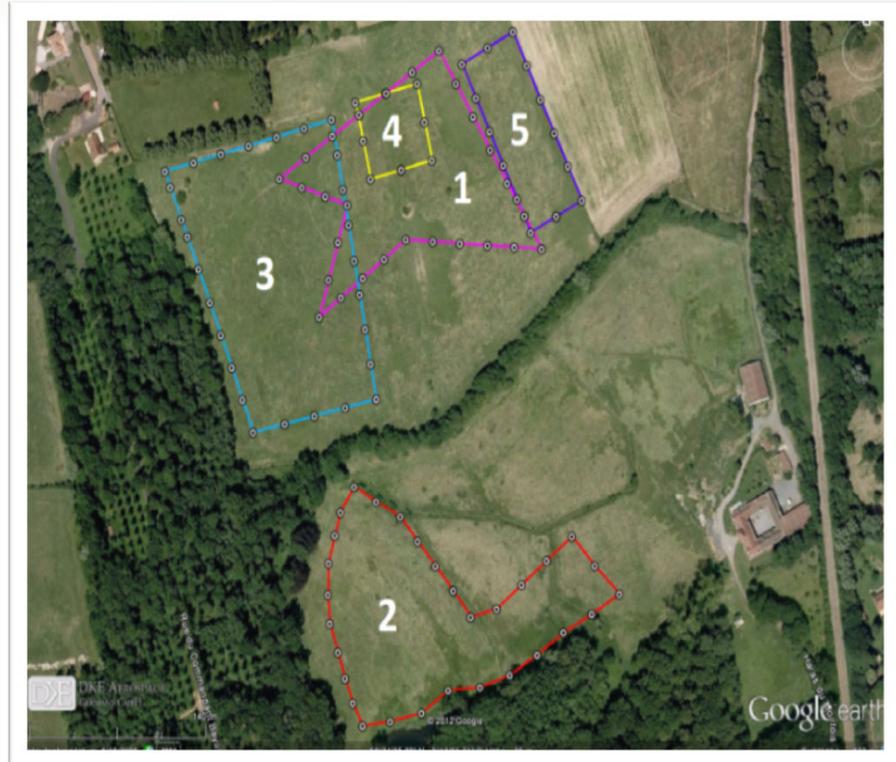
- 5 parcels with 8 sets per parcel and 4 repetitions for parcel and set
- The shapes of the parcels varied from very simple to irregular shapes
- Two full test campaigns carried out in Cracow (Poland) and Geneq (France)
- Trials done for the vertex mode only
- A virtual validation for the receivers was done covering the case in which differential corrections are retrieved through a NTRIP server



Preliminary results of the CAP trials done by EGNOS/EDAS enabled device (3/4)



Poland



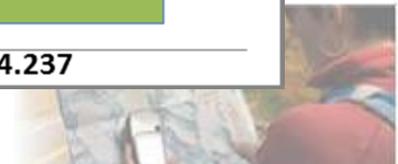
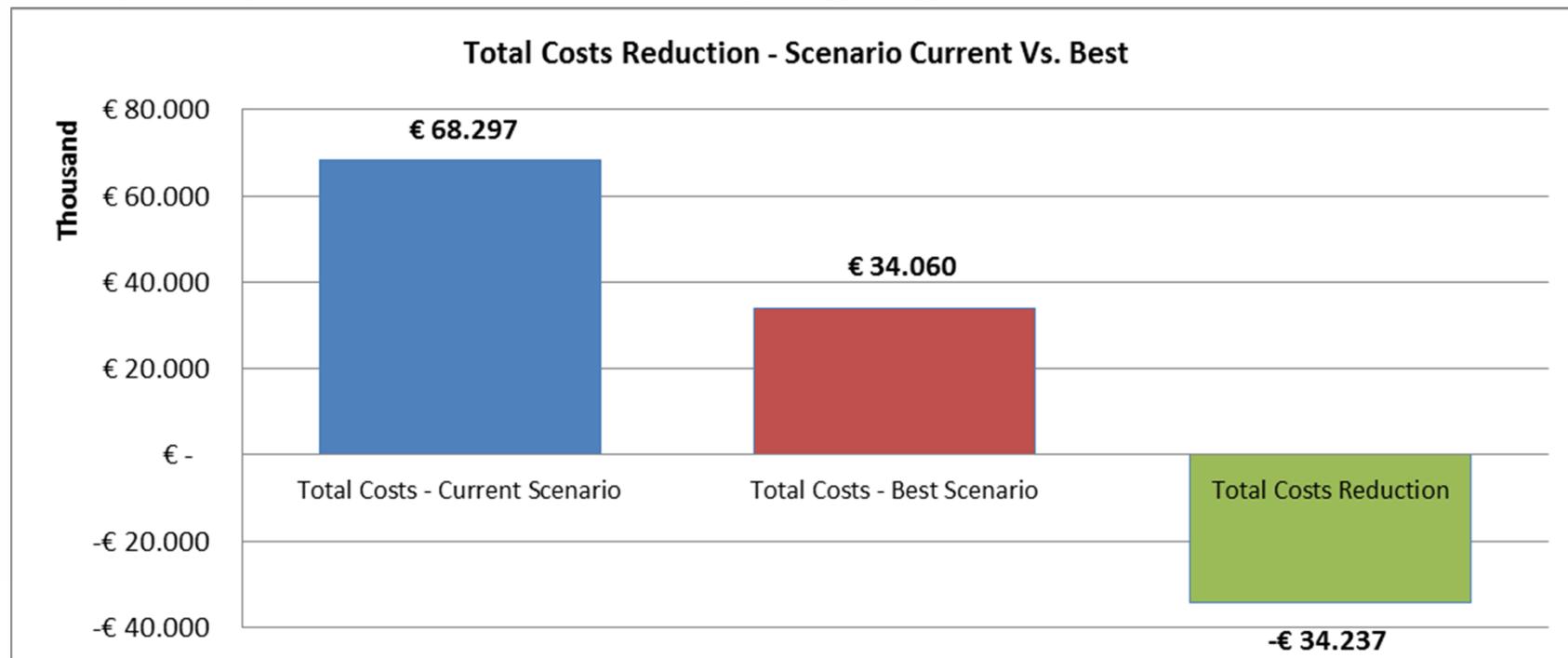
France



Preliminary results of the CBA of EGNOS for CAP applications (2/2)

Under the assumption that the switch to EGNOS occurs by 2016 the CBA demonstrates a cost reduction of around:

- **€132,000 per year per Paying Agency**
- **€1,317,000** for each Member State in the ten year period
- **€34,200,000 across all Paying Agencies at European level**



Preliminary results of the CAP trials done by EGNOS/EDAS enabled device (4/4)

Results:*

Total improvement	Poland	France
EGNOS SiS vs. GPS	68%	2%
NTRIP vs. GPS	160%	65%



EDAS shows significant improvements in all conditions

* The difference in the EGNOS performance across the two countries is related to the fact that the parcels in France were more complex.



Many devices are EGNOS enabled...

Illustrative
<klick>



Microsoft Excel
Worksheet



NOMAD 900G Series



TOPCON
GMS-2 Pro



Leica Geosystems
Zeno 10 & 15



ashtech
MobileMapper100



GENEQ inc.
Scientific instruments

SXBlue Mapper 200, 400 & 800

SOKKIA
GIR1600



....these devices are out there.
You're using them.
Do you use EGNOS?
How is the EGNOS feature performing in different situations?





Thank you

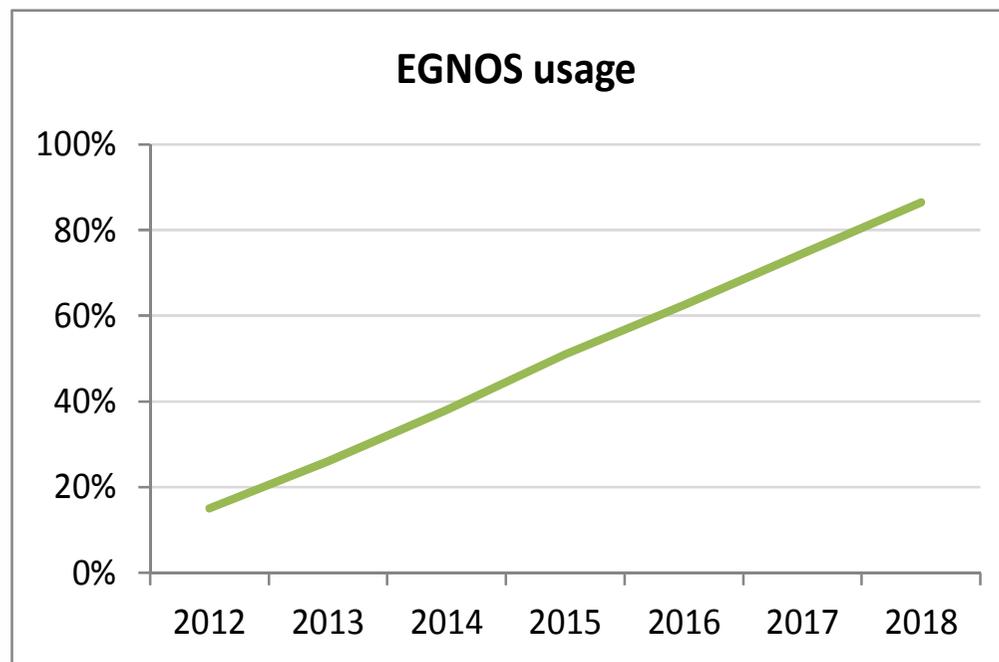
For further information contact:

**Reinhard Blasi
Market Development Officer
reinhard.blasi@gsa.europa.eu
Tel.: +420 234 766 608**

Annex

EGNOS-enabled devices are increasing their market share in Europe

- 100% penetration should be reached by 2014
- EGNOS is expected to be used in 86% of devices by 2018

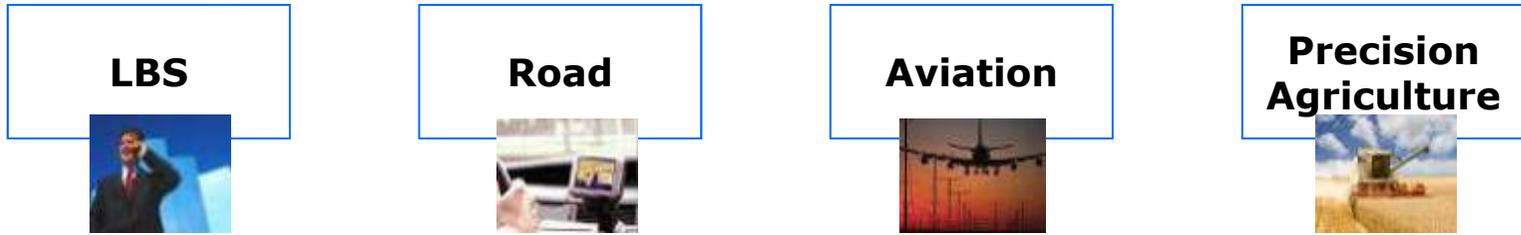


- It is assumed that the annual growth of GNSS market is 6%

Source: CLGE industry survey and desk-based research



Not just revenues: monetized indirect GNSS benefits



Institutional benefits

- Social benefit:
 - New jobs*
- Public economic benefit:
 - Additional VAT on device and services
 - Additional corporate tax

Social benefits

- Violent crimes reduction
- Quality of life improvements (e.g. blind people)*
- Saved lives*
- Decrease of severity of injuries
- Safed lives*
- Congestion reduction per avoided accidents
- Less noise*
- Decrease of delays
- Decrease of diversions
- Decrease of cancelled flights
- Fatigue reduction*

Environmental benefits

- Fuel consumption
- Air pollution reduction
- CO2 emissions reduction
- Pesticides consumption reduction
- Fertilizers consumption reduction

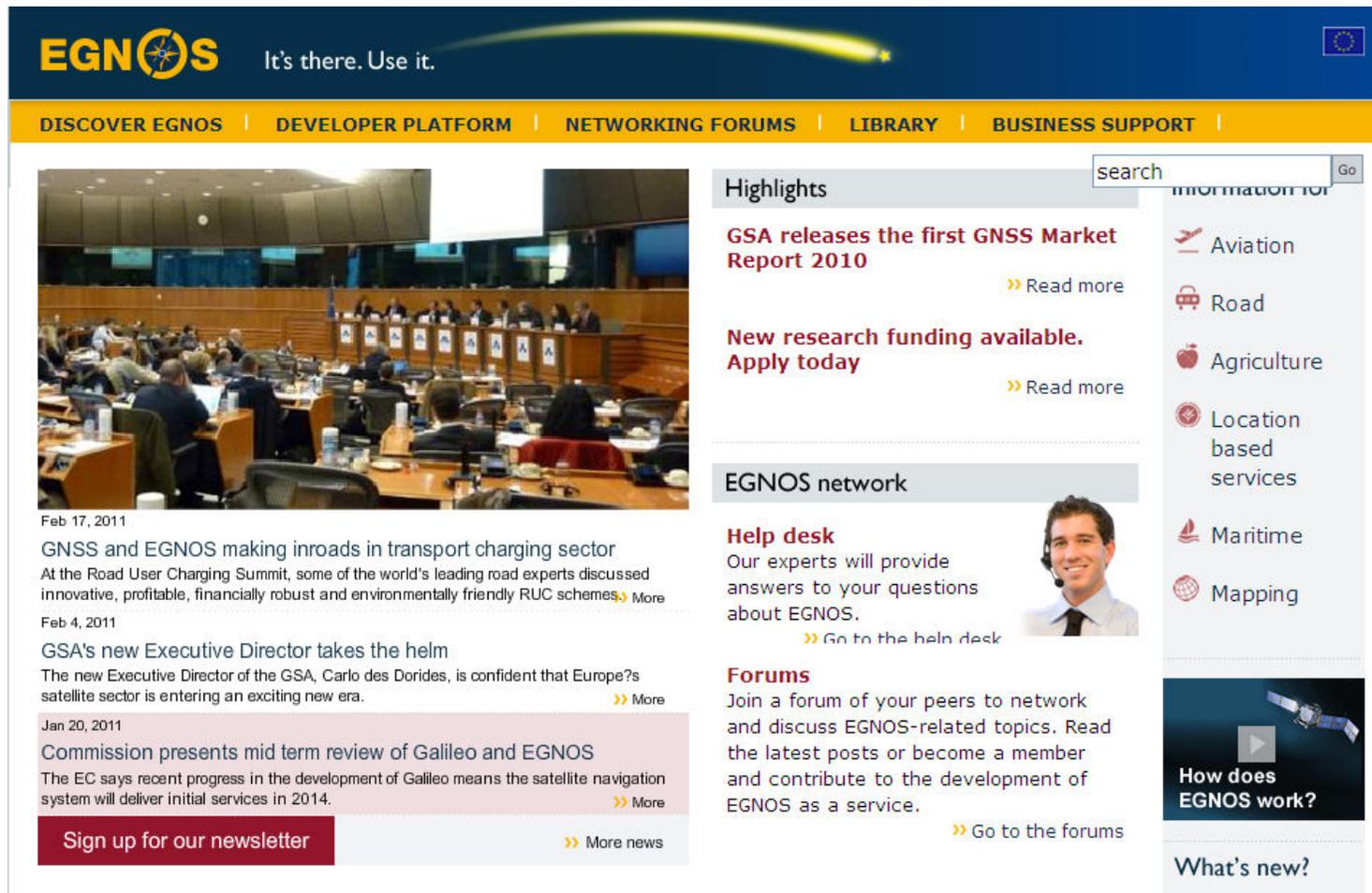
*non-monetized benefits



GSA communication activities



GSA communication activities



EGNOS It's there. Use it. 

DISCOVER EGNOS | DEVELOPER PLATFORM | NETWORKING FORUMS | LIBRARY | BUSINESS SUPPORT

search

Highlights

- GSA releases the first GNSS Market Report 2010** [» Read more](#)
- New research funding available. Apply today** [» Read more](#)

EGNOS network

- Help desk**
Our experts will provide answers to your questions about EGNOS. [» Go to the help desk](#) 
- Forums**
Join a forum of your peers to network and discuss EGNOS-related topics. Read the latest posts or become a member and contribute to the development of EGNOS as a service. [» Go to the forums](#)

Information for

-  Aviation
-  Road
-  Agriculture
-  Location based services
-  Maritime
-  Mapping

How does EGNOS work? 

What's new?

Sign up for our newsletter [» More news](#)

News articles:

- Feb 17, 2011**
GNSS and EGNOS making inroads in transport charging sector
At the Road User Charging Summit, some of the world's leading road experts discussed innovative, profitable, financially robust and environmentally friendly RUC schemes. [» More](#)
- Feb 4, 2011**
GSA's new Executive Director takes the helm
The new Executive Director of the GSA, Carlo des Dorides, is confident that Europe's satellite sector is entering an exciting new era. [» More](#)
- Jan 20, 2011**
Commission presents mid term review of Galileo and EGNOS
The EC says recent progress in the development of Galileo means the satellite navigation system will deliver initial services in 2014. [» More](#)



GSA communication activities

EGNOS FOR AVIATION

EGNOS is the first European satellite navigation system. Focusing mainly on providing service to the aviation sector, EGNOS offers substantial reduction in 5 error, especially in the vertical dimension, but more importantly, it provides the critical integrity information required for GNSS-based approach operations close to ILS Cat 1, without any ground infrastructure required at the airport, the so-called (PV)LPV approach procedures.

EGNOS is the European equivalent of the proven WAAS system in the USA, where more than 2 000 LPV approach procedures are already available. EGNOS is free and the EC is committed to it in the long term.

In order to accelerate the use of EGNOS, the European Commission funds the ACCEPTA project

Its main objectives are two-fold: the promotion of the installation of LPV aircraft for daily operations (including co-financing the pioneer airports throughout Europe, for the design and publication of APVA) and Airlines and end users are actively being encouraged to participate in ACCEPTA.

For more information about EGNOS and ACCEPTA, please visit the ERA general assembly exhibition.

More information on EGNOS and ACCEPTA will also be provided at the "Group" session held on 22 September by Luis Echeano, ACCEPTA Project Manager.

www.egnos-portal.eu/users/aviation

EGNOS It's there. Use it.

EGNOS PORTAL NEWSLETTER - July 2010 www.egnos-portal.eu

News

Next generation navigation system scoops 2010 GSA Prize
 Mobilize, the winners of this year's GSA's ESNC Special Topic Prize believe their Wikitude Drive system will be a "game changer" for personal navigation.

European Satellite Navigation Competition awards 2010 prizes
 Austrian start-up Mobilize won the GSA's Special Topic Prize and overall 'Galileo Masters' prize at the annual prize giving ceremony.

EGNOS for Road
 The EC-funded GINA project has designed and tested a system for accurate location of vehicles with respect to 'geo-objects' and for recording the distance they travel, thus laying the groundwork for a fairer system of GNSS-only road pricing.

EGNOS for Aviation
 European regional airlines welcome EGNOS to ERA General Assembly.

EGNOS for Africa: EU and AU join forces.

Highlights

FP7 : Apply now
 The 7th Framework Programme for research and development is the European's Union's main instrument for funding research in Europe in the period 2007-2013.

EGNOS OS SSD Consultation
 Participate in the online consultation on the Service Definition Document for the EGNOS Open Services.

Documents

FP7 Satellite Navigation Applications projects overview and database
 Learn more about the latest EU-funded satnav projects.

Galileo Application Days

Galileo Application Days, 3-5 March, will feature live demonstrations in a unique application village and the launch of the 2010 European Satellite Navigation Competition. The event is hosted by the European Commission and is organised by the European GNSS Supervisory Authority (GSA) and the Application Centre for Satellite Navigation in Oberpfaffenhofen (Germany).

Location-Based Services

IEGLO project a big hit at regional trade fair
 The EU-funded IEGLO project drew public and media attention at this year's Intersana trade fair in Nuremberg, Germany.

Events

GSA and Galileo Master at Munich event
 European GNSS Supervisory Authority Executive Director, Pedro Pedro and the 2009 Galileo Master Award winner, José Caro Ramón, address participants at the first 'Discuss & Discover' conference in Munich.

Precision

Using satellite navigation to improve precision
 Galileo Sat adapts an automated...

GSA awards special topic prize Galileo Master competition

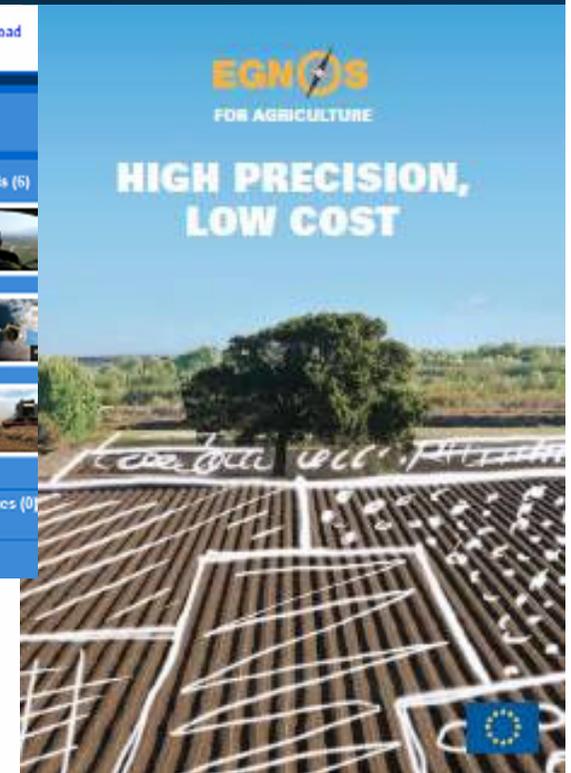
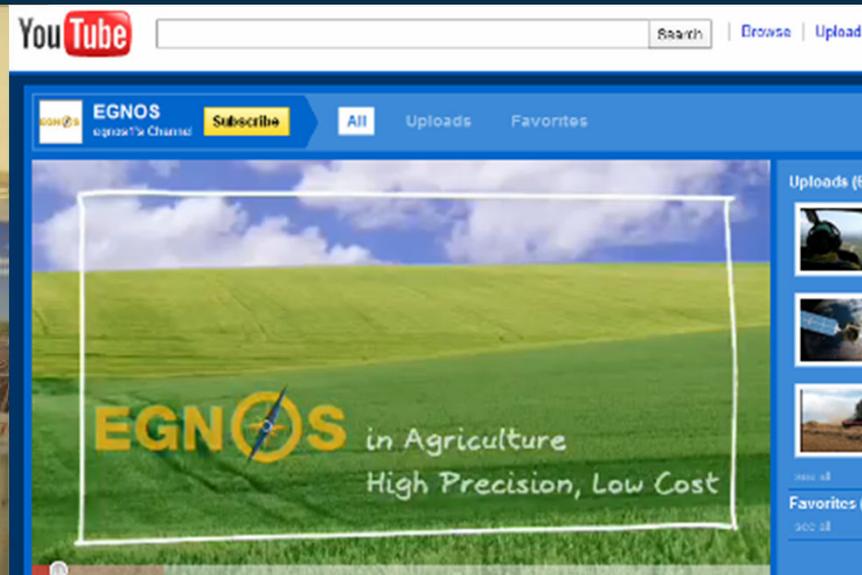
GSA communication activities



Communication activities



It's there. Use it.



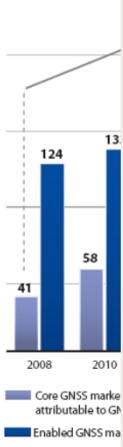
The GSA published a new Market Monitoring and Forecasting report including Surveying and Maritime



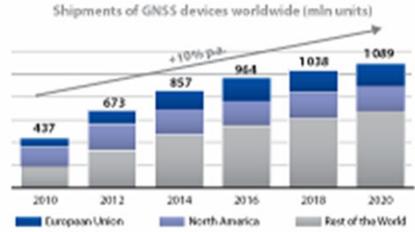
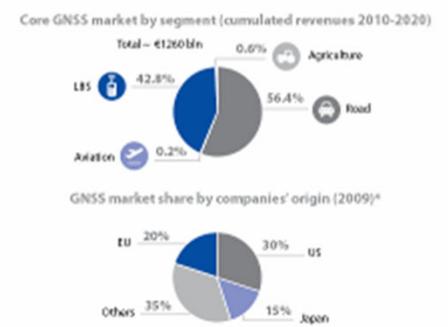
2nd issue released in May 2012, Surveying and Maritime market added

The market for GNSS will grow significantly over the next decade

Global: Core GNSS market to reach €165 bln in 10 years



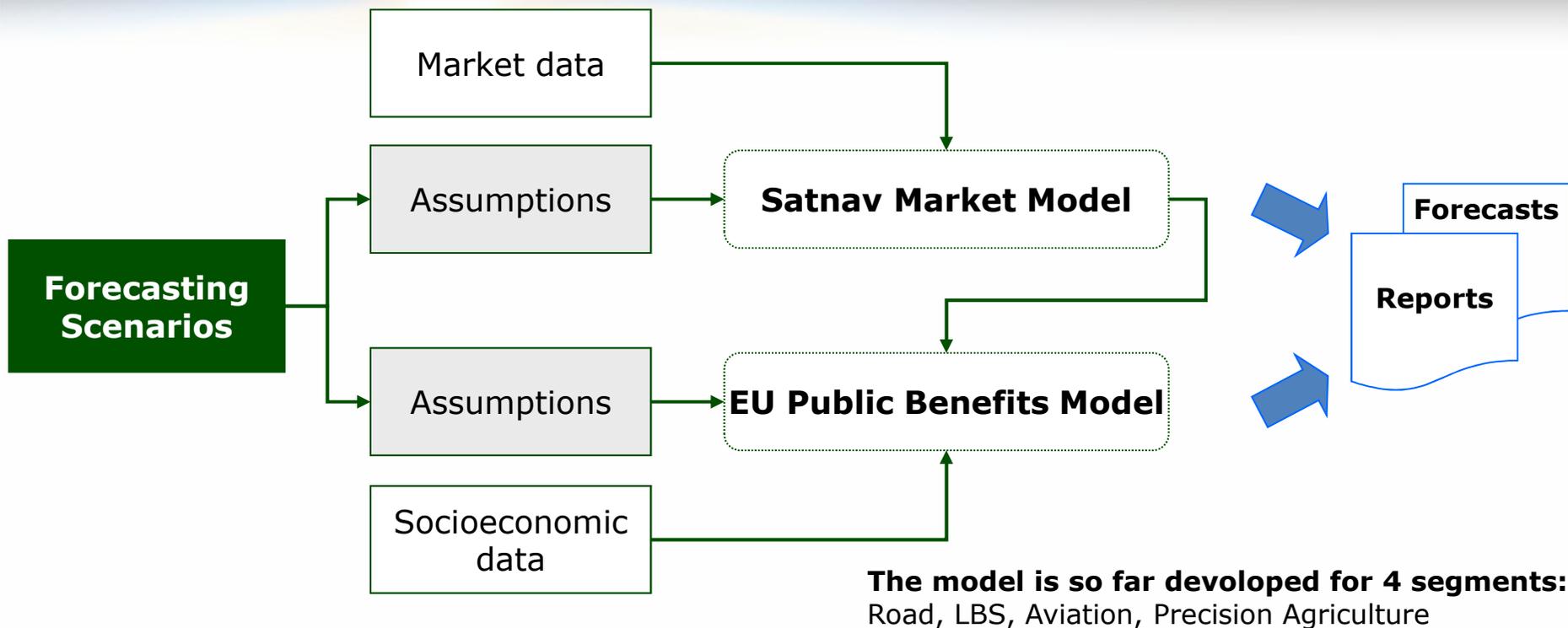
- GNSS device shipments will grow on average 10% per year over the next decade reaching 1.1 bln shipments by 2020.
- Despite significant growth since 2006, significant untapped potential remains. The overall worldwide GNSS revenues for civil applications are expected to grow on average by 11% per year reaching €165 bln in 2020 (core market, of which €32 bln is generated in the EU).
- LBS and Road will be the market sectors with the highest revenue generation.



Please download at:
www.gsa.europa.eu



The Market Monitoring process – was built with advanced econometric techniques



Main outputs

1. Global satnav market
2. Incremental impact of Galileo
3. European public benefits of satnav
4. Incremental value of public benefits from Galileo



EGNOS potential was confirmed at leading mapping conferences

Jean-Yves Pirlot
President Council
of the European
Geodetic
Surveyors



"We think **EGNOS** can play a **role in the Mapping sector** and are happy to help exploring this by promoting the **GSA-survey** amongst our partners across Europe."



Eric Gakstatter
GPS World Editor
Survey &
Construction

"GSA folks provide a **dynamic and effective service** in educating the community of ground users (...) Yes, my European brethren, **EGNOS can be used reliably for sub-meter mapping.**"

GPS World
The Business and Technology of
Global Navigation and Positioning

INTERGEO Conference: Final Thoughts

October 14, 2010
By: Eric Gakstatter

The final count, 17,500 attendees against an estimated 16,500 as reported by INTERGEO. That's pretty impressive given that conference attendance, in general, has been in decline the past two years. Is it a sign of economic recovery? I don't think so.

In fact, I think the outlook of the North American economy looks pretty bleak. The unemployment rate is going to stay where it's at for the foreseeable future. Companies are making money, but as you've seen reported, they are not spending it on hiring people.

The good news is that we are in an industry that's growing, and ripe for growth for the foreseeable future. What industry am I talking about? It's not so easy to define. I wrote an article about a year ago entitled "Who is Geospatial?". No matter how you apply location, whether it's a municipal GIS or the location component of Facebook, it involves geospatial data and it's red-hot.

The Portable Navigation Device (PND) market wouldn't exist without the geospatial data (eg. digital maps) that run in the background. The navigation app on your mobile phone wouldn't have any value either.

INTERGEO doesn't cover the entire spectrum of geospatial, but it doesn't have to. It covers the so-called LBS (Location-Based Services) and mobile mapping, which are two related but distinct topics altogether.

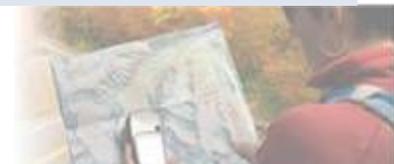
Geospatial products and services are everywhere. As I mentioned in my earlier article, the largest presence was from the mobile displays, as big as I've seen at the ION conference, as big as I've seen at the ION conference, as big as I've seen at the ION conference. It's the most complete geospatial conference I've ever attended. It includes the ION GNSS conference. I think the manufacturers said it's their biggest.

It's a stark contrast to the ESRI User Conference, which is on the technical sessions.

Oct. 6. My presentation was "Sub-meter mapping". Click on the image below if you want to see the list of presentations until you see my presentation.

Positioning, delivering 50cm - 1m accuracy, is well received already at launch (INTERGEO)

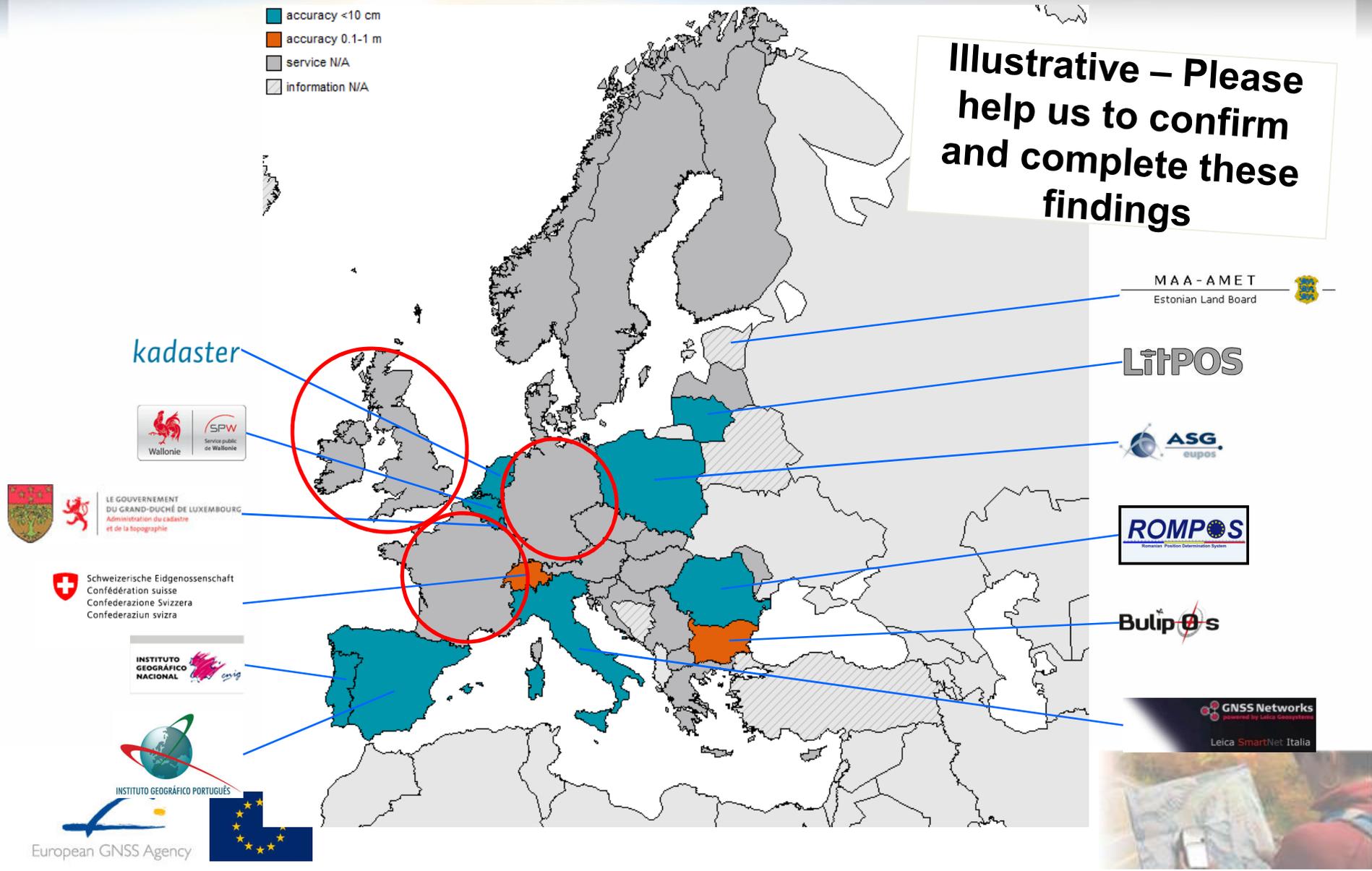
- Device manufacturers give positive feedback
- Users, i.e. surveyors, municipalities..., show interest
- Experts confirm SBAS is used for sub-meter mapping in US, with similar potential in the EU



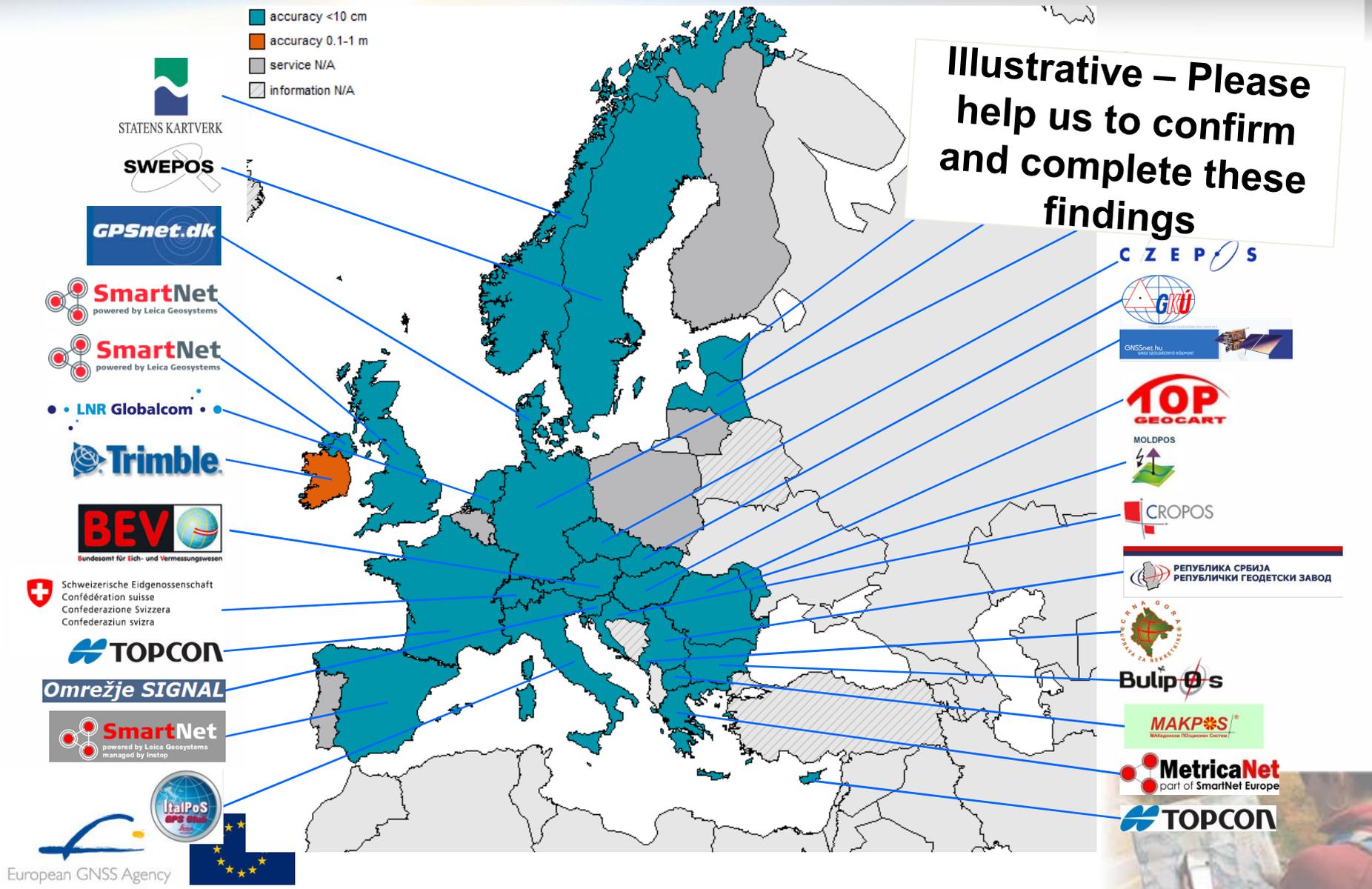
Availability of free real-time positioning

- accuracy <10 cm
- accuracy 0.1-1 m
- service N/A
- information N/A

Illustrative – Please help us to confirm and complete these findings



Commercial real-time positioning



A survey in cooperation with CLGE shows results with promising potential

Which networks do you use?

RTK 	45.79%	49
DGPS 	25.23%	27

Real time or post-processing?

Real-time  EGNOS potential	57.14%	56
Post-processing 	42.86%	42

White spots in operating area?

Yes  EGNOS potential	46.43%	26
No 	53.57%	30

EGNOS instead additional reference stations to fill spots?

Yes  EGNOS potential	47.06%	24
No 	52.94%	27

EGNOS interesting as affordable basic solution?

Yes  EGNOS potential	63.79%	37
No 	36.21%	21

Do you already use it?

Yes  EGNOS potential	22.73%	10
No 	77.27%	34

Do you consider using it in the future?

Yes  EGNOS potential	69.09%	38
No 	30.91%	17

Can EGNOS integrity information be useful?

Yes  EGNOS potential	48.98%	24
No 	51.02%	25

70 participants from 20 different countries



In summary: why EGNOS?

EGNOS is...

...an effective option for a wide range of mapping applications with meter accuracy

...free; it does not require installation of hardware nor ongoing subscriptions.

...in most of the new GNSS devices

...covers the majority of Europe - no white spots

...permitting real time positioning.

...thanks to EDAS, also receivable by terrestrial communication means, (e.g., internet or GPRS)

...providing system integrity, supplying information on the reliability of GPS signals.



EGNOS, it's there. Use it.

For more information, please visit:

www.egnos-portal.eu



Precise navigation, powered by Europe

EGNOS is Europe's first venture into the field of GNSS and a precursor to Galileo, Europe's global satellite navigation system, currently under development. EGNOS is an open system, now operational and available for use.



How does EGNOS work?

EGNOS, the European Geostationary Navigation Overlay Service, improves the accuracy of position measurements, transmitting signals that correct GPS data and provide information on its reliability.

The EGNOS network includes more than 30 reference stations in 20 countries. Ranging and Integrity Monitoring Stations (RIMS) on the ground pick up signals from GPS satellites, which are processed in Master Control Centres (MCC).

The accuracy of the GPS signals is determined, and confounding factors, such as electrical disturbances in the atmosphere, are corrected.

A new EGNOS signal is generated, containing the GPS correction information, and then relayed via three geostationary satellites back to users on the ground, thus providing far greater positioning accuracy than would be achieved through GPS alone.

