EGNOS Extension to Eastern Europe

UN/Latvia Workshop on the Applications of GNSS

Date: 14-18 May 2012

Place: Riga

What is EGNOS ?

EGNOS – European Geostationary Navigation Overlay Service

- SBAS developed by ESA in agreement with the EC and Eurocontrol.

- Ownership transferred to EC since 2009

- Operational since 2009 as an Open Service

- Certified for SoL applications – March 2011

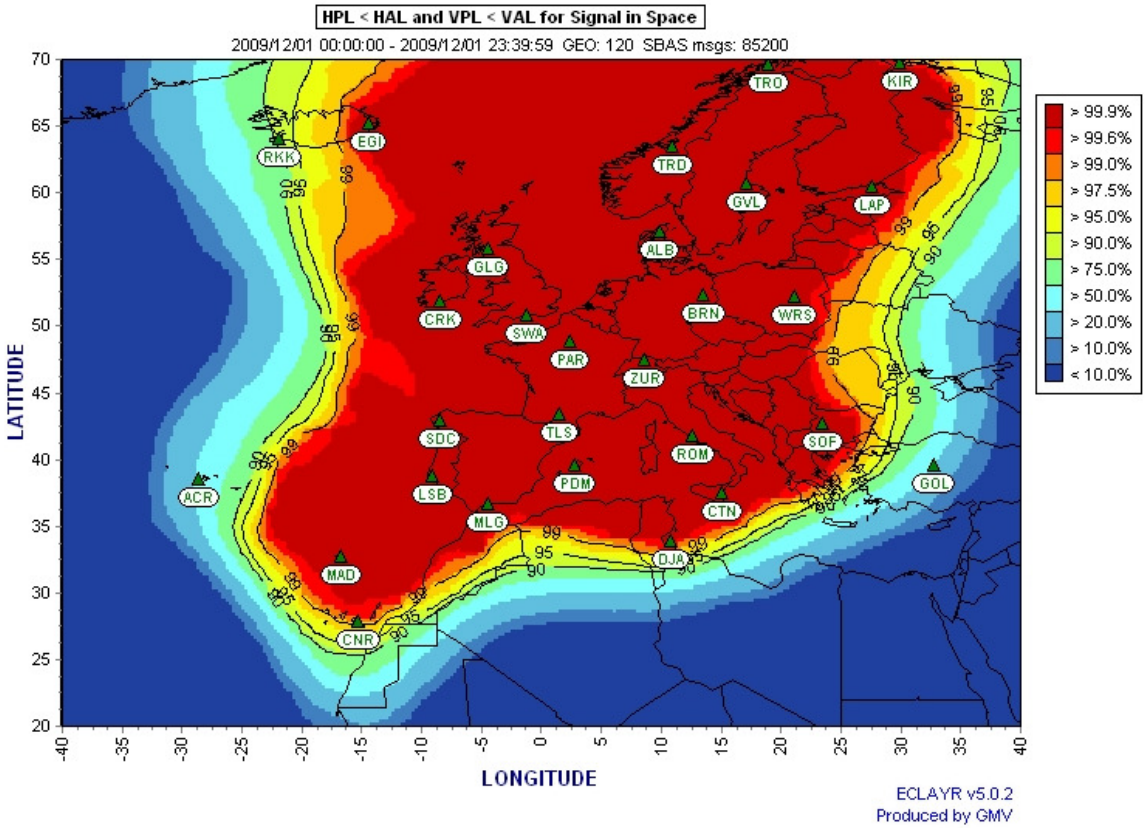
Architecture : - 3 Geostationary satellites

- 4 Mission Control Centres

- 40 Ranging and Integrity Monitoring Stations

Current EGNOS coverage status

Nominal Case – All RIMS OK



EGNOS APV-I Availability for December 1st 2009

What has been done…

EEGS

EGNOS Extension to Eastern Europe

EEGS – Main Objectives

EEGS has 4 main objectives :

- To prove through demonstrations that EGNOS can be “easily” extended to cover all Eastern Europe
- To assess the level of interoperability between EGNOS and SDCM (the Russian SBAS)
- To promote EDAS on the GNSS market in Russia in order to provide a high precision positioning service (PPP)
- To study the impact of Galileo in the scenarios implying EGNOS extension to Eastern Europe and EGNOS/SDCM interoperability.

EEGS – Consortium

GMV (Spain) – Consortium Leader

RSS (Russia)

AENA (Spain)

ROSA (Romania)

AENI (Spain)

SRC (Poland)

MAO (Ukraine)

EEGS – Methodology and Rationale

1st objective : two main activities

- A technical activity –implying the assesment of two methods of improvements : extending coverage of EGNOS services by data processing improvements and by infrastructure improvements (additional RIMS)
- A management activity –involving the necessary studies done by the Eastern European partners which will analyse the RIMS implementation possibilities and the EGNOS provision scheme

2nd and 3rd objective : an interoperability study realized by GMV and RSS and a set of demonstrations with the aim of showing the results of the two studies

4th objective : AENI will study the impact of Galileo in the presented scenarios

EEGS – Analysis

GMV assesed first the EGNOS performance using analysys tools such as ***eclayr***. Afterwards, using the same tool, GMV assessed the performance of ***magicSBAS*** for the same cases. The comparison prooved that CPFPS is the main driver of current EGNOS performances and that ***magicSBAS*** can be used to test potential improvements in the EGNOS system.

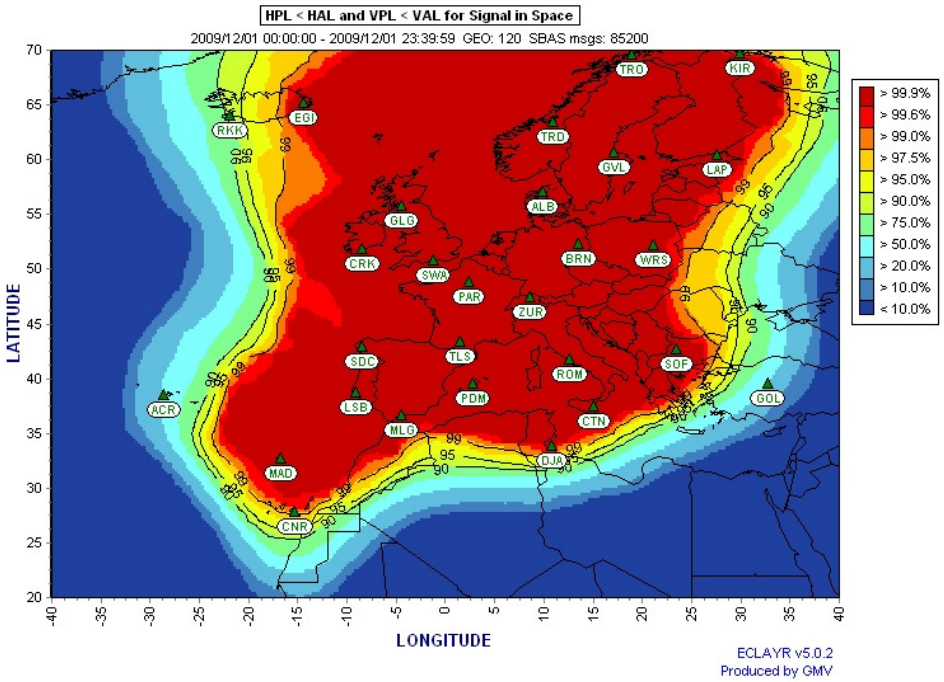
For this analysis ROSA provided RINEX data from the BUCU reference station (by the courtesy of the Faculty of Geodesy - UTCB)

The data covered three days of observations covering three types of situations:

- Nominal Case (nominal EGNOS behaviour)
- Degraded EGNOS behaviour with all RIMS working correctly
- Degraded EGNOS behaviour with RIMS problems

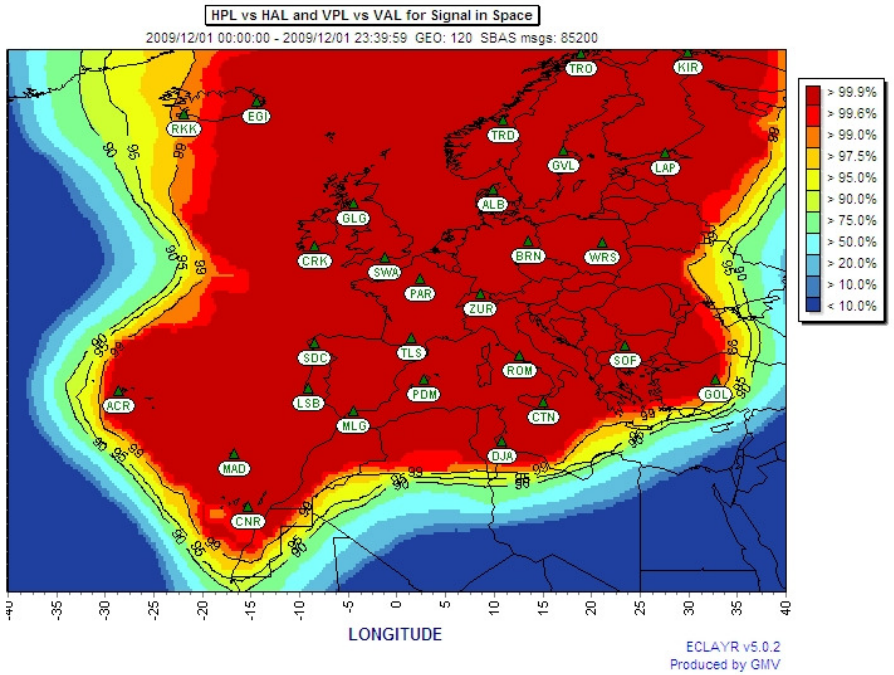
EEGS – Analysis results for nominal case

EGNOS release (V.2.3.1)



EEGS proposed release

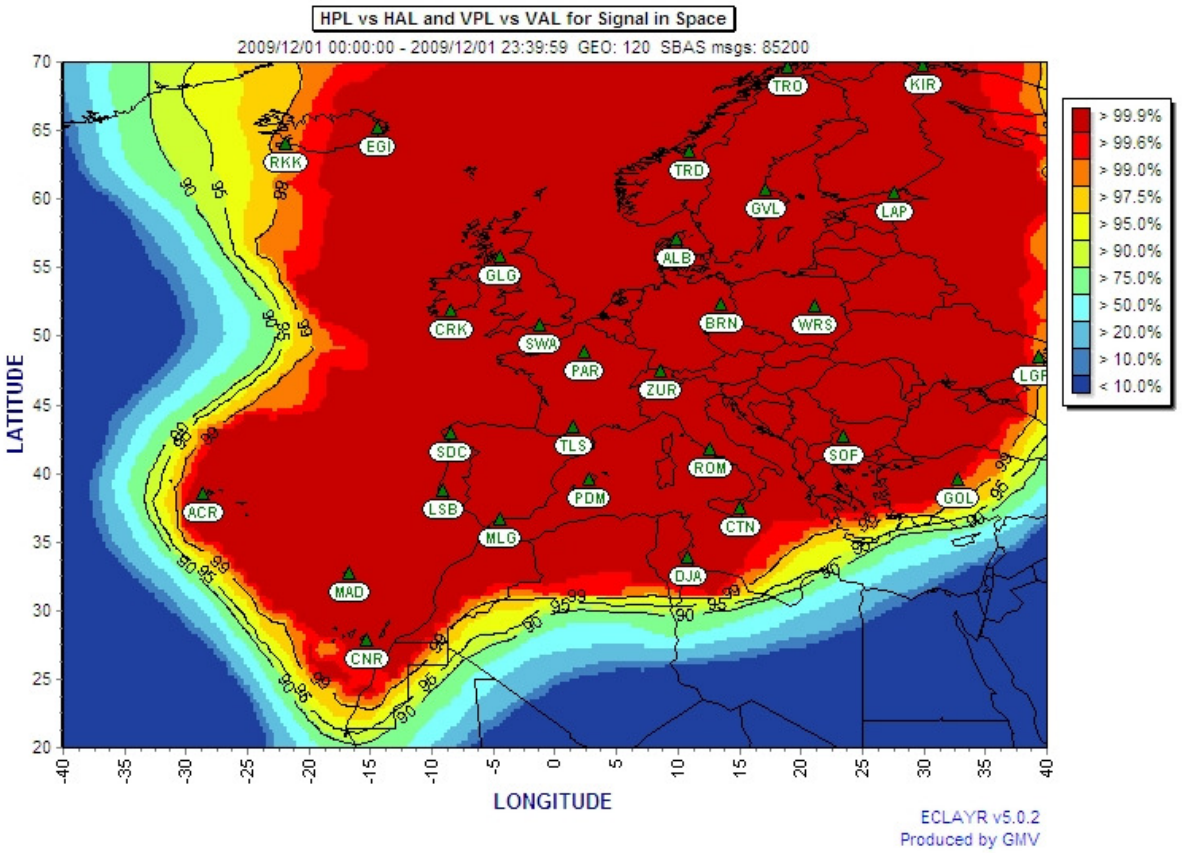
(no additional RIMS)



EEGS – Analysis results for degraded case with RIMS OK

EEGS proposed release

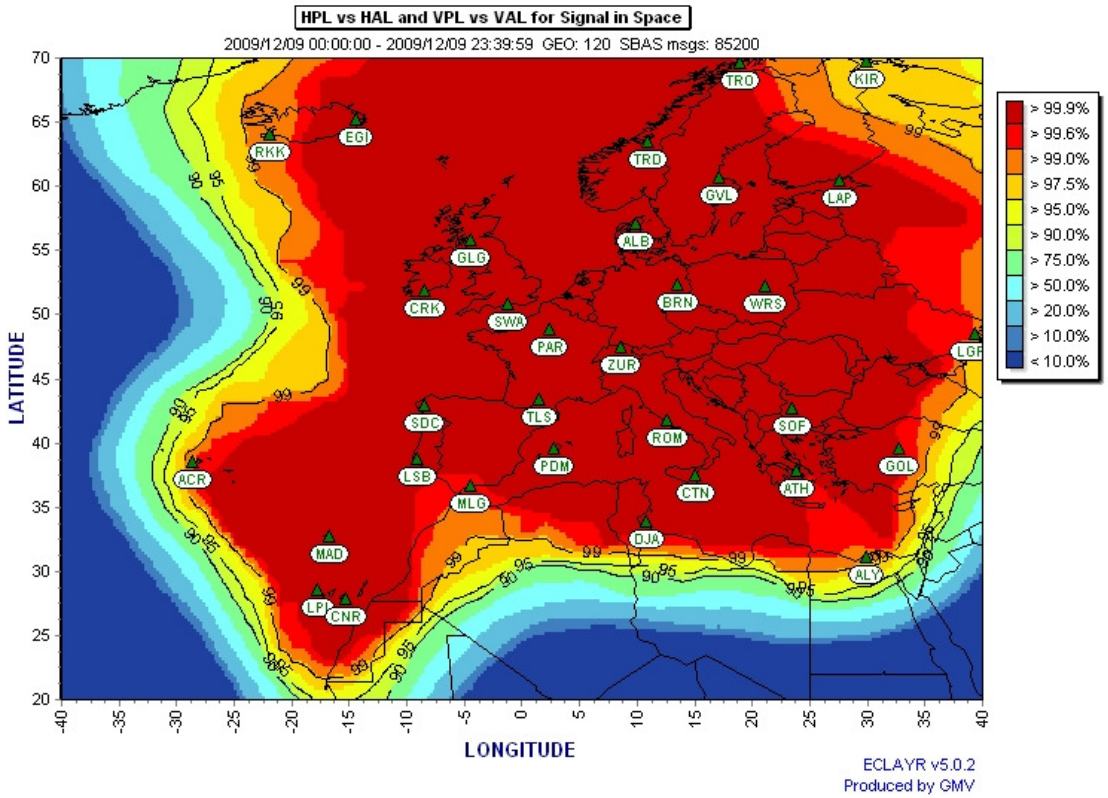
with one additional RIMS in Eastern Ukraine



EEGS – Analysis results for degraded case with RIMS problems

EEGS proposed release

with one additional RIMS in Eastern Ukraine



EEGS – Demonstrations

- In order to validate the results obtained in the previous phase, a set of demonstrations were foreseen at each partner's level.

- For Romania, the trials took place in March 2011 and consisted of applications with the aim of showing the improvements obtained by using an EGNOS-like signal.

- Three types of demonstrations:
  - A static trial using an I-10 receiver placed at ROSA's premises in order to collect a large amount of data used to assess the level of availability, accuracy, integrity and continuity
  - Two dynamic trials using the same receiver with the same aim (a car trial and a boat trial).

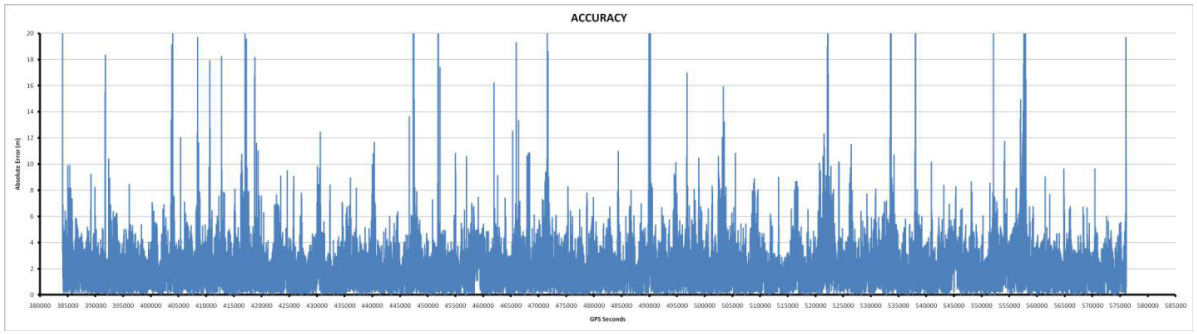
EEGS – Static demonstration

Location of the tests – ROSA premises

EEGS – Static demonstration (Accuracy)

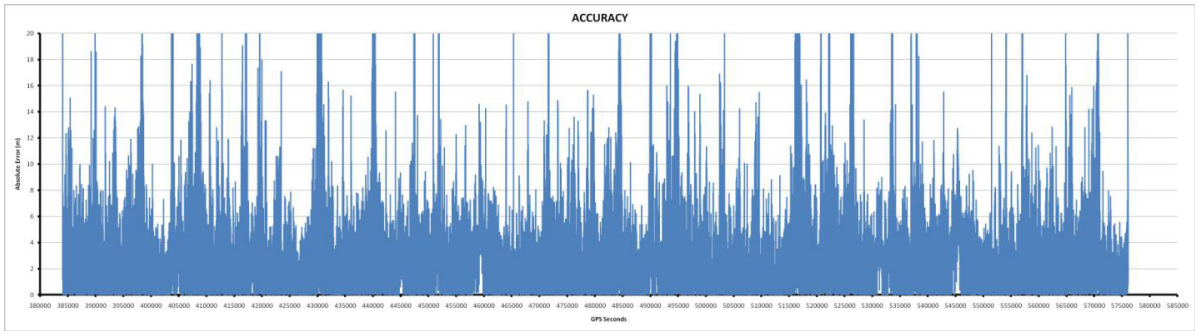
Horizontal Accuracy

H_{error}<2m for 55.5% of the time



Vertical Accuracy

H_{error}<3m for 60.7% of the time

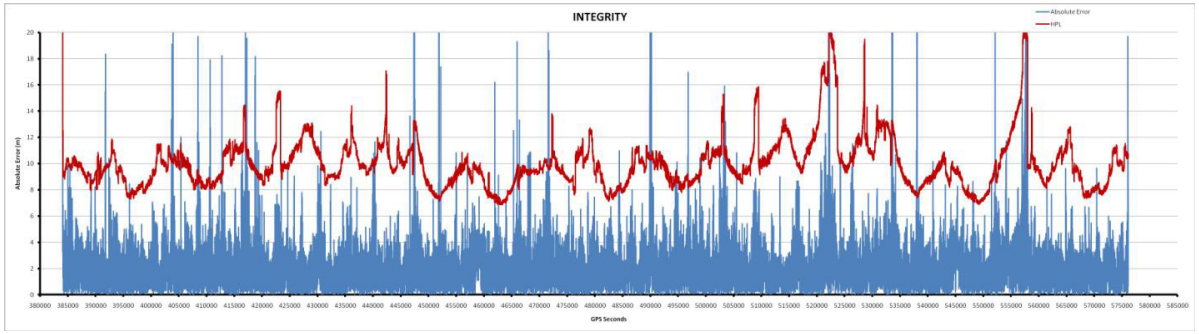


Good Mean /Bad Variance → Possible multipath effect

EEGS – Static demonstration (Integrity)

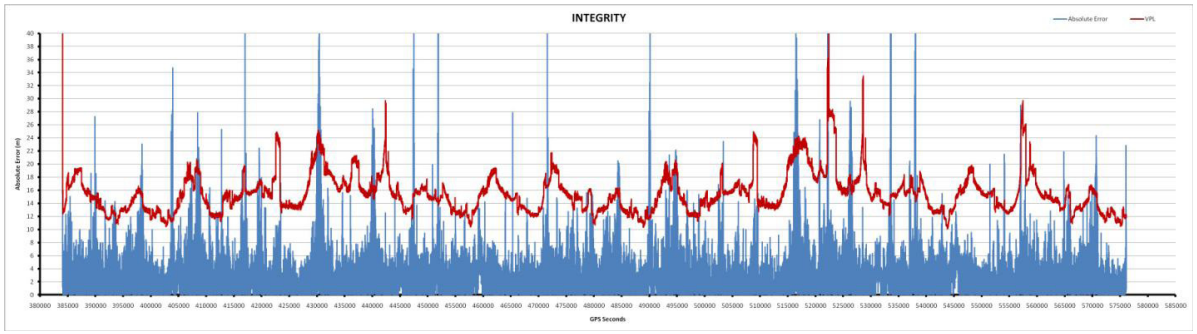
Horizontal Integrity

99.6% horizontal integrity



Vertical Integrity

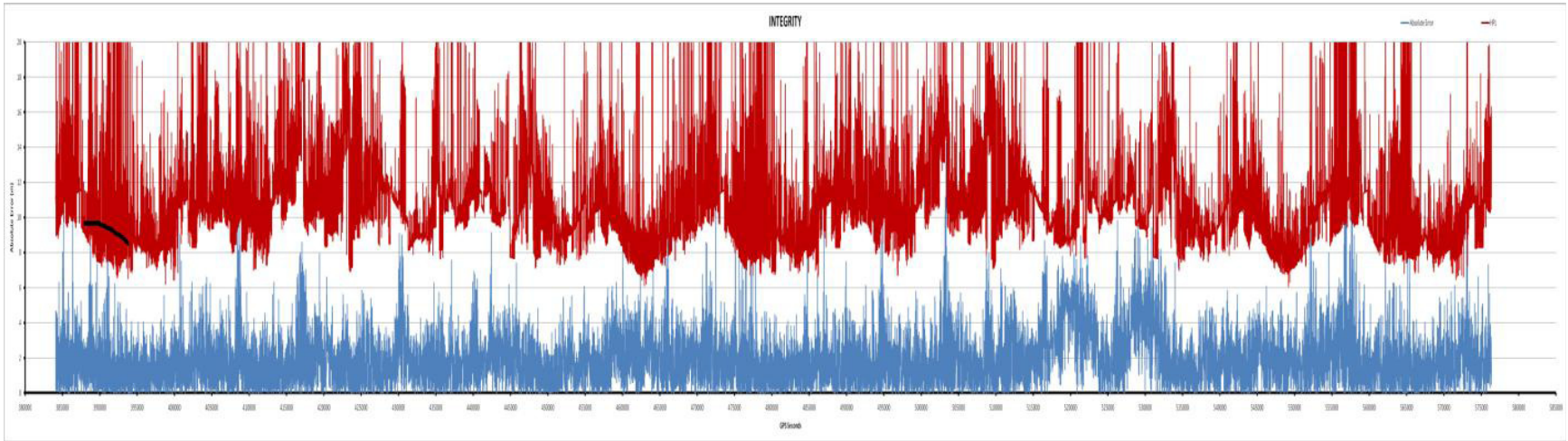
98.9% vertical integrity



Most integrity violations have a 24 hour cycle → Possible multipath effect

EEGS – Static demonstration (Integrity)

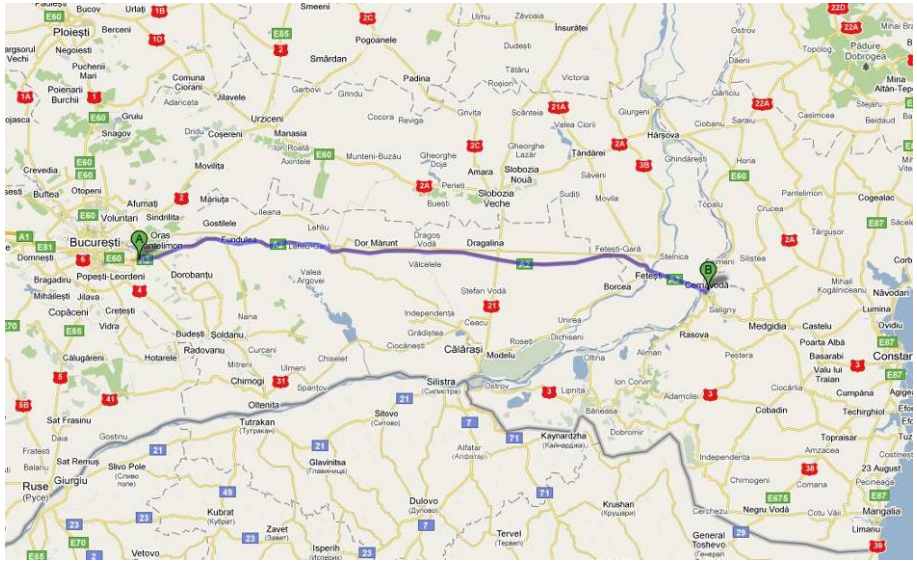
Horizontal Integrity with RAIM algorithm for multipath smoothing



Some integrity violations still remain (<0.1%) Mostly due to low DOP.

EEGS – Dynamic demonstration 1

Route and installation

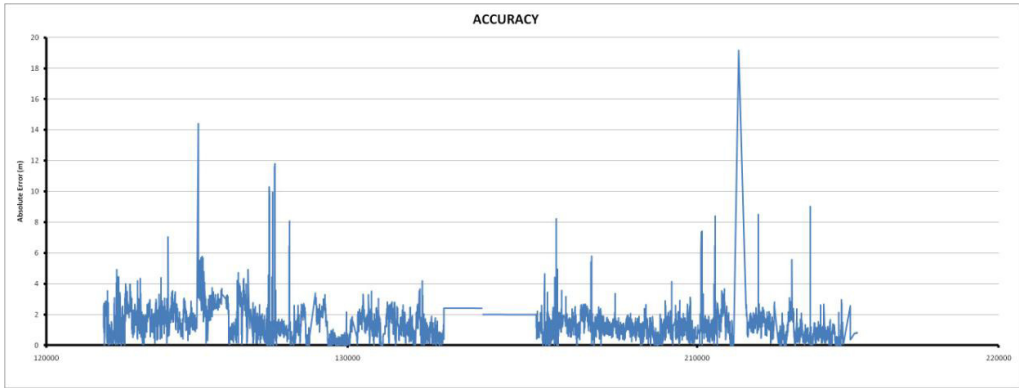


Time	Km	Instruction	Toward
1h 15 min	150 km	1.Head **East** on **A2** toward **Cernavoda**	Cernavoda
1 min	700 m	2.Turn **right** to exit the **A2 Highway**	Cernavoda
2 min	200 m	3.At the roundabout, take the **2nd** exit onto the **A2 Highway**	Bucharest
1h 15 min	150 km	4.Continue on **A2 Highway**	Bucharest
1 min	400 m	5. Exit **A2** Highway	Bucharest
1 min	170 m	6.At the roundabout, take the **3rd** exit onto the **A2 Highway**	Cernavoda
1h 15 min	150 km	7. Head East on **A2 Highway**	Cernavoda
5 min	200 m	8. Exit the Highway	

EEGS – Dynamic demonstration 1

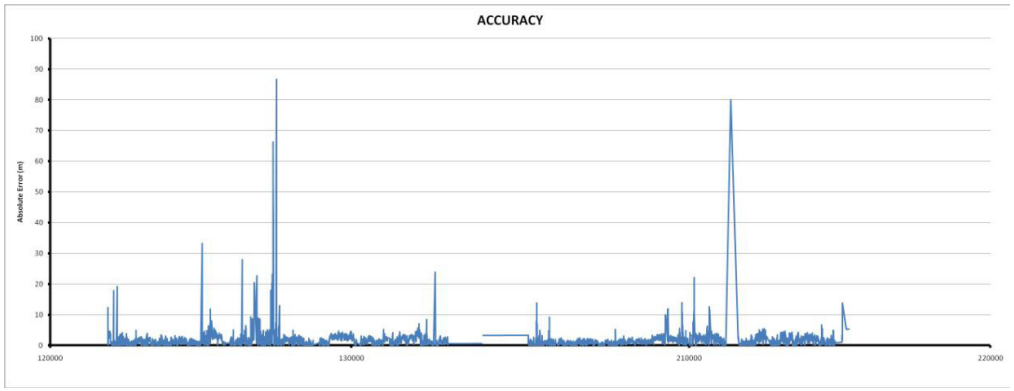
Horizontal Accuracy

H_{error}<2m for 89% of the time



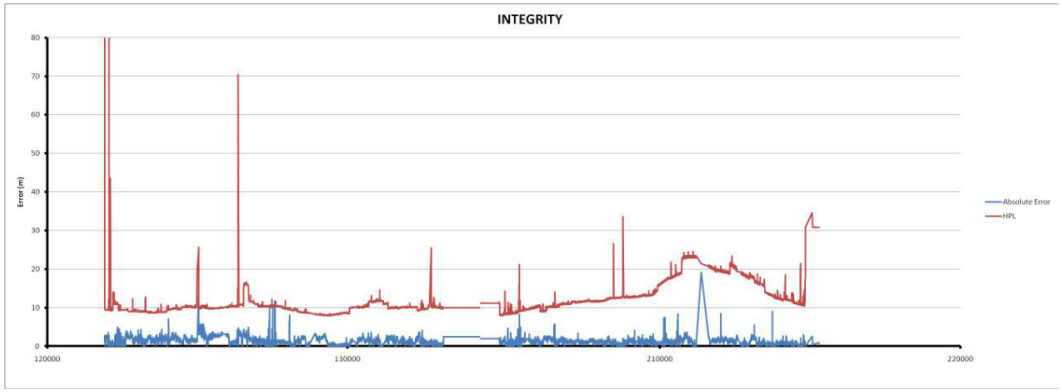
Vertical Accuracy

H_{error}<3m for 90% of the time

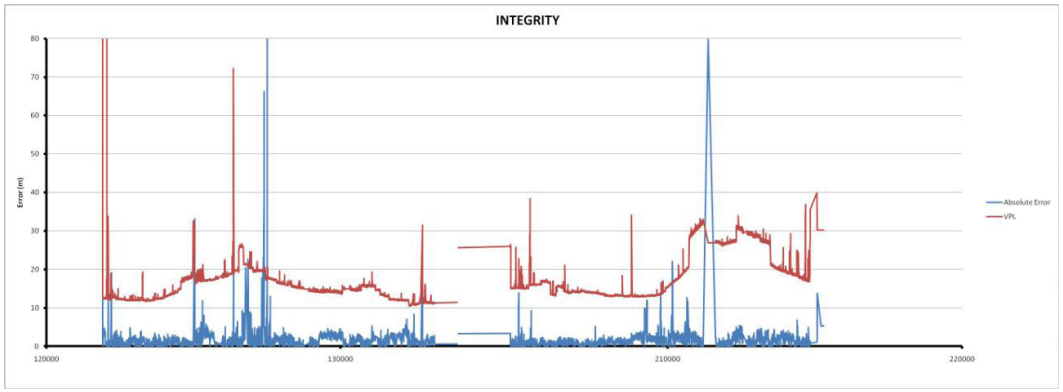


EEGS – Dynamic demonstration 1

Horizontal Integrity



Vertical Integrity



7(H)/25(V) integrity violations theoretically caused by multipath near Cernavoda

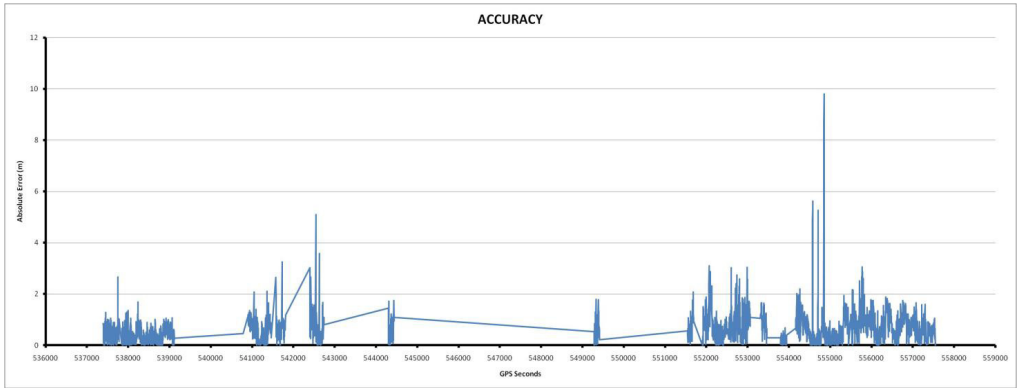
EEGS – Dynamic demonstration 2

Route and installation

EEGS – Dynamic demonstration 2 (Accuracy)

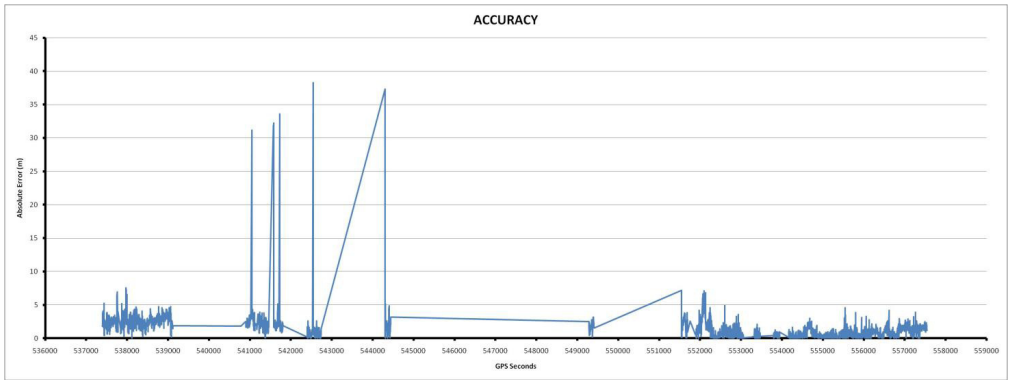
Horizontal Accuracy

H_{error}<2m for 98.5% of the time



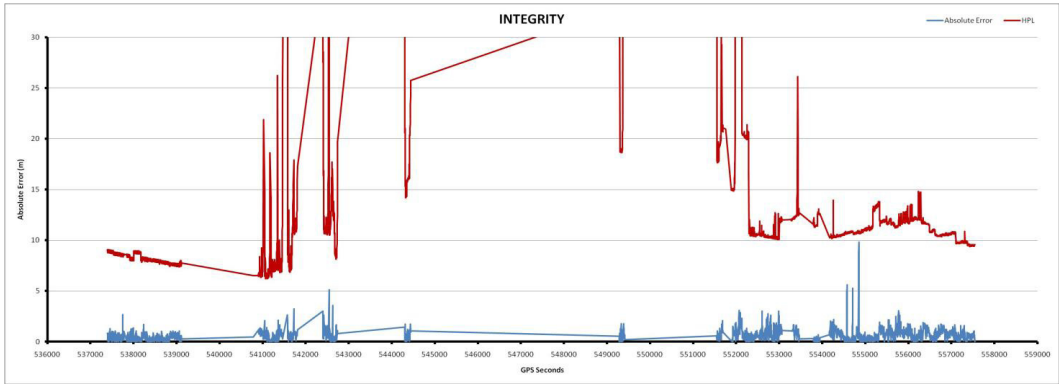
Vertical Accuracy

H_{error}<3m for 89% of the time

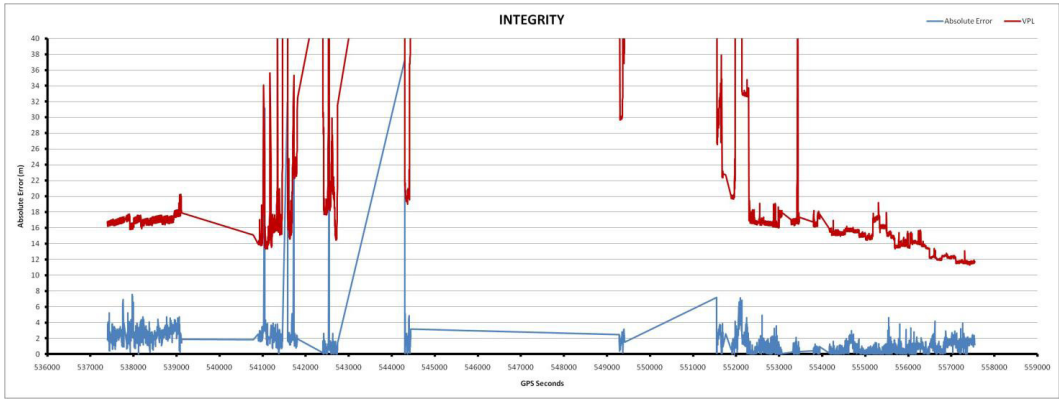


EEGS – Dynamic demonstration 2 (Accuracy)

Horizontal Integrity



Vertical Integrity



3 Vertical integrity violations due to rough environment

EEGS – Conclusions

- EGNOS Services may easily be extend to fully cover Romania and Poland by algorithm modiffications while fully covering Ukraine needs additional RIMS.

- The demonstrations in Romania proved that an extended EGNOS service may be used for SoL applications

- All the project's outcomes and opinions are belonging to the consortium and are not necessarily endorsed by EC

What we will do…

EEGS2

EGNOS Extension to Eastern Europe: Applications

EEGS2 – Main Objectives

1. To demonstrate, through flight trials, the benefits of EGNOS in Eastern Europe where EGNOS is not yet available and prepare the civil aviation and service providers of those areas for the future usage of EGNOS.

- Preparation of flight procedures
- Preparation of hardware in the airfield
- Preparation of the avionics onboard
- Analysis of the flight performances

2.To study the impact of SBAS technology in transport management in the scenarios of EGNOS service in Eastern Europe.

3.To promote EDAS, EGNOS and Galileo.

EEGS2 – Consortium

GMV (Spain) – Consortium Leader

RSS (Russia)

TUM (Moldova)

ROSA (Romania)

NDConsult (UK)

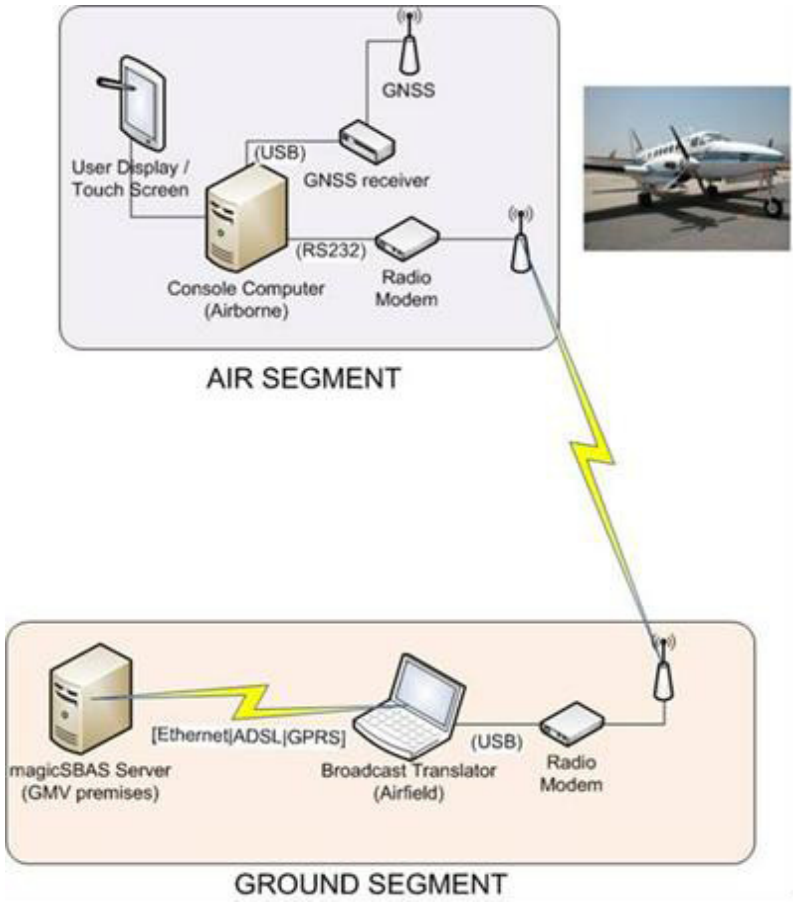
SRC (Poland)

MAO (Ukraine)

KHU (Ukraine)

EEGS2 – Flight trials - architecture

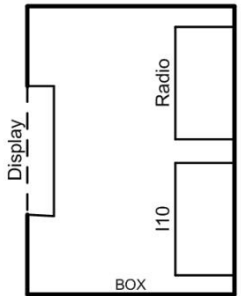
- Regarding the Flight Trials the main idea is to demonstrate the benefits of the SBAS systems for final approaches from the intermediate altitude (2000 m) to the Decision height (200-250 ft).



DISPLAY


Radio Modem


I10



EEGS2 Activities

- ROSA will conduct a commercial feasibility study and a market study on SBAS for aviation in Romania based on templates and guidelines provided by NDC

- ROSA will prepare the flight trials in Romania together with GMV

- Activities to be undertaken for the Flight Trials
  - Procuring the necessary infrastructure (PCs, receivers, RF modems, etc.)
  - Providing the aircraft
  - Preparing the first flight procedure to be flown (GMV)
  - Prepare the three remaining procedures (ROSA)
  - Safety case assesment
  - Flying the procedures
  - Performance analysis

EEGS2 – Flight trials

- The 4 airports in Romania where the flight trials will be conducted were chosen but modifications may appear: Bucharest, Bacau, Craiova and Sibiu)
- First flight procedure to be flown is planned for September 2012
- The aircraft used for the flight trials is a Hawker King Air C90 GTx

Thank you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