lunch

EGNOS survey open!


7-8 October
Lisbon

The EGNOS Service Provision workshop
## AGENDA (14:30 – 17:00)

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Benefits of EGNOS/EDAS for Inland Waterway Navigation

Lisbon, 08.10.2014, EGNOS Service Provisioning Workshop

Gergely Mező
RSOE, Hungary

Tamás Horváth
Alberding GmbH, Germany
Outline

RSOE and Alberding GmbH

River Information Services

Benefits of EGNOS/EDAS for inland navigation

EDAS-based virtual DGNSS test results

Outlook/future plans
About RSOE

- 32-years-old non-profit association (NGO) based in Budapest
- main profile:
  - operation and development of ICT systems, services (inland navigation and disaster management mainly),
  - project management and communication,
- operation of Danube River Information Services (RIS) for Hungary (PannonRIS) commissioned by the National Transport Authority,
- operation of RIS centre (24/7 dispatcher centre) for the Danube,
- participation in 20+ EU-funded projects (Phare CBC, TEN-T, FP5, FP6 GJU, FP7, CADSES, SEE, IPA CBC programmes etc.).
Alberding GmbH

- German GNSS software and hardware development company
- 20 years of experience with high accuracy GNSS positioning
- Specialised in GNSS data management, processing and monitoring
- Independent from receiver manufacturers
- Alberding Beacon.net modular software for the operation of maritime and inland waterway DGNSS services
RSOE and Alberding GmbH

River Information Services

Benefits of EGNOS/EDAS for inland navigation

EDAS-based virtual DGNSS test results

Outlook/future plans
River Information Services (RIS)

„river information services (RIS)’ means the harmonised information services to support traffic and transport management in inland navigation...” (2005/44/EC Directive, Article 3, a)

„For the purpose of RIS, for which exact positioning is required, the use of satellite positioning technologies is recommended.” (2005/44/EC Directive, Article 6)
PannonRIS – the Hungarian RIS system
Hungarian AIS (Automatic Identification System) network:

- covers the 400km long Hungarian Danube stretch
- complies with inland AIS standard (415/2007 EC regulation)
- 11 AIS base stations along the Danube
- 3 base stations are generating corrections with own algorithm using SBAS enabled GPS receivers and distributing DGNSS data via AIS (Message17)
- data processed in the Budapest centre and can be accessed via internet on secure web interface (strict access rights)
- AIS use is mandatory since 01.01.2012 above 20m vessel length
RSOE and Alberding GmbH

River Information Services

Benefits of EGNOS/EDAS for inland navigation

EDAS-based virtual DGNSS test results

Outlook/future plans
EGNOS/EDAS pros and cons

• EGNOS advantages
  – Free of charge service
  – Wide coverage area through GEO satellite transmission
  – Meets IMO accuracy requirements for inland waterways
  – Integrity monitoring

• EGNOS limitations
  – Geostationary satellite signals may be obstructed (terrain, buildings, bridges)
    ➔ EGNOS/EDAS corrections can be re-transmitted via IALA radio beacons or AIS base stations
  – EGNOS enabled GNSS receiver required with SBAS raw data output
    ➔ IP-based access via EDAS
  – IALA radio beacons and AIS base stations require RTCM input
    ➔ EGNOS RTCA data has to be converted into RTCM SC-104 format
Benefits of AIS DGNSS use in IWT

Crucial areas
• River manoeuvres
• Accident investigation
• Law enforcement procedures

IWT requirements
• Improved integrity
• Higher availability and continuity
• Higher accuracy
Alberding Beacon.net with EGNOS

Data conversion module

• EGNOS RTCA data conversion to RTCM SC-104 corrections for user definable positions: “EGNOS VRS”

• Input data sources:
  – EGNOS enabled GNSS receiver
  – EDAS via IP

• Rebroadcast via
  – IALA radio beacons, AIS, Ntrip

• Can be used as a backup solution to conventional DGNSS or even as primary system
RSOE and Alberding GmbH
River Information Services
Benefits of EGNOS/EDAS for inland navigation
EDAS-based virtual DGNSS test results
Outlook/future plans
• IRIS Europe 3 is a multi-beneficiary TEN-T project focusing on further enhancement and fine-tuning of RIS key technologies, services and applications.

• Hungarian DGNSS pilot by RSOE (subcontractor: Alberding GmbH):
  – Assess the performance of the currently used AIS-based DGPS service and its alternatives for DGNSS correction generation and dissemination
DGNSS performance monitoring

Alberding Monitor

Processing Software

- DGPS Processing
- Pre-Broadcast Monitoring

Web Interface

- Status
- Diagrams
- Warnings

Operators

AIS DGPS Monitoring Stations

- AIS Monitoring Station BUTE
- AIS Monitoring Station PAKS

EGNOS

EDAS SL2 data

Virtual DGPS corrections

(RTCM)

Alberding EuroNet

Alberding GmbH server, Germany

Raw GPS data

Raw GPS data
EGNOS VRS performance in Hungary

Delta North

Delta East

Delta Height

Delta Horizontal

EGNOS VRS Absolute GNSS

DGNSS processing software: Alberding Beacon.net
GNSS raw data input: geodetic grade GNSS receiver
Correction source: EDAS SL2-based “EGNOS VRS”
Date: 2014.03.02-06
EGNOS VRS performance in Hungary

Horizontal scatter

Horizontal accuracy

Vertical accuracy

EGNOS VRS

Absolute GNSS

DGNSS processing software: Alberding Beacon.net

GNSS raw data input: geodetic grade GNSS receiver

Correction source: EDAS SL2-based “EGNOS VRS”

Date: 2014.03.02-06
EGNOS VRS performance in Hungary

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<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
<th>Mean.</th>
<th>2σ</th>
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<tbody>
<tr>
<td>Δ North [m]</td>
<td>-2.56</td>
<td>3.78</td>
<td>0.08</td>
<td>0.99</td>
</tr>
<tr>
<td>Δ East [m]</td>
<td>-1.45</td>
<td>2.20</td>
<td>-0.13</td>
<td>0.71</td>
</tr>
<tr>
<td>Δ Height [m]</td>
<td>-3.95</td>
<td>4.14</td>
<td>0.07</td>
<td>1.47</td>
</tr>
<tr>
<td>Δ Horizontal</td>
<td>0.00</td>
<td>4.01</td>
<td>0.52</td>
<td>0.70</td>
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DGNSS processing software: Alberding Beacon.net
GNSS raw data input: geodetic grade GNSS receiver
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Date: 2014.03.02-06
RSOE and Alberding GmbH
River Information Services
Benefits of EGNOS/EDAS for inland navigation
EDAS-based virtual DGNSS test results

Outlook/future plans
Outlook

• **EDAS integration into the Hungarian AIS DGNSS system** as primary or backup correction source in order to improve the current quality of service

• Continue and strengthen **international cooperation** in the field of DGNSS (as inland navigation system operator)

• Regional cooperation for **harmonising AIS DGNSS services along the river Danube**
Thank you for your attention!

Gergely Mezo
gerely.mezo@rsoe.hu

Tamás Horváth
horvath@alberding.eu
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Steps towards maritime application of EGNOS

Alan Grant & Nick Ward, General Lighthouse Authorities

Date: 8 October 2014
Maritime navigation

- GNSS (actually GPS) is the primary system
- GPS does not have inherent integrity
- RAIM is not generally used
- SBAS is an option
- Beacon DGNSS is the accepted augmentation
e-Navigation & Resilient PNT

e-Navigation is defined by the International Maritime Organisation (IMO) as:

“the harmonized collection, integration, exchange, presentation and analysis of maritime information on-board and ashore by electronic means to enhance berth-to-berth navigation and related services, for safety and security at sea and protection of the marine environment.”

The IMO Maritime Safety Committee has stated:

“e-Navigation systems should be resilient and take into account issues of data validity, plausibility and integrity for the systems to be robust, reliable and dependable. Requirements for redundancy, particularly in relation to position fixing systems should be considered.”
Satellite Based Augmentation Systems
- EGNOS, WAAS, MSAS, GAGAN, SDCM, QZSS, BeiDou

Generally use Geo-stationary Orbit satellites (GEO) to provide corrections and integrity warnings

Coverage runs out above 70 deg latitude

QZSS uses quasi-zenith (highly elliptical orbits) satellites

BeiDou has a combination of GEO, MEO and LEO
Most of these systems were developed for aviation applications

MSAS was intended to have cross-sector applications

Receivers for non-SOLAS applications may be enabled for EGNOS and WAAS (users may not be aware)

Some SOLAS receivers may also be using SBAS

There is no recognition of SBAS by IMO

There are no maritime standards for SBAS receivers

There are no channels of communication for informing maritime users about the status of SBAS
Potential consequences

- Users may believe that they are using IALA beacon DGPS (as provided by the GLA) when they are actually using SBAS.
- Users may attribute problems to IALA beacon DGPS (which does warn users if it is not functioning correctly).
- Users may be unaware of a disruption to SBAS.
- Erroneous information may be provided by SBAS, without warning.
- Position accuracy may be degraded by SBAS (compared with uncorrected GNSS).
Not a satisfactory situation!

- So what can we do about it?

- Steps towards maritime recognition of SBAS
  - IMO WWRNS – regional systems, need for joint submission?
  - Development of receiver standards, lengthy process

- Service considerations
  - Establish lines of communication, e.g. GSA/EMRF
  - Need for formal Service Level Agreement?
  - Coverage area considerations
  - Awareness of use across the maritime sector

- EMRF meeting at IALA, 28 Nov., opportunity to progress
Maritime recognition of EGNOS as part of WWRNS

- ESA and the GSA want to expand EGNOS application to non-aviation sectors, including maritime
- One important step is to propose recognition of SBAS at IMO – to show how it meets the WWRNS requirements.
- This needs a proposal to the Maritime Safety Committee for an Unplanned Output for the NCSR Sub Committee
- If accepted (there is resistance to such proposals) it could be considered by NCSR 2 in July 2015
- Assessment then reports back to NCSR 3 in 2016. Approval by MSC could take place by the end of 2016
Receiver standards

- Simultaneous submission for development of IMO Performance Standards for SBAS receivers would follow a similar timeline
- Proposal to IEC for a new Work Item developing Performance Requirements and Test Specifications
- Both these developments would require sponsorship and support from several national administrations
- At present, no apparent interest outside Europe (US has not taken any initiative on maritime use of WAAS)
- However, multi-system receiver standard (including SBAS) is already under development in IMO (completion at NCSR 2?)
Indicative timeline

2014 MSC 94
2015 MSC 95
2016 MSC 97
2019 e-Navigation Introduction

2014 NCSR 1
2015 NCSR 2
2016 NCSR 3

7/14 MS RX PS
7/19

IEC MS RX Test Spec.
Updating equipment
WWRNS Recognition

EGNOS Standardisation timeline
Performance monitoring

- EGNOS infrastructure is designed for aviation
- GLA have monitoring sites in coastal locations
- GLA & others have carried out trials on ships
- Other organisations?
- Need to pool results
Demonstrations/test beds

- ACCSEAS
- MONA LISA 2
- EFFICIENSEA 2
- Other EU Projects?
  - PROSBAS follow-on?
Scope for integration

- IALA DGPS reference stations on coasts
- Potential to provide EGNOS corrections via 300kHz broadcast
- Extend coverage – VHF Data Exchange System
- Potential for Arctic region
- Inland waterways
Summary

- SBAS are quite widely used for maritime applications
- There is no international recognition for maritime use of SBAS, no standards in place for receivers and no channels of communication between service providers and users
- It would take at least three years for recognition and standards to be put in place
- GLA/EMRF/IALA providing assistance to ESA and GSA to improve situation
- More performance monitoring and demonstrations needed
- Possibilities of integration with beacon DGPS and expansion of coverage should be considered
Thank you

Contact Information
Dr. Alan Grant, Email: alan.grant@gla-rrnav.org, Phone: +44 (0)1255 245141
www.gla-rrnav.org
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Cost Benefit Analysis in maritime: showing EGNOS benefits

Marco Bolchi, VVA
Lisbon, October 8, 2014
The study assessing EGNOS potential in the maritime and IWW

- The assignment (2012) for the European Commission aimed at getting views on the introduction of EGNOS in maritime and IWW and at testing the performance of EGNOS in different areas. It also aimed at delivering a roadmap towards the certification of EGNOS receivers for maritime use.

- The study involved interviews with many entities, organizations and companies:
  - 4 Maritime administrations
  - 6 Inland waterway authorities
  - 8 Equipment manufacturers, technology solutions providers
  - 1 Industry association
  - 15 IALA DGPS operators, both IWW and Maritime
  - 2 Port and VTS Operators

- Different tests were performed across the EU comparing the performance of GPS, EGNOS and DGPS receivers on different ends of the market.
The impact is diversified depending on equipment used on-board of vessels, taking into consideration various maritime sub-segments. 

Net Benefits = BEST scenario – Business As Usual scenario

### Business as Usual (BAU) scenario

- **SOLAS vessels**
  - Using DGPS
    - DGPS available
    - DGPS offline
  - Using GPS

- **Non-SOLAS commercial vessels**
  - Using DGPS
    - DGPS available
    - DGPS offline
  - Using GPS and EGNOS
  - Using GPS

- **Recreational crafts**
  - Using GPS and EGNOS
  - Using GPS

### BEST scenario

- **EGNOS as complement and back-up to available positioning and navigation solutions (e.g. GPS, DGPS, etc.) where beneficial**

The diagram outlines the use of DGPS and GPS in different scenarios, highlighting the benefits of EGNOS in enhancing maritime navigation. The net benefits are calculated as the difference between the BEST scenario and the Business As Usual scenario.
Where feasible, the identified benefits were quantified for the Maritime Regulated segment, as well as for the Unregulated one.

**Open waters**
- Improved safety of navigation

**Coastal and port approaching**
- Improved safety of navigation
- Optimization of shore-based infrastructure
- Enhanced traffic management and collision avoidance

**Ports/Harbors**
- Optimization of ground-based navaids
- Enhanced LBS applications (information, tracking apps) through mobile platforms

**Not quantified benefit**
- Operational efficiency (navigation, dock identification and reservation, assisted docking)
Most of the benefits are generated by recreational vessels, due to the high number of crafts and accidents positively impacted.
The identified impact of EGNOS shows that all the user groups considered will benefit from the increased EGNOS adoption.

**EGNOS Net Benefits (2012-2025) - cumulated**

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<tr>
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<th>Net Benefit - BAU vs BEST - Safety related and Private</th>
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<tr>
<td></td>
<td>Private (BAU)</td>
<td>€(-359) million</td>
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<td></td>
<td>Private (BEST)</td>
<td>€14.209 million</td>
</tr>
<tr>
<td></td>
<td>Public (BAU)</td>
<td>€3.475 million</td>
</tr>
<tr>
<td></td>
<td>Public (BEST)</td>
<td>€889 million</td>
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**Average Annual Net Benefit**

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<tr>
<td>Private (BAU)</td>
<td>€(-26) million</td>
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<tr>
<td>Private (BEST)</td>
<td>€391 million</td>
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</tr>
<tr>
<td>Public (BAU)</td>
<td>€64 million</td>
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</tr>
<tr>
<td>Public (BEST)</td>
<td>€1.015 million</td>
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**Comments**

- All the **user groups** (operators, ports, etc.) would benefit from an increased adoption of EGNOS.
- EGNOS foreseen to mildly optimize investments for **Infrastructure Managers**.
- Society foreseen to achieve the **biggest EGNOS Net Benefit** mainly because of improved safety of navigation that leads to the reduction of accidents, which generates a positive impact on life losses, human injuries and external costs of transport.

**EGNOS Net Benefit by Beneficiary**

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<tbody>
<tr>
<td>TOT €5835</td>
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<tr>
<td>Safety related</td>
<td>€13.320</td>
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<tr>
<td>Private</td>
<td>€3.308</td>
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<tr>
<td>Infrastructure managers</td>
<td>€7</td>
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<tr>
<td>Operators</td>
<td>€2.520</td>
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**Average Annual EGNOS Net Benefit**

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<tbody>
<tr>
<td>Society</td>
<td>€951 million</td>
<td></td>
</tr>
<tr>
<td>Infrastructure Managers</td>
<td>€0.5 million</td>
<td></td>
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<tr>
<td>Operator s</td>
<td>€180 million</td>
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<tr>
<td>Port Authorities</td>
<td>€236 million</td>
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The study allowed us to identify a series of EGNOS benefits expected and/or perceived by the Maritime community.

For Operators:
- **Integrity**
  - Enhanced safety of operations
  - Improved reliability of data
- **Accuracy**
  - Enhanced safety of operations
  - Increased efficiency of operations

For administrations and authorities:
- **Integrity**
  - Enhanced safety of operations
  - Improved reliability of data
- **Accuracy**
  - Enhanced safety of operations
  - Increased efficiency of operations
- **Coverage**
  - Complementary to GPS
  - Complementary to DGPS services
- **Operating costs**
  - Low investments and operating costs

Source: interviews, VVA analysis
EGNOS shows a positive impact on activities of Maritime segment, the maritime community should better exploit it

- Most of the receivers produced by equipment manufacturers already are EGNOS-ready
- Low additional investments for Operators
- Improved safety of navigation, in particular in restricted waters
- EGNOS regional coverage to be exploited immediately
- EGNOS in the future could be a component of a multi-SBAS global network
- AIS ground-based infrastructure could be leveraged to transmit EGNOS corrections via AIS Msg. 17
- Innovative applications, such as professional LBS, tracking & tracing, fleet management, logistics operations could benefit from EGNOS
coffee break
EGNOS survey open!

7-8 October
Lisbon
The EGNOS Service Provision workshop
# AGENDA (14:30 – 17:00)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>14:30-16:15</td>
<td><strong>EGNOS use in maritime domain</strong>&lt;br&gt;- Benefits of EGNOS/EDAS for inland waterway navigation&lt;br&gt;- Steps towards Maritime application of EGNOS&lt;br&gt;- Use of EGNOS in Maritime and SAR applications: the manufacturer perspective&lt;br&gt;- Cost Benefit Analysis in maritime: showing EGNOS benefits</td>
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<td>16:15-16:45</td>
<td><strong>Coffee break</strong></td>
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<td>16:45-17:00</td>
<td><strong>Conclusions</strong></td>
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