EGNOS for River Information Services

UN International Meeting on the Use and Applications of GNSS

Vienna, 15th of December 2004
- Fairway Information Services
  - Electronic navigational charts and its updates
  - Notices to Skippers
- Traffic Information Services
  - Tactical Traffic Information
  - Strategic Traffic Information Services
- Traffic Management
  - Lock and Bridge Management
- Calamity Abatement Support
- Information to Enforcement
  - TTI to immigration authority
  - Immigration and Customs Control Service
- Transport Management
  - TTI to terminals and fleet operators
Aims of GALEWAT

- Increase safety of Waterway Transport
- Evaluation of the possible benefits of EGNOS and GALILEO in RIS
- Development of concepts Seamless integration of GALILEO and EGNOS in future RIS installations
GPS and EGNOS for GALEWAT (1/2)

GPS: Global Positioning System

EGNOS: European Geostationary Navigation Overlay Service

- EGNOS provides enhancement of GPS to make the navigation service more accurate and reliable
- EGNOS is transmitted from geostationary satellites
Problem:
EGNOS uses Geostationary satellites, and shading will occur at some points.
Automatic Identification System (AIS)

Characteristics:
- Ship’s position is automatically broadcast to other ships and to shore
- VHF frequencies are used, hence direct line of sight as with radar is not required
- Default transmission is every 2 s for inland navigation
- Static information like ship’s name, destination and cargo is also broadcast
- Safety related SMS can be sent between ships and between ships and shore
- Navigation data can be broadcast from shore to ships, for example EGNOS data
The Galewat System consists of following elements

- Ship Segment
- Shore Segment
- Regional Segment
- External Segment

- GPS and EGNOS satellites, and in the future, Galileo
Galewat aims at providing redundant EGNOS information:

• The Ship receives GPS and EGNOS signals directly from the satellites.
  => Improved accuracy and reliability (integrity) of position fix as compared to standalone GPS

• In case of shading of the EGNOS satellites, the Ship receives the EGNOS data from AIS Shore Station via Msg 17.
  => Improved availability as the EGNOS benefits are also available when EGNOS is shaded
  => The problem posted earlier is solved
Overview

Differential Position Sensor (DPS 116)

Automatic Identification System (AIS 100)

AIS dGPS

GPS/SBAS/IALA Antenna

IALA Beacons

Physical Shore Stations

AIS/GNSS

External Segment Server (ESS)

External Segment Client (ESC)

AIS Service Management (ASM)

Electronic Chart System

Heading Antenna

Automatic Identification System (AIS 100)

Differential Position Sensor (DPS 116)

TTI

GEO

GPS Satellite

EGNOS Satellite

VESSEL

GPS + VHF Antennas

AIS dGPS

INTERNET
Measurement Planning - Aims

- Major aim of measurement campaign: Compare performance of:
  - GPS (stand alone)
  - EGNOS (from direct SiS)
  - EGNOS (broadcast over AIS)
  - IALA
  - Weighted DGPS (weighted mean of above solutions)

- Study usability of advanced AIS systems on inland waterways

- Evaluate advantages of a GALEWAT-like system compared to standard AIS systems
Measurement Planning – Vienna Route
Measurement Results (1)

Kinematic position accuracy: GPS and GPS/EGNOS compared to reference
Measurement Results (2)

Kinematic position accuracy: GPS and GPS/AIS compared to reference
Measurement Results (3)

Kinematic position accuracy: GPS and WDGPS compared to reference
### Availability of position

<table>
<thead>
<tr>
<th></th>
<th>REF</th>
<th>GPS</th>
<th>EGNOS</th>
<th>AIS</th>
<th>WDGPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total epochs observed</td>
<td></td>
<td>16201</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability (%)</td>
<td>79.91</td>
<td>89.80</td>
<td>86.13</td>
<td>88.85</td>
<td>90.18</td>
</tr>
</tbody>
</table>

### Accuracy of position

<table>
<thead>
<tr>
<th>Confidence level (%)</th>
<th>GPS</th>
<th>EGNOS</th>
<th>AIS</th>
<th>WDGPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>63%</td>
<td>2.97</td>
<td>2.23</td>
<td>1.82</td>
<td>1.95</td>
</tr>
<tr>
<td>95%</td>
<td>4.35</td>
<td>3.30</td>
<td>2.52</td>
<td>2.75</td>
</tr>
<tr>
<td>99.99%</td>
<td>6.81</td>
<td>5.19</td>
<td>3.75</td>
<td>4.16</td>
</tr>
</tbody>
</table>
– EGNOS improves GPS accuracy
– EGNOS provides additional ranging sources
– EGNOS provides GPS integrity

– EGNOS needs line-of-sight between GEOs and receiver
– EGNOS data messages can be re-transmitted over terrestrial radio networks
# Measurement Results (6)

<table>
<thead>
<tr>
<th>Condition</th>
<th>EGNOS</th>
<th>AIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPL &lt; HAL (25 m)</td>
<td>99.80%</td>
<td>100%</td>
</tr>
<tr>
<td>HPL &gt; Accuracy (empiric)</td>
<td>&gt;99.99%</td>
<td>&gt;99.99%</td>
</tr>
</tbody>
</table>
Measurement Results (7)
Measurement Results (8)
Summary

- For safety critical operations on inland waterways, there is a need for reliable position information
- EGNOS increases positioning accuracy of GPS
- EGNOS provides integrity to GPS
- EGNOS broadcast over AIS bridges outages of EGNOS SIS