MODERNIZATION OF MARITIME DGPS IN POLAND

Author: Marek Dziewicki

Maritime Office Gdynia
Department of AtoN Technique and Radionavigation Systems

“TransNav 2009” AM Gdynia, Poland
Presentation plan

- Introduction - Why DGPS?
- IALA approach
- European options

- Modernization of Polish DGPS (base stations & coverage)
- IT infrastructure

- Field tests
- RS RTK installation
- Future expectations and Conclusions
WHY DGPS …?

• Useful. Most of mariners use GNSS as a primary means of navigation. Available GNSS does not meet the requirements of IMO with respect to integrity, while the use of IALA maritime DGNSS does fulfil these requirements.

• International maritime standards exist for both: onboard receiver and LB DGNSS service.

• Popular. DGPS beacon systems were installed in many countries over the period 1993-2000 and now became obsolete. The R-NAV (presently e-Navigation) Committee concluded that there is a requirement to recapitalise national systems.

• It is potentially a good reason to re-organise the system for the benefit of users and to enhance DGNSS capabilities taking into account technical innovations as well as e-Navigation architecture.

• Validation. At the same time countries are considering submission of their DGNSS services to IMO as components of the World Wide Radio Navigation
IALA approach

- The baseline approach would be to replace existing equipment with similar, dedicated RSIM based on known, commercially available technology. New dedicated hardware Reference Stations and Local Integrity Monitors (RSIM). This solution could limit the potential for future development.

- Modernization of DGNSS should be considered in the context of requirements for e-Navigation.

Possibilities include:

- Software Reference Stations and Integrity Monitors (RSIM)
- Virtual Reference Station (VRS)
- SBAS (EGNOS, WAAS) Integration
The response of representatives at the meeting indicate that most administrations providing DGNSS services are undertaking re-capitalization or are planning such activities based also on co-operation with National Geodetic Networks.

- **Sweden** is currently studying options for software RSIM solutions and transmissions of VRS data via MF beacon system taking into account also the geodetic network SWEPPOS.

- **Germany** is planning to implement DGNSS recapitalization plan by creating RAAS and VRS based on national network operated from national centre of control. The new concept of “moving centre of system accuracy” was presented.

- A new type of MF transmitting antenna (NTA) was presented.
European trends

- **Germany** also announced a feasibility study to investigate the addition of ranging signals (R-Mode) on MF beacon and AIS carriers.

- **Scotland** referred UK and Ireland studies of DGPS replacement options which concluded that the lowest risk would be hardware replacement, although the flexibility provided by the software option would better meet emerging requirements and should not be ruled out. The GLA have tendered for new RSIM equipment, which may be fulfilled by either hardware or software solution.

- **Russia** is testing broadcast of DGlonass and DGPS corrections via AIS system in Golf of Finland.
Introduction to DGPS-PL

- **Established** - since 1995 – 1996
- **Modernized** 2007-2008

**Driving factors:**
- IALA R-NAV Recommendations
- SOLAS Convention, Ch.V

**Legal regulations:**
- ITU-R, RTCM regulations
- Declaration on the Safety of Navigation and Emergency Capacity in the Baltic Sea Area” – Copenhagen 2001

TransNav09, 17-19 June 2009, AM Gdynia
Layout of Polish DGPS coverage

DZIWNOW 283.5 kHz

ROZEWIE 301.0 kHz
RTCM transmission from DGPS-PL

Table I. Polish DGPS stations

<table>
<thead>
<tr>
<th>Station name</th>
<th>Identification Nos</th>
<th>Geographic Position Lat/lon</th>
<th>Station in operation</th>
<th>Integrity Monitoring</th>
<th>Transmitted message types</th>
<th>Freq (kHz)</th>
<th>Bit Rate (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dziwnów</td>
<td>741 742</td>
<td>54°01' N 14°44' E</td>
<td>yes</td>
<td>yes</td>
<td>9,3,7,16</td>
<td>283.5</td>
<td>100</td>
</tr>
<tr>
<td>Rozewie</td>
<td>743 744</td>
<td>54°49' N 18°20' E</td>
<td>yes</td>
<td>yes</td>
<td>9,3,7,16</td>
<td>301.0</td>
<td>100</td>
</tr>
</tbody>
</table>
DGPS-PL SYSTEM TOPOLOGY
New antenas and RS-IM equipment

L1, L2 antymultipath GPS antennas 24 channels L1,L2 RS doubled receivers and L1 integrity monitor, rack mounted industrial PC
REMOTE CONTROL
Farfield IM monitor in Gdynia Port (24 h)
FIELD MEASUREMENTS

- **Station Name:** DGPS Dziwnow
- **Start:** 2008-8-1 10:23
- **End:** 2008-8-5 10:23

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission</td>
<td>235.5 kHz</td>
</tr>
<tr>
<td>Average Signal</td>
<td>102.00 dBmV/m</td>
</tr>
<tr>
<td>Noise Ratio</td>
<td>-47.95 dB</td>
</tr>
<tr>
<td>Truth Reference</td>
<td>Last Delta Position Error:</td>
</tr>
<tr>
<td></td>
<td>Average Delta Position Error:</td>
</tr>
<tr>
<td>Lon</td>
<td>N 54°01.19.185</td>
</tr>
<tr>
<td>Lat</td>
<td>E 02°43.200.55</td>
</tr>
<tr>
<td>Ht</td>
<td>45.400</td>
</tr>
</tbody>
</table>

Sample interval: 56731.00 Seconds
Average 9.04 Seconds

- Number of Samples: 38234
- % Of DGPS: 100.00%
- Position Standard Deviation: 0.25 m (dN), 0.16 m (dE), 0.43 m (dH)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal Position</td>
<td>0.00 m</td>
</tr>
<tr>
<td>Time Outside</td>
<td>0.00 %</td>
</tr>
<tr>
<td>Threshold:</td>
<td>0.00 m</td>
</tr>
</tbody>
</table>

Error Statistics:

- 0-1m -> 99.57%
- 1-2m -> 0.47%
- 2-3m -> 0.00%
- 3-4m -> 0.00%
- 4-5m -> 0.00%
- 5-10m -> 0.00%
- >10m -> 0.00%

Remarks:

TransNav09,17-19 June 2009, AM Gdynia
Permanent RTK, RS-Hel

Table II Characteristics of RTK RS-Hel

<table>
<thead>
<tr>
<th>Name RS-Hel</th>
<th>Receiver type</th>
<th>Corrections output</th>
<th>Radio-transceiver</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>System</td>
<td>R-5</td>
<td>RTCM 18, 19, 20, 21</td>
<td>Satellite 3AS Epic</td>
<td>VRS</td>
</tr>
<tr>
<td>Application</td>
<td>GPS, Glonass</td>
<td>Binary code CMR, CMR+</td>
<td>UHF 2-10W R1 range 10-40km</td>
<td>RTK, DGPS</td>
</tr>
<tr>
<td>Frequency</td>
<td>L1, L2, L5</td>
<td>1Hz</td>
<td>434.25 MHz</td>
<td>+/- 1MHz</td>
</tr>
<tr>
<td>Link Mode</td>
<td>Network (LAN)</td>
<td>serial, NMEA</td>
<td>simplex, Com</td>
<td></td>
</tr>
</tbody>
</table>
Statistics based on tracking ships...
Conclusions and plans

- Modernized DGPS-PL system is operational in Polish responsibility zone, RTCM corrections are being internationally available,
- DGPS+AIS data became the main source of information for traffic analysis, FSA and evidence purposes
- Additional 2 remote IM stations are planned,
- New transmitting system is under construction
- All of the described systems require permanent (24h/7d/365d) system monitoring,
Thank You for Your attention

marekdz@umgdy.gov.pl