Russian Federation in GNSS Open Service
Performance Parameters Template Creation

Bolkunov Alexey

Russian Federal Space Agency
Central Scientific-Research Institute for Machine building
Information and Analysis Center for PNT
Advantages of GNSS Performance Standard Template

• On national level
  – Effective national planning in GNSS sphere - all GNSS parameters and methods of their calculation are defined, unified and are guaranteed by corresponding country-provider

• On augmentations level
  – Possibility of using all GNSS for Augmentations

• On Industry and Service Providers level
  – Possibility of creating design methods and algorithms for combined constellation
  – Making marketing strategies and decisions by region/country/sector easier

• For international GNSS parameters monitoring, control and validation system
Major Challenges of GNSS PS Template Creation

• Impossible to create fully unified Template for every GNSS:
  – Possible nonconcurrence with country-provider’ national regulatory framework
  – GNSS’ specific features.

• A primary consideration is harmonization of parameters and methods of their calculation.
GLONASS and GNSS Open Service Performance Parameters Standards

- Creation of GLONASS Open Service Performance Parameters Standard (maximally harmonized with GNSS PS Template)
- Participation in creating unified GNSS PS Template
GLONASS Parameters in Russian Federation
Regulatory Framework

• Current Russian Federation Regulatory Framework:
  – Federal Target Program «GLONASS Sustainment, development and usage in 2012-2020 period»
  – GLONASS Operation Requirement
  – GLONASS Technical Requirements

• There is no document similar to GPS Open Service Performance Parameters Standard in Russian Federation now
  – Harden SDCM certification procedure
  – Harden GLONASS usage by international (air and sea) users (in safety-of-life applications)
GNSS PS Template Parameters for GLONASS

• Main parameters:
  – Constellation Structure
  – SIS Coverage
  – SIS Accuracy
  – SIS Integrity
  – SIS Continuity
  – SIS Availability
  – Position/Time Domain Standards
    • Availability standards
    • Position/Time Accuracy

• Harmonization of parameters and methods of their calculation is still needed
Russian Federation view for Roadmap of GNSS PS Template

- Starting point
- GNSS PS Template parameters analysis
- Russian Federation regulatory framework parameters analysis
- Harmonizing calculation methods of parameters from GNSS PS Template - international level
- Harmonizing parameters and methods of their calculation - Russian Federation level
- GLONASS-specific amendments to GNSS PS Template
- GNSSs-specific amendments to GNSS PS Template
Suggestions to GNSS PS Template

Proposed Template can serve as a baseline for ICG GNSS PS Template

• develop standard applicable for all open signals in all bandwidths taking into account planned advanced signals
• add section describing GNSS specific features
• create methods for harmonizing parameters computed with different methods or to create unified methods to achieve equipotential validation
• harmonize reference data used for parameters validation
• add different requirements for GNSS parameters depending on SC type
• widen GNSS Service Volume (Space Service Volume)

Vertical positioning accuracy degradation and sizes of degradation zones
Summary

• Now
  – Parameters in GNSS PS Template and in national regulations framework are analyzed
  – General parameters list is harmonized
  – Proposed Template can serve as a baseline for ICG GNSS PS Template

• It is proposed to
  – To develop standard applicable for all open signals in all bandwidths taking into account planned advanced signals
  – Add section describing specific features for each GNSS
  – To create and harmonize methods for validating parameters calculation (both on national and international level)
  – To create methods for harmonizing parameters computed with different methods or to create unified methods to achieve equipotential validation
  – To harmonize reference data used for parameters validation
  – To add different requirements for GNSS parameters depending on SC type
  – To widen GNSS Service Volume (Space Service Volume)

• More detailed suggestions would be presented in working order to provide for the next meeting a GNSS PS Template harmonized with Russian Federation
Contacts

Bolkunov Alexey

Senior Research Associate
Central Scientific-Research Institute for Machine building
Information and Analysis Centre For Positioning, Navigation and Timing

Alexei.Bolkunov@glonass-iac.ru
www.glonass-center.ru
tel/fax: + 7 495 513 4576
Backup slides
## GNSS Parameters in PS Template and in Russian Federation Regulatory Framework

<table>
<thead>
<tr>
<th>Parameters</th>
<th>SPS PS Template</th>
<th>Operation Requirement</th>
<th>GLONASS Federal Target Program</th>
<th>GOST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constellation Structure</strong></td>
<td>Satellite number (baseline, surplus); orbital planes; reference orbit parameters</td>
<td>Satellite number (baseline, surplus); orbital planes; satellite distribution by planes; general orbit parameters</td>
<td>Satellite number</td>
<td>Satellite number and reference to constellation structure in ICD'</td>
</tr>
<tr>
<td><strong>SIS Coverage</strong></td>
<td>Per-Satellite (received power contour surface ); Service Volume</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>Constellation Coverage: Service Volume</td>
<td>Service volume defined</td>
<td>n/a</td>
<td>Service volume and signal power characteristics defined</td>
</tr>
<tr>
<td><strong>SIS Accuracy</strong></td>
<td>URE SIS: for different AOD, 95%)</td>
<td>URE SIS: 95%, 1 day interval</td>
<td>URE SIS: 95% for reporting period</td>
<td>Range error</td>
</tr>
<tr>
<td></td>
<td>URE SIS: 95%</td>
<td>URRE SIS: 95%, 1 day interval</td>
<td>n/a</td>
<td>User Range Rate Error</td>
</tr>
<tr>
<td></td>
<td>URAE SIS: 95%</td>
<td>n/a</td>
<td>n/a</td>
<td>User Range Acceleration Error</td>
</tr>
<tr>
<td><strong>UTC Accuracy</strong></td>
<td>UTCOE: 95%</td>
<td>GLONASS Time to UTC(SU) offset with 95% probability</td>
<td>GLONASS Time to UTC(SU) and UTC(SU) to UTC corrections accuracy with 95% probability</td>
<td>UTC(SU) offset error: 95%, 1 day period, taking into account satellite offset error</td>
</tr>
<tr>
<td><strong>SIS Integrity</strong></td>
<td>Probability of exceeding URE NTE; time to alert</td>
<td>Time to alert message with specified probability</td>
<td>Time to alert message with specified probability</td>
<td>Probability of exceeding URE NTE globally and for standalone station</td>
</tr>
<tr>
<td><strong>SIS Continuity</strong></td>
<td>Probability of OS being healthy over specified time interval</td>
<td>Only definition of continuity, no standards</td>
<td>n/a</td>
<td>«Availability factor»</td>
</tr>
<tr>
<td><strong>SIS Availability</strong></td>
<td>Per-slot: probability of slot being occupied by healthy satellite</td>
<td>n/a</td>
<td>n/a</td>
<td>«Availability factor»</td>
</tr>
<tr>
<td></td>
<td>Constellation: probability of M from N slots are occupied by healthy satellite</td>
<td>n/a</td>
<td>n/a</td>
<td>Availability B</td>
</tr>
<tr>
<td><strong>Position/Time Domain Standards</strong></td>
<td>PDOP availability: probability of PDOP &lt; 6 globally and in worst site</td>
<td>Availability: probability of PDOP &lt; 6 globally</td>
<td>Availability: probability of PDOP &lt; 6 globally</td>
<td>«Service Volume Value»</td>
</tr>
<tr>
<td></td>
<td>Position Service Availability: probability of errors being higher than defined, horizontal and vertical (95% on 24-days interval)</td>
<td>n/a</td>
<td>n/a</td>
<td>Availability A</td>
</tr>
<tr>
<td><strong>Position/Time Service Accuracy Standards</strong></td>
<td>Position domain accuracy, horizontal and vertical (95% on 24-day interval), globally and in worst site</td>
<td>Positioning, velocity and time errors (globally, 95%, 24-day interval, PDOP=2)</td>
<td>Positioning error (globally, 95%, for reporting period)</td>
<td>Horizontal and vertical errors (95% on 24-days interval) globally and in worst site</td>
</tr>
<tr>
<td><strong>Additional Standards</strong></td>
<td>GNSS to Inertial Reference frame Transformation parameters</td>
<td>Requirements for GLONASS Fundamental Maintaining Facilities</td>
<td>UTC (SU) to UTC; ERP to GGSK corrections accuracy, solar and bodies orbits determination accuracy</td>
<td>n/a</td>
</tr>
</tbody>
</table>