GLONASS current status and update programme

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NATIONAL SATELLITE NAVIGATION POLICY AND ORGANIZATION


- Federal Programme on GLONASS Sustainment, Development and Use for 2012-2020 – planning and budgeting instrument for national PNT activities

- Programme governance:

- Programme Goals:
  - Improving system performance in terms of accuracy and integrity
  - Ensuring guaranteed positioning, navigation and timing solutions in restricted visibility, interference and jamming conditions
  - Enhancing current application efficiency and broadening application domains
**GLONASS STATUS**  
(as of 6 December 2016)

**SPACE-BASED AUGMENTATIONS**
- 24 reference stations in Russia
- 8 reference stations abroad

**SDCM GEO satellites**
- In total 3
  - Operational 2
  - Maintenance 1

**In total** | 27
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**Operational** | 23
**Maintenance** | 1
**Orbital spares** | 2
**Flight testing** | 1

**FUNDAMENTAL FACILITIES**
- 3 Telescopes (32 m)
- 2 Telescopes (7 m)
- 3 Correlators
- 1 Cold-atom Optical Frequency Reference
- 50 Astronomic and Geodetic Network Stations

**GROUND CONTROL COMPLEX**
- 2 System Control Centers
- 9 Reference Stations
- 6 Uplink Stations
- 3 Laser Ranging Stations

**REGIONAL AND LOCAL AUGMENTATIONS**
- 77 stations of Ministry of Transportation
- 4104 stations of Federal Service for State Registration, Cadastre and Cartography

**Glonass-K**

**Glonass-M**

**MEO Satellites**
CURRENT STATUS OF GLONASS TIMESCALE AND UTC(SU) BROADCAST ACCURACY

• before Aug. 2014 ~400 ns offset between GLONASS Time and UTC(SU)
  • in compliance with Specs
  • but stopped meeting growing requirements of timing users
• Aug. 18, 2014 – start of correction activities
• 2015 – offset kept within 35 ns
• 1st half of 2016 – offset kept within 25 ns

• 2nd half of the 2016 – malfunctions of the Central Synchronizer GLONASS System Time Generation disturbances increased offset to UTC(SU)
• GLONASS Timescale is being corrected with an increment of ~2 ns per day by changing the control correction
• by the end of 2016:
  • GLONASS Time Offset relative to UTC(SU) is expected to reach ± 20 ns
  • UTC(SU) broadcast error is expected to reach ± 5 ns

• before Aug. 2014 ~200 ns UTC(SU) broadcast correction systematic error
• Aug. 18, 2014 – start of correction activities
• Aug. 2014 – Jun. 2016 – UTC(SU) broadcast error is within 10 ns
## GLONASS CONSTELLATION SUSTANMENT

<table>
<thead>
<tr>
<th>Year</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>Total in constellation</td>
<td>28</td>
<td>28</td>
<td>27</td>
</tr>
<tr>
<td>Operational</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

**Glonass-M**

- 2 Glonass-M satellites decommissioned in 2016
- 2 Glonass-M satellites launched (07 Feb 16 and 29 May 16)
- a number of block M sats operate beyond their design life
- 7 Glonass-M sats in ground stock to be launched in 2016-2018 to replace those well beyond their design life

**Glonass-K**

- 2 Glonass-K in orbit
  - 1 undergoing flight testing
  - 1 commissioned in Feb 2016, operational

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Current constellation and ground spares will provide robust system operation until new-generation satellites FOC.
**Glonass-K Satellites**
- Signals: L1/L2OF, L1/L2SF, L1/L2OC, L1/L2SC, L3OC
- 2 phased-array antennas (for FDMA and CDMA signals)
- New message structure
- Enhanced antijam capabilities of new CDMA signals
- Experimental clock – 5x10^{-14}–5x10^{-15}
- Onboard one-way laser ranging
- More frequent ephemeris and clock data uploads, optical crosslinks
- 12.5 year design life
- SaR

**Enhanced Glonass-K**
- Signals: L1/L2OF, L1/L2SF, L1/L2OC, L1/L2SC, L3OC
- 2 phased-array antennas (for FDMA and CDMA signals)
- New message structure
- Enhanced antijam capabilities of new CDMA signals
- Experimental clock – 5x10^{-14}–5x10^{-15}
- Onboard one-way laser ranging
- More frequent ephemeris and clock data uploads, optical crosslinks
- 12.5 year design life
- SaR

**Glonass-K Evolution (K2)**
- Single phased-array antenna for L1/L2/L3 FDMA and CDMA signals
- Advanced clocks – 5x10^{-14}–5x10^{-15}
- Design to be finalized by the end 2016
All types of augmentations to support all types of high accuracy services developed and continue to expand.

- network densification
- space segment modernization
- coverage extension

**Glonass Augmentations**

**Broadcasting Facilities**
- GEO
- L1/L5 SBAS
- L1/L3 GLONASS

**Global Monitoring Network**
- Internet
- NTRIP

**GNSS Constellation**
- Data Processing Facility
  - Master Center
  - Back-Up Center
- Independent monitoring and verification of performance characteristics versus system requirements documents of GLONASS and its constituent parts
- Generating input data to assess GLONASS Program KPIs
- Determining GLONASS performance at user level
- Calculating input data for GLONASS certification
4 GLONASS REFERENCE DOCUMENTS ARE TO BE RELEASED IN Q-4 2016

- Interface Control Document “General Description of the GLObal NAvigation Satellite System with the Code Division Multiple Access Signals”
- Interface Control Document “GLONASS L1 Open Service Code Division Multiple Access Signal”
- Interface Control Document “GLONASS L2 Open Service Code Division Multiple Access Signal”
- Interface Control Document “GLONASS L3 Open Service Code Division Multiple Access Signal”

<table>
<thead>
<tr>
<th>Type of difference</th>
<th>FDMA signal reference documents</th>
<th>CDMA signal reference documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable number of SVs</td>
<td>0 to 24</td>
<td>0 to 63</td>
</tr>
<tr>
<td>Message structure</td>
<td>Fixed structure</td>
<td>Continuous sequence of strings, non-fixed length, variable composition depending on the number of operational SVs, types of strings can be added, backward compatibility with receivers currently in use</td>
</tr>
<tr>
<td>Time stamp length</td>
<td>30 bits</td>
<td>12 bits</td>
</tr>
<tr>
<td>Value of LSB</td>
<td>0.4 m</td>
<td>0.001 m</td>
</tr>
<tr>
<td>Signal health status</td>
<td>1 per 4 sec</td>
<td>1 per 2 sec for L1 and L2&lt;br&gt;1 per 3 sec for L3</td>
</tr>
</tbody>
</table>
GLONASS USER INFORMATION SUPPORT

USER INFORMATION SUPPORT (WWW.GLONASS-IAC.RU)

PURPOSE: PROVIDING RUSSIAN AND INTERNATIONAL USERS WITH INFORMATION ABOUT GLONASS AND OTHER GNSS – ONE OF THE ROSCOSMOS ACTIVITIES

PRIMARY TASKS:
- GLONASS orbital constellation monitoring in real time
- Official GLONASS SCC bulletins
- Estimation and quality prediction for GLONASS and other GNSS radio-navigation fields
- GLONASS and other GNSS performance evaluation
- High-precision GLONASS and other GNSS ephemeris and time information
- Information and consultation service on satellite navigation

WWW.GLONASS-IAC.RU
- GLONASS budgeting is planned through 2020, planning for the next period is underway
- Orbital constellation + Glonass-M ground spares will provide robust system operation until more new generation satellites come into service
- Phased approach to space segment modernization
- Activities focused at performance improvement underway
- All types of augmentations developed and continue to expand
- 4 GLONASS reference documents are approved and to be publicly released in the nearest future
Thank you!

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