GLONASS Program Update

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2015
• GLONASS Government Policy
• GLONASS Constellation Status
• Recent Events and Constellation Sustainment
• Modernization Plans
• SDCM
• Global PPP
• Monitoring and Performance Assessment System
• GLONASS Use
• Summary
The Presidential Decree № 638 of May 17, 2007

• GLONASS is the core element of the national PNT infrastructure ensuring national security and economic development
• PNT infrastructure sustainment and development are Government’s function
• GLONASS civil services are free and unlimited globally
• GLONASS or GLONASS/GNSS user equipment is to be used for government applications
• GLONASS Federal Program is the instrument for implementing national policy in PNT
• GLONASS Federal Program 2012-2020
  • Budget for 9 years secured
  • Most contracts awarded
GLONASS Modernization 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

Key Quality Indicator of Program – guaranteed provision of announced GLONASS performance characteristics
GLONASS Performance Improvement Plan

❖ Four-fold accuracy improvement

by means of

• ground control segment modernization
• introduction of new onboard atomic frequency standards (2 CAFs + 2 RAFs)
• introduction of advanced satellite control and command, orbit and clock determination technologies based on crosslinks in RF and optical bands
• transition to PZ-90.11 Geodetic System aligned to ITRF with mm level
• synchronization of GLONASS Time Scale with UTC (SU) at less than 2ns while keeping UTC (SU) long-term stability at $10^{-17}$
Till August 2014 the offset of GLONASS Time relative to UTC(SU) was about 400 ns. Therefore, to increase the accuracy of GLONASS Time synchronization to UTC(SU) on 18th August, 2014 the procedure for GLONASS Time correction was started. Now the offset is kept within 35 ns.

On 18th August, 2014 the generated corrections to GLONASS Time were also changed to eliminate the systematic component of about 200 ns. Now the error of broadcast corrections for GLONASS Time – UTC(SU) offset does not exceed 10 ns (rms).
The constellation provides global continuous navigation
Latest Launches and Short-term Sustainment

- 1 Glonass-M (#54) launched March 24, 2014
- 1 Glonass-M (#55) launched June 14, 2014
- 1 Glonass-K launched December 1, 2014
- 2015-2016 – up to 9 Glonass-M launches
- Further launches by Soyuz (1 satellite) or Proton (3 satellites in a batch) launch vehicles will be determined by operational necessity
GLONASS Architecture

**Fundamental Segment**
- UTC (SU)
- Earth Rotation Model and parameters
- Reference systems

**Space Complex**
- MEO orbit constellation
- Ground control
- Launch facilities

**Augmentations**
- Space-based systems
  - High accuracy
  - Integrity
- Regional and local differential systems for transport and geodesy

**User Capabilities**
- Integrated user equipment
  - (communication, inertial sensors and other sources of navigation information)
Space Segment Modernization

- Increase of guaranteed life-time
- Evolution of satellite service systems
- More stable on-board clocks
- New control, command and ODTS technologies
- Introduction of SAR payload
- New signals

Phased capabilities build-up
## GLONASS Signal Implementation Plan

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<thead>
<tr>
<th>Satellite</th>
<th>FDMA Signals</th>
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<th>CDMA Signals</th>
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<td>Glonass-M</td>
<td>L1OF L1SF</td>
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<td>Glonass-K</td>
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<td>L2OF L2SF</td>
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<td>L3OC</td>
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<td>Modernized Glonass-K</td>
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<td>L2OF L2SF</td>
<td>L1OC L1SC</td>
<td>L2OC L2SC</td>
<td>L3OC</td>
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System of Differential Correction and Monitoring (SDCM)

Objectives
- SBAS L1 full coverage over Russian territory by 2016
- SBAS L1 dual coverage and L5 service in the central part of Russia by 2018
- SDCM SBAS service certification by 2019
- Precise point positioning service through signals from GEO in GLONASS bands

System Architecture

Broadcasting channels
- 3 L1 GEO
- 1 L1/L5 GEO
- SiSnet server

RIMS network
- 46 stations in Russia
- up to 8 stations abroad

Processing facilities
- Main (Moscow)
- 2 Regional

Constellation Status
- Luch-5A launched at 16° W on December 11, 2011
- Luch-5B launched at 167° E on November 3, 2012
- Luch-5V launched at 95° E on April 28, 2014
• Q - elevation angle
• P1 (Q) - SDCM signal level at the surface (direct beam)
• P2 (Q) - SDCM signal level at the surface (7 deg to the north)
**Global System of Real-time Precise Orbit and Clock Determination**

**Objectives:**
- Global Precise Point Positioning service (real time)
- Precise Orbit and Clock generation (real-time and post-processed)

**Broadcasting Facility**

**GEO**

**L1/L3 GLONASS**

**L1/L5 SBAS**

**Internet**

**NTRIP**

**Data Processing Facility**
- Master Center
- Back-Up Center

**GNSS Constellation**

**Global Monitoring Network**
GNSS Monitoring and Performance Assessment System

- Independent civil monitoring and prediction of performance characteristics contained in the system requirements documents for the system and its constituent parts
- Generating input data to assess the GLONASS Program target indicators and performance
- Determining user level performance
- Calculating input data for GLONASS certification
Multi-GNSS user equipment is used (generally GLONASS/GPS)
Social and economic effect in Russia:
Saving more than 4,000 lives annually*

* estimated provided 100% of the automobile fleet is equipped

ERA-GLONASS – an integration of navigation, communication, information and microelectronics technologies for saving lives and protecting health
• GLONASS Program is among priorities of the Russian Government Policy
• GLONASS open service is free for all users
• GLONASS Program (2012 – 2020) approved on March 3, 2012
  – Government commitments for major performance characteristics
  – GLONASS sustainment, development, use
• GLONASS will continue
  – Keep the GLONASS traditional frequency bands
  – Transmit existing FDMA signals
  – Introduce new CDMA signals
Thank you!

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