• GLONASS Government Policy
• GLONASS Program 2012-2020
• GLONASS Constellation Status
• Recent Events and Constellation Sustainment
• Modernization Plans
• Augmentations
• International Cooperation
• Summary
Government Policy

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
- Mandatory use of GLONASS for government applications and critical industries
- 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

Federal GLONASS Program is a basis for Russian Policy in PNT
GLONASS Federal Program 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
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 $10^{-17}$

![SIS User Positioning Accuracy, m](chart.png)
GLONASS Orbital Constellation Status
(28 November 2014, 00:00)

Orbital Constellation and Satellite Status

<table>
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<tr>
<th>Status</th>
<th>Count</th>
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<tr>
<td>In total</td>
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<tr>
<td>Glonass-M</td>
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<tr>
<td>Glonass-K</td>
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<td>Used for navigation</td>
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<td>In-orbit flight test</td>
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<td>In commissioning phase</td>
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<td>Prime Contractor Check</td>
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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
- 2015-2016 – up to 9 Glonass-M launches
- Further launches by Soyuz or Proton will be determined by operational necessity
  - triple launch planned for the beginning of 2015
- 1 Glonass-K in ground storage to be launched in the end of 2014
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

**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 build-up of capabilities
<table>
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<tr>
<th>Satellite</th>
<th>FDMA Signals</th>
<th>CDMA Signals</th>
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<td></td>
<td>L1</td>
<td>L2</td>
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<tr>
<td>L1OF L1SF</td>
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<td>Glonass-K</td>
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<td>L1OF L1SF</td>
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<tr>
<td>Modernized Glonass-K</td>
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<tr>
<td>L1OF L1SF</td>
<td>L2OF</td>
<td>L1OC L1SC</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
**SDCM Performance**

- 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)

**Coverage**

- **Accuracy (0.95)**

**Plane**

**Height**
Global Precise Positioning System Architecture

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

**BROADCASTING FACILITY**
- GEO
- Internet
- L1/L3 GLONASS
- L1/L5 SBAS
- NTRIP
- GNSS CONSTELLATION
- GLOBAL MONITORING NETWORK

**DATA PROCESSING FACILITY**
- Master Center
- Back-Up Center
International Cooperation on GNSS

- Provision of Compatibility and Interoperability of GLONASS with other GNSS
- Promoting Global Use of GLONASS
- Pursuing competitiveness of GLONASS Enhancing System Performance
China
- 13 October 2014 – Signing Memorandum of Understanding
- Committee on Strategic Projects on Satellite Navigation
- Deployment of monitoring stations on mutual basis

Brazil
- Deployment of GLONASS tracking stations

USA
- 9 June 2012 - Renewed Statement of Cooperation between GLONASS and GPS

EU
- Consultations on Agreement on Cooperation in Satellite Navigation
• GLONASS Program is among priorities of the Russian Government Policy
• GLONASS open service is free for all users
• GLONASS Program (2002–2011) completed, goal achieved
  – Performance is comparable with GPS
  – Full constellation (24 sats) deployed
• New GLONASS Program (2012 – 2020) approved 3 March 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

• International cooperation aims at making GLONASS one of the essential elements of the international GNSS infrastructure for worldwide user benefits
Thank you for your attention!