GLONASS
Status and Progress

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- GLONASS Architecture and Status
- Modernization Plan
- SDCM
- Summary
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Next Launches:

- Block 43 (3 SV «Glonass-M»),
  *December 2010*

- Flight Test Begin of «Glonass-K»
  *December 2010*
In orbit: 26 SV
Operational: 20 SV
Spare: 2 SV
In commission: 3 SV
In maintenance: 1 SV

The constellation provides:
- Continuous navigation over Russia
- Practically global continuous navigation
Global availability is 98% (PDOP < 6, γ > 5°)
GLONASS accuracy has 5 time improved for last three years

Now it is the same order of GPS

Next improvement phase is expected by 2011

Ideal receiver positioning accuracy
GLONASS Accuracy
17 - 19.09.2010

Signal In Space Range Error, m
GLONASS Accuracy by Satellite
17 – 19.09.2010

Signal In Space Range Error, m

I plane

II plane

III plane
On-Board Clock Stability
10 – 18.09.2010

Alan variation
(interval 100000 sec)
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1982

- 3 year design life
- Clock stability $5 \times 10^{-13}$
- Signals: L1SF, L2SF, L1OF, (FDMA)
- Totally launched 81 satellites
- Real operational life time 4.5 years

2009

- 7 year design life
- Clock stability $1 \times 10^{-13}$
- Signals: L1SF, L2SF, L1OF, L2OF (FDMA)
- Totally launched 81 satellites
- Real operational life time 4.5 years

2010

- 10 year design life;
- Clock stability $5 \times 10^{-14}$
- Signals L1SF, L2SF, L1OF, L2OF (FDMA)
- L3OC (CDMA) - test
  - Totally launched 28 satellites and going to launch about 11 satellite until to end 2012

2013

- 10 year design life;
- Clock stability $1 \times 10^{-14}$
- Signals L1SF, L2SF, L1OF, L2OF (FDMA)
- L1OC, L3OC, L1SC, L2SC (CDMA)
GLONASS Planning

- Full constellation deployment in 2010
- Ground Control Segment modernization
- New GLONASS-K satellite (with improved performance) IOV start by 2010
- GLONASS will continue transmitting existing FDMA signals
- Additional new CDMA signals since GLONASS-K deployment
- GLONASS performance competitive ability provision plan
- GLONASS Federal Program extension until 2020
The direction of GLONASS navigation signals modernization

- Provide better potential accuracy for pseudorange and phase measurements
- Provide a better interference and multipath resistance of GLONASS signals
- Provide of greater interoperability with GPS and future GALILEO and other GNSS

Introduction of new CDMA signals since GLONASS-K deployment
### GLONASS signals modernization

<table>
<thead>
<tr>
<th></th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L1, L2</th>
<th>Future</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
<td>«Glonass»</td>
<td>L1OF, L1SF</td>
<td>L2OF, L2SF</td>
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<tr>
<td>«Glonass-M»</td>
<td>L1OF, L1SF</td>
<td>L2OF, L2SF</td>
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<tr>
<td>«Glonass-K1»</td>
<td>L1OF, L1SF</td>
<td>L2OF, L2SF</td>
<td>L3OC test</td>
<td>-</td>
<td>From first test sat (2010 г.)</td>
<td>From first test sat (2010 г.)</td>
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<tr>
<td>«Glonass-K2»</td>
<td>L1OF, L1SF</td>
<td>L2OF, L2SF</td>
<td>L3OC</td>
<td>L1OC, L1SC, L2SC</td>
<td>From #3 sat Glonass-K</td>
<td>From #3 sat Glonass-K</td>
</tr>
</tbody>
</table>

- **FDMA signals**
- **CDMA signals**
Major positions of the GLONASS-2020 Concept

Sustainment, Development, Use

- **Sustainment**
  - *State commitments* on performance (constellation, availability, accuracy, stability of performance)
    - Launch program until 2020 with spares in-orbit and on the ground

- **Development**
  - Constellation improvement
  - New signals implementation
  - Accuracy and availability improvement
  - Interference protection improvement
  - New functions implementation
  - Service area widening

- **Use**
  - Governmental use support
  - Private activity encouraging
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Objectives

- GNSS monitoring
  - Integrity
  - Deep analysis in postprocessing
- Differential corrections
- Service area – Russian territory

Current status of monitoring stations

- Operational network
  - 12 stations in Russia
  - 1 station in Antarctic
- Future development
  - 8 stations more in Russia
  - 5 stations more outside
SSI-01 monitoring station installation and commissioning
(Bellingshausen, Antarctica, 2010)

Main view of the SSI-01

Off-site equipment

GLONASS/GPS antenna + Vaisala weather station

Satellite communication channel antenna
Envisaged locations for GEOs “Luch” with SDCM payload (2011-2013 timeframe)

- Luch-5A: 2011, 16° west
- Luch-5B: 2012, 95° east
- Luch-4: 2013, 167° east
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Summary

• GLONASS Program is the high priority of the Russian Government policy
• GLONASS Program is in a progress
• GLONASS improvement is a major objective:
  – Performance to be comparable with GPS by the end of 2011
  – Full constellation (24 sats) by the end of 2010
• GLONASS will continue
  – Keeping the GLONASS traditional frequency bands
  – Transmitting existing FDMA signals
  – Introducing new CDMA signals
• New GLONASS Program is under development
  – State commitments for major performance
  – GLONASS sustainment, development, use
• International cooperation – make GLONASS as one of key elements of the international GNSS
Thank you for your attention!