



GLONASS Status

Central Research Institute of Machine Building,
Information Satellite System - Reshetnev Company,
Russian Federal Space Agency

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РЕШЕТНЕВ

ОАО «ИСС»



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GLONASS Program



New Federal program for GLONASS 2012-2020 have approved

Program Goals:

- Mass introduction of domestic navigation technologies
 - Guaranteed provision of navigation services to meet continuously growing requirements of all categories of users
 - for the national security purposes
 - for social and economic benefit
 - for pursuing leadership in satellite navigation
- by means of
- Sustaining
 - Further development of GLONASS
 - improvement of performance ,
 - broadening functional capabilities
 - conditions and domains of usage
 - balanced evolution of system's components



- Program Approved
- Budget for 9 years defined
- RFPs opened



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Main GLONASS Program Directions



- **Constellation sustainment (24 sats with spares)**
 - Glonass-M launches up to 2014
 - Glonass-K launches since 2015
 - 24 satellites transmitting CDMA signals by 2020
- **GLONASS improvement**
 - Constellation (availability)
 - Accuracy of the core system
 - Augmentations development (accuracy, integrity, availability, assisting technologies...)
 - References improvement (geodesy, time, Earth rotation and attitude data...)
- **User segment development**
 - Governmental applications
 - Chips and chipsets, navigation maps
 - Encouraging commercial applications



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GLONASS Segments



GLONASS Space Complex (core)

- Open basic navigation service
- Authorized basic navigation service

SDCM

Ground based augmentations

- SBAS service
- Accuracy improvement
- Integrity

Precise Orbit and Clock Determination System

- Post processed data
- Real time data

Fundamental Segment

- Geodetic reference system
- System time scale steering to UTC
- Earth rotation and attitude parameters

User Segment

- Governmentally authorized users
- Civil users

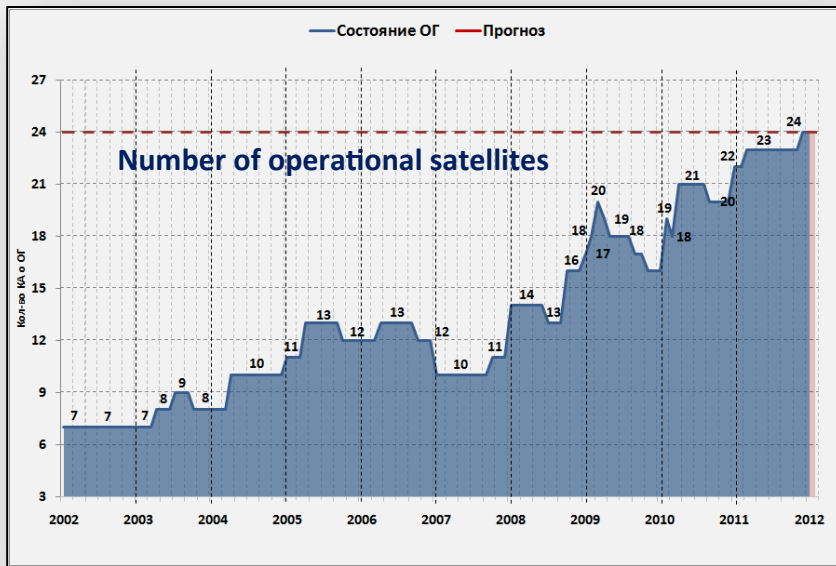


GLONASS 2002-2011 Program Results

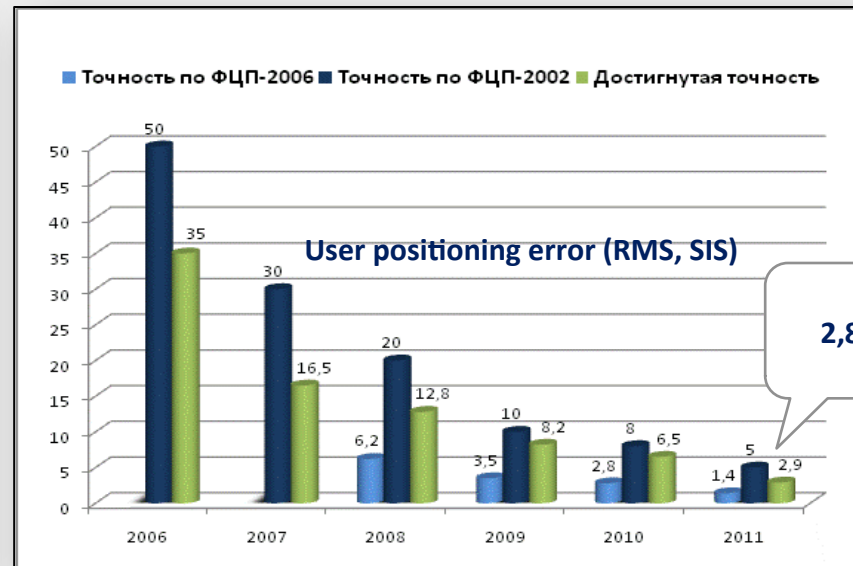


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Constellation recovery



Accuracy improvement



- **GLONASS recovered!**
- **GLONASS recognized worldwide!**
- **Performance is comparable to that of GPS!**
- **Open for cooperation!**

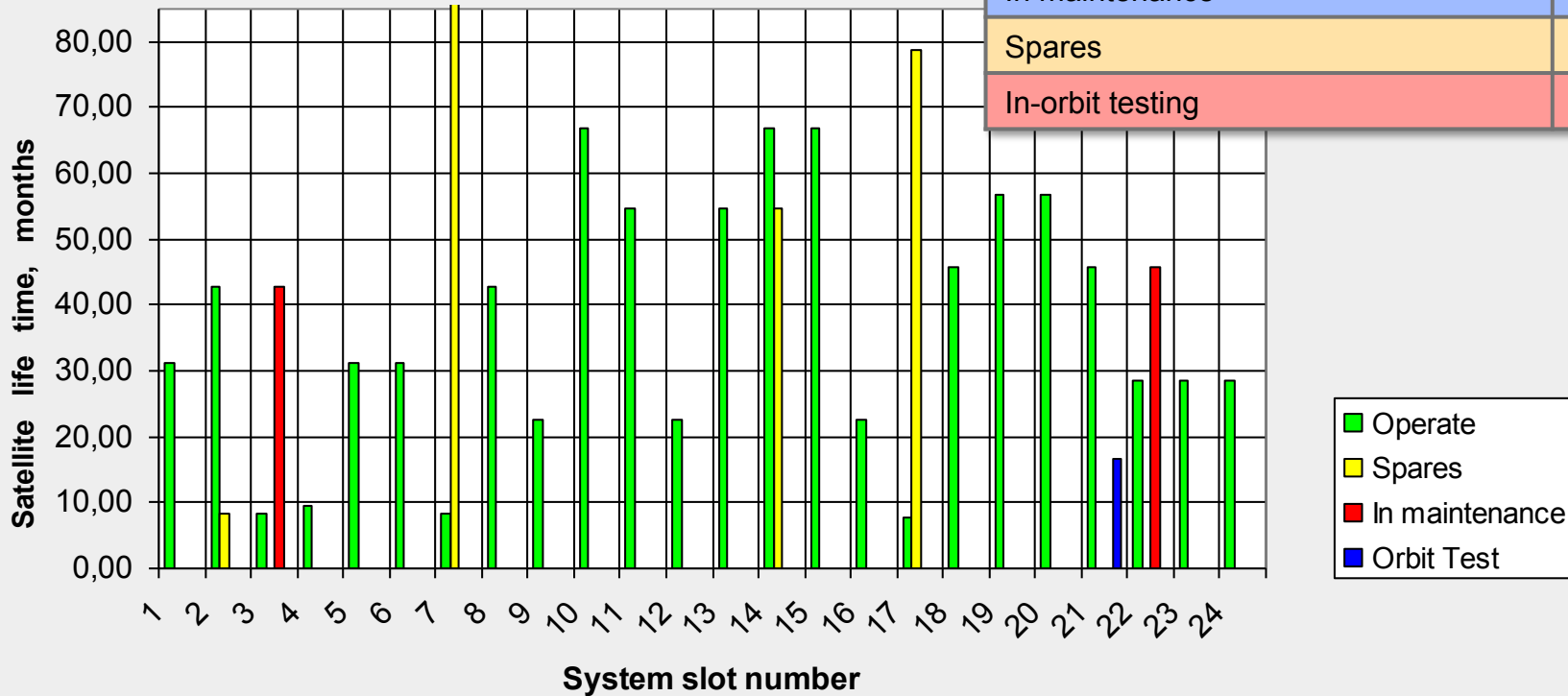


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GLONASS Constellation Status 18.07.2012



Total satellites in constellation	31 SV
Operational	24 SV
In commissioning phase	-
In maintenance	2 SV
Spares	4 SV
In-orbit testing	1 SV





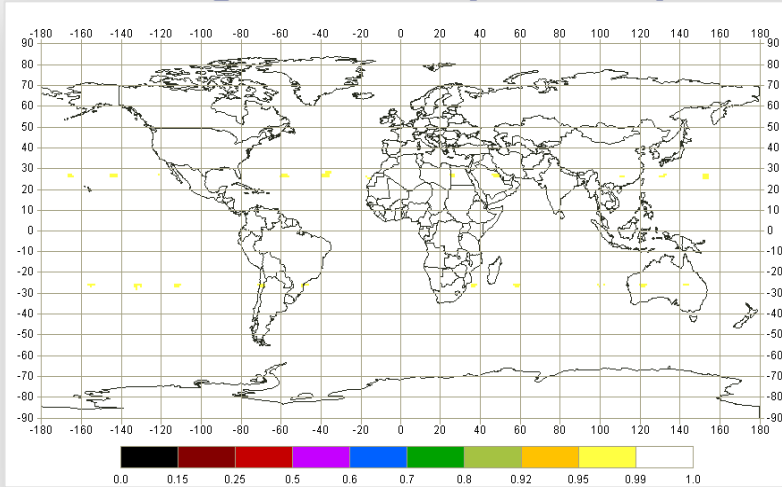
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GLONASS Performance



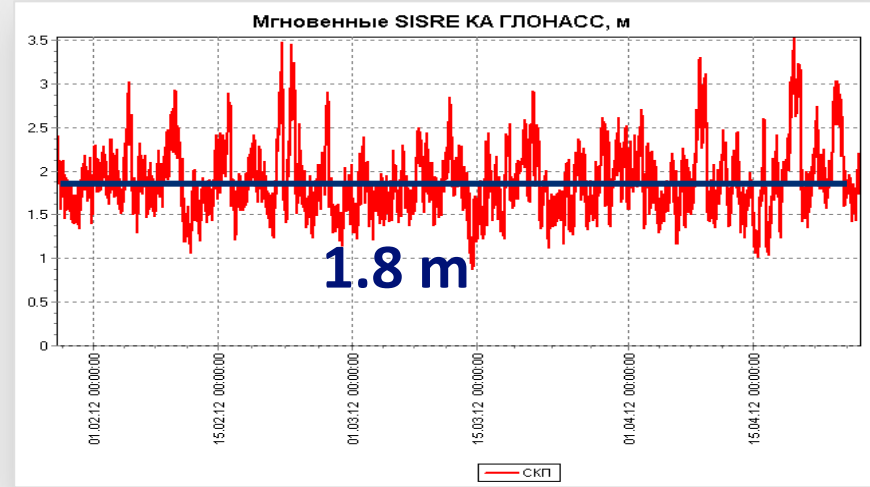
AVAILABILITY

Average availability for a day



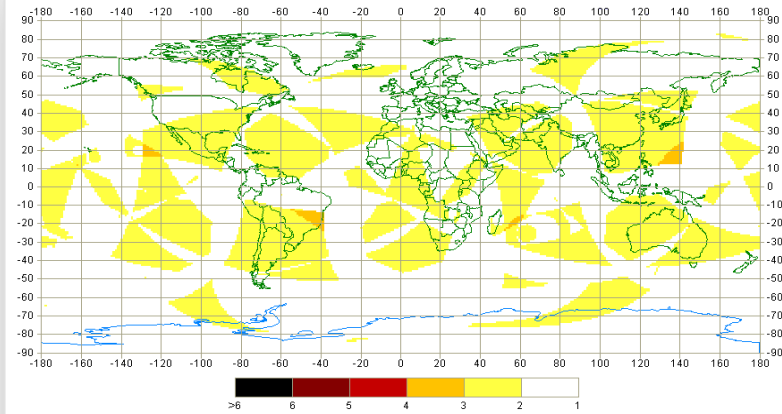
ACCURACY

Instant SISRE, m



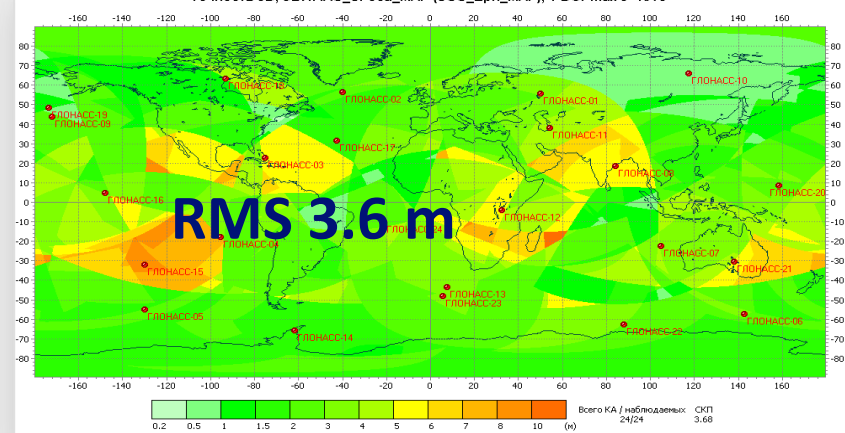
Instant availability (PDOP map)

Время: 10:27:38 04.05.2012 (декретное Московское время)



User position accuracy map (SIS)

Точность 3D, ЗВИ: IAC_SPЗси_MAP (SCC_Eph_MAP), PDOPmax 6 КА 5° 04.05.2012 07:25:41 UTC





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Constellation maintenance

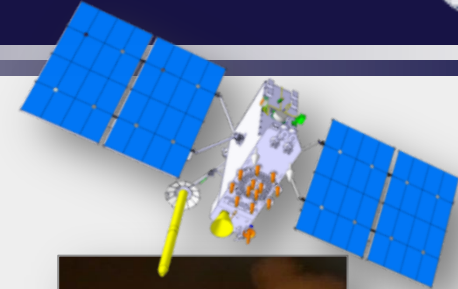


Launches in 2011:

- 26.02.2011 the first GLONASS-K launch (Flight test begins)
- 03.10.2011 – 1 SV GLONASS-M
- 04.11.2011 – 3 SV GLONASS-M
- 28.11.2011 – 1 SV GLONASS-M

Next launches:

- 1 GLONASS-K (test) autumn 2012
- 3 GLONASS-M in ground store and will be launch as necessary



03.10.2011



26.02.2011



28.11.2011



04.11.2011



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GLONASS Modernization

1982

2003

2011

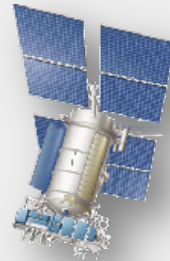
2014

“Glonass”



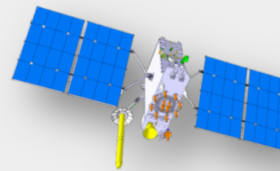
- 3 year design life
- Clock stability - $5 \cdot 10^{-13}$
- Signals: L1SF, L2SF, L1OF, (FDMA)
- Totally launched 81 satellites
- Real operational life time 4.5 years

“Glonass-M”



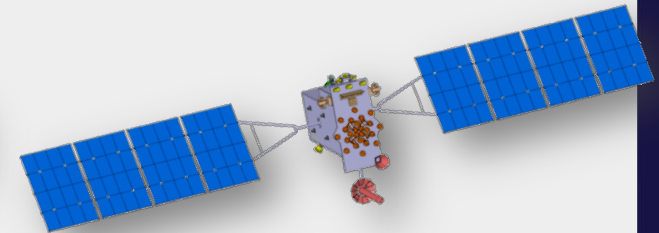
- 7 year design life
- Clock stability $1 \cdot 10^{-13}$
- Signals: Glonass + L2OF (FDMA)
- Totally launched 28 satellites and going to launch 8 satellite by the end 2012

“Glonass-K1”



- 10 year design life
- Unpressurized
- Expected clock stability $\sim 10 \dots 5 \cdot 10^{-14}$
- Signals: Glonass-M + L3OC (CDMA) – test
- SAR

“Glonass-K2”



- 10 year design life
- Unpressurized
- Expected clock stability $\sim 5 \dots 1 \cdot 10^{-14}$
- Signals: Glonass-M + L1OC, L3OC, L1SC, L2SC (CDMA)
- SAR



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Directions of GLONASS Signal Modernization



- **Improved accuracy of phase and range measurements**
- **Better interference protection and robustness**
- **Interoperability with GPS, Galileo and other GNSS**

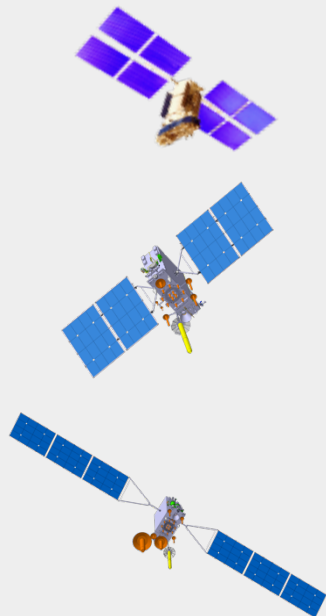
New CDMA signals introduced on Glonass-K

Keeping on transmitting the existing FDMA signals



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GLONASS navigation signals modernization



Satellite	FDMA signal		CDMA signal			Status
	L1	L2	L1	L2	L3	
“Glonass-M”	L1OF L1SF	L2OF L2SF	-	-	-	Done
“Glonass-K” I	L1OF L1SF	L2OF L2SF			L3OC	New L3 CDMA signal since 04/2011
“Glonass-K” II	L1OF L1SF	L2OF L2SF	L1OCd L1OCp L1SCd L1SCp	L2OCp L2SCd L2SCp	L3OCd L3OCp	ICD in develop.



POCKOCMOC

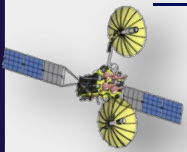
System of Differential Correction and Monitoring (SDCM)



Objectives

- GNSS monitoring
 - integrity
 - differential corrections
 - orbit and clock data
 - GNSS quality monitoring (GLONASS and GPS)
- Service area – Russian territory

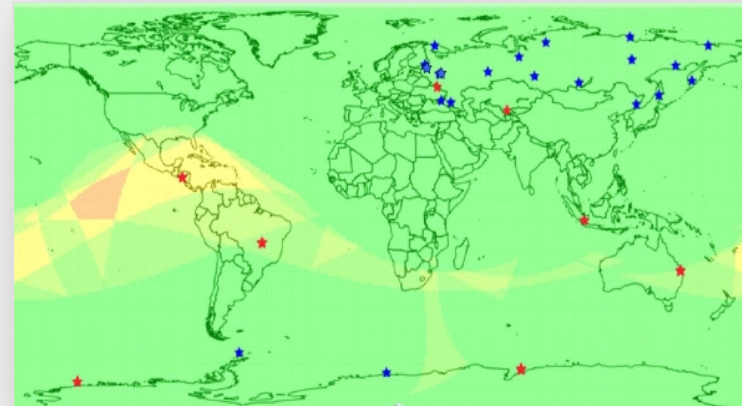
Broadcasting facilities



- 3 (+ 1) GEO sats
 - Luch 5A launched 11 Dec. 2011
 - Luch 5B – Oct. 2012
 - Luch 5V – Mar. 2014
- SiSnet server

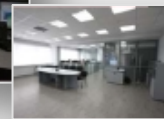
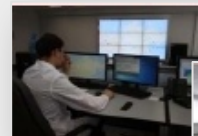
Reference stations network

- 19 stations in Russia
+up to 29 planned stations
- 6-8 stations abroad
+up to 53 planned stations



Central Processing Facilities

- Main (Moscow)
- Reserve (TBD)





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Summary



- First GLONASS Program completed
- GLONASS is full operable and provide global service
- GLONASS open service is free for all users in L1 , L2
- New GLONASS Program (2012 – 2020) approved 3 March 2012
- New CDMA signals have designed and first edition of ICD could be issued to the end of 2012
- International cooperation – to make GLONASS one of key elements of the international GNSS infrastructure for worldwide user benefits



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Thank you for your attention!

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