



ROSCOSMOS

GLONASS STATUS

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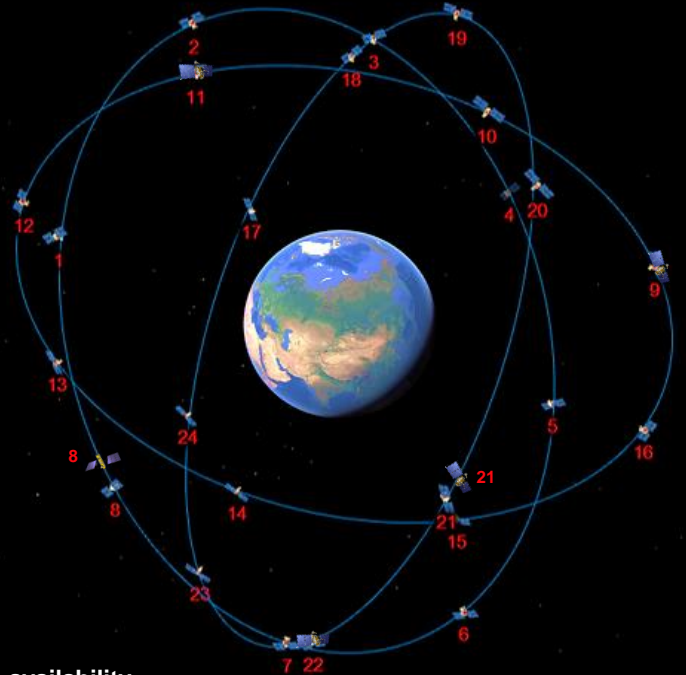
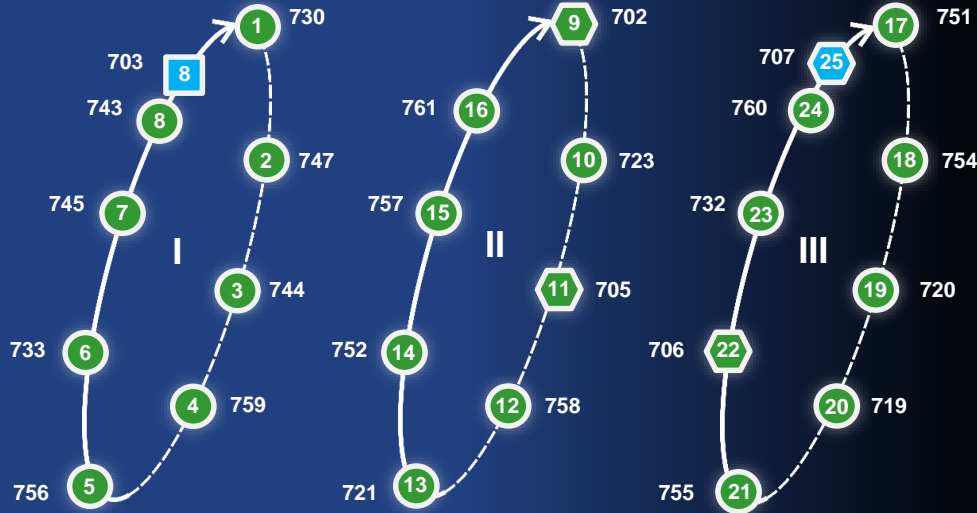
ROSCOSMOS STATE SPACE CORPORATION

The UN Workshop on the Applications of GNSS

April 22, 2024

GLONASS SPACE SEGMENT STATUS

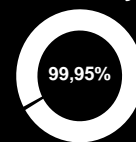
updated 20.03.2024



Σ 26 MEO satellites

- 24 operational
- 2 commissioning
- GLONASS-M batch 21
- ◡ GLONASS-K batch 4
- GLONASS-K2 batch 1

availability

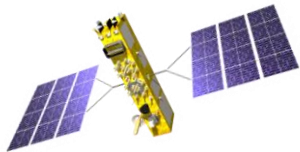


The constellation provides continuous global PNT service

Basic Service	Service of Improved Accuracy and Reliability	Relative Navigation Service	High-Accuracy Service
Infrastructure			
GLONASS	<ul style="list-style-type: none"> • System for Differential Correction and Monitoring/SDCM (SBAS) • GBAS stations 	Distributed network of base RTK-stations	System for High-Precision Definition of Ephemeris and Clock Corrections based on the analogue of PPP technology
Status			
Operational	Pre-operational (SBAS) Operational (GBAS)	Operational	Operational
Service Area			
Global (including up to 2000 km altitude of space volume)	Russia	Local service areas in Russia	Global
Broadcast Channels			
24 GLONASS satellites <ul style="list-style-type: none"> • L1OF, L2OF open signals • L1OC, L2OC, L3OC open signals as pre-operational 	<ul style="list-style-type: none"> • 2 LUCH GEO relay satellites (L1) • SISNET (access via Internet) • ground HF & UHF radio channels of GBAS stations (coverage radius up to 200 km) 	<ul style="list-style-type: none"> • ground radio channels of base stations (coverage radius up to 30 km) • Internet (access to post-processing information) 	Internet, including mobile communications
Provided information			
<ul style="list-style-type: none"> • Ephemeris and timing information • Global ionospheric model (L1OC, L3OC) 	<ul style="list-style-type: none"> • Real-time corrections for GLONASS & GPS • Integrity information • Ionospheric corrections (VTEC) 	Assistive real-time and post-processing OSR information (precise station coordinates, code and phase observations)	Precise absolute orbit & clock (SSR) real-time and post-processing corrections for all GNSS



The launch of the first GLONASS-K2 satellite in August 2023



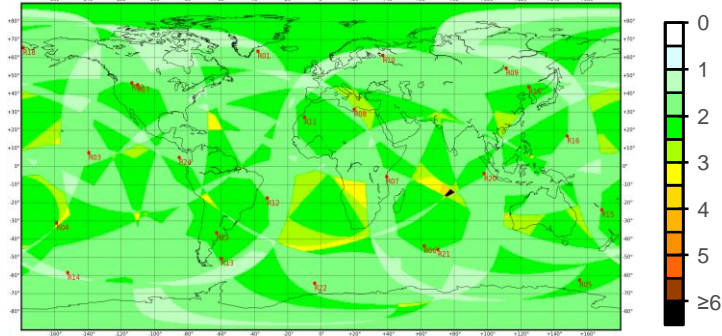
**The second
GLONASS-K2 satellite
is planned to be
launched in 2024**

	 GLONASS-M	 GLONASS-K	 GLONASS-K2
Planned quantity	-	10	15
Inter-Satellite Links	+	+	+
Clocks	Cs	Cs, Rb	H-maser, Cs, Rb
Open FDMA L1OF & L2OF	+	+	+
Open CDMA signal L3OC	+	+	+
	(6 satellites)		
Open CDMA L1OC & L2OC	-	-	+
COSPAS-SARSAT payload	-	+	+
Laser Retroreflectors	+	+	+

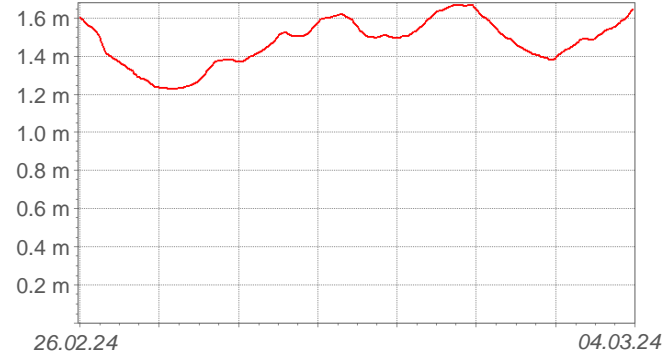
GLONASS BASIC SERVICE PERFORMANCE



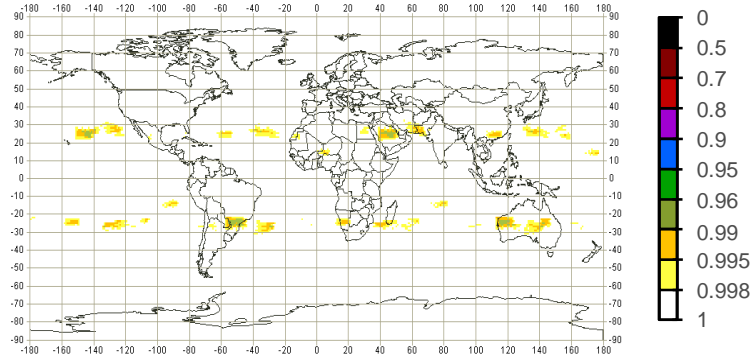
Global GLONASS PDOP
11.03.2024, IAC PNT assessments (elevation $\geq 5^\circ$)



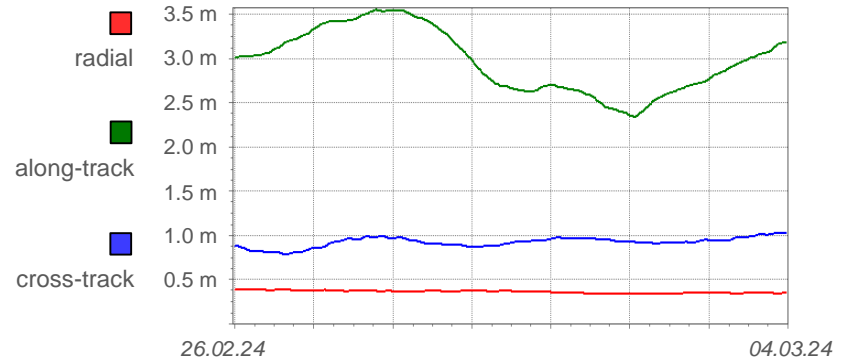
Daily GLONASS SISRE (RMS)
26.02.2024 – 04.03.2024, IAC PNT assessments



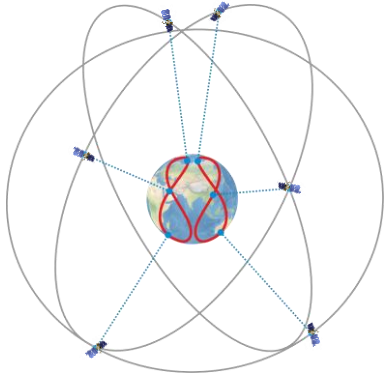
GLONASS Availability
11.03.2024, IAC PNT assessments (elevation $\geq 5^\circ$, PDOP < 6)



Daily GLONASS broadcast satellite ephemeris errors (RMS)
26.02.2024 – 04.03.2024, IAC PNT assessments



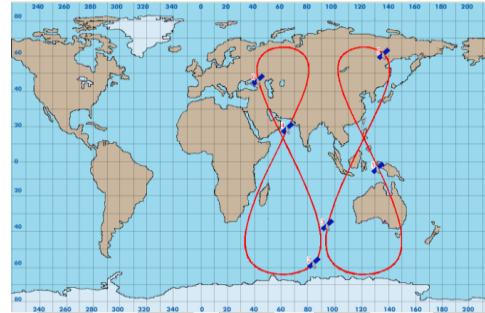
Planned Architecture



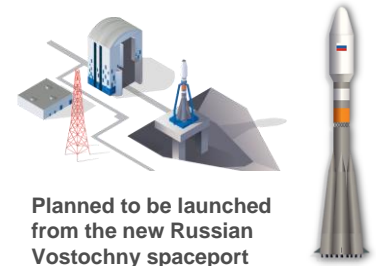
6 satellites in inclined geosynchronous orbits in 3 orbital planes

Orbit altitudes	34 000 – 38 000 km
Orbital inclination	64.8°
Semi-major axis	42 164.142 km
Orbital period	86 164 s
Eccentricity	0.072

Ground tracks of satellites



Launch vehicles:
Soyuz-2 family



Planned to be launched from the new Russian Vostochny spaceport

Signals & Services



L1OC & L2OC open signals as a complement to GLONASS MEO constellation signals to improve GLONASS Basic Service



L3SVI open signal to broadcast PPP corrections for all GNSS and integrity information to improve GLONASS High-Accuracy Service

Planned Results



Enhanced availability in difficult conditions for signal reception (elevation > 25°) by 15%



Increased availability in high latitudes, including Arctic region



Improved PDOP leads to 25% accuracy improvement in the Eastern hemisphere



Extended coverage zone and increased availability of GLONASS High-Accuracy Service



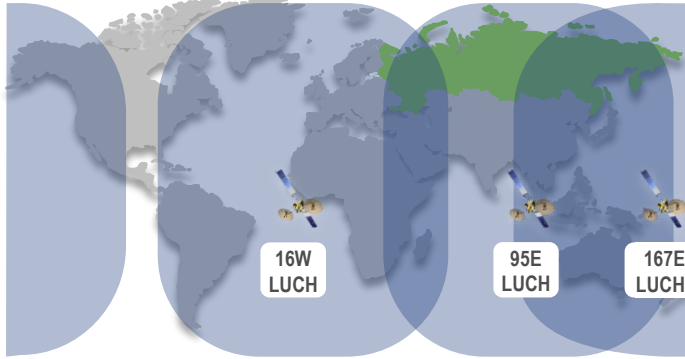
More reliable GLONASS High-Accuracy Service due to integrity



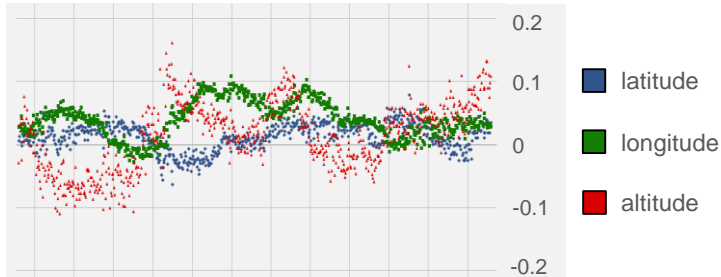
Ionospheric activity compensation in high latitudes with global ionospheric model in L1OC

GLONASS HIGH-ACCURACY SERVICE

Expected GLONASS L3SVI signal (1202.025 MHz) coverage based on LUCH GEO relay satellites


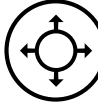






GLONASS High-Accuracy Service accuracy (m)



Static accuracy in each of 3 dimensions based on GLONASS + GPS + GLONASS High-Accuracy Service real-time solution is within 20 cm

(NPK SPP assessments. March 18-19, 2024)

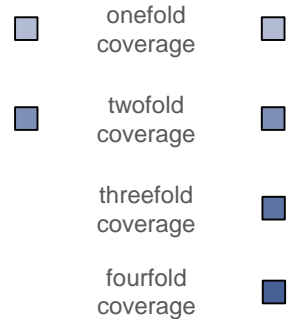
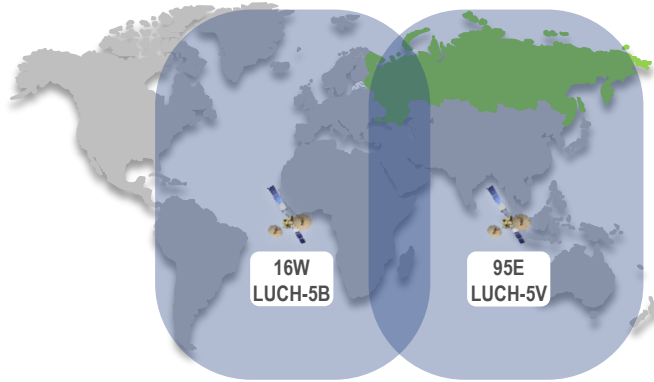
Service Levels	Basic Level	GEO Level	High-Orbit Level	Auxiliary Level
 Real-time corrections	orbit & clock corrections	orbit & clock corrections, code & phase biases	orbit & clock corrections, code & phase biases	ionospheric & tropospheric models
 Service Area	Global	Limitedly global	Limitedly global	Russia
 Broadcast Channels	Internet, mobile links	L3SVI signal by 3-5 GEO	L3SVI signal by High-Orbit GLONASS	TBD
 Augmented GNSS	All GNSS	GLONASS & GPS	All GNSS	-
 Service Integrity	-	-	+	-
 Realization Time	Already operational	2030+	2030+	TBD

SYSTEM FOR DIFFERENTIAL CORRECTION AND MONITORING

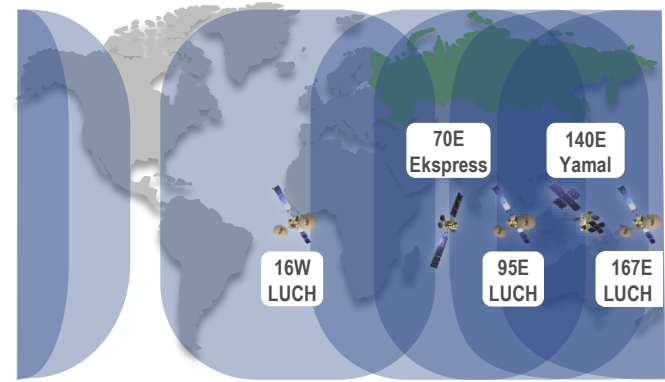







SDCM has successfully passed the preliminary certification tests in accordance with the requirements for typical approach operations with vertical guidance (APV-I and APV-II) and is pre-operational now

Approximate current L1 signal coverage zone based on LUCH GEO relay satellites

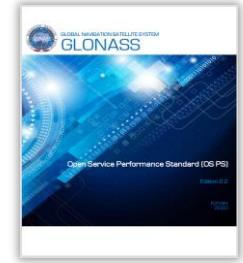


Approximate future L1/L5 signals coverage zone based on new LUCH GEO relay & other GEO satellites



	 Broadcast Channels	 Augmented GNSS	 Real-time corrections	 SBAS Integrity	 SBAS Authentication
SF SBAS	L1 signal by 2 GEO (5 GEO after 2030) + SISNET	GLONASS & GPS	SF corrections + VTEC	Integrity with alert time within 6 s	L1 authentication (after 2030)
DFMC SBAS after 2030	L5 signal by 5 GEO + SISNET	all GNSS	DF corrections	Integrity with alert time within 6 s	TBD

The Russian System for GLONASS Performance Monitoring and Verification is continuously collecting global observation data for real-time GLONASS characteristics assessment to confirm their correspondence to the guaranteed levels defined in GLONASS Open Service Performance Standard (edition 2.2) and ensure that GLONASS domestic and foreign civil users are provided with Basic (PNT) Service of proper quality



Applied User Center of Roscosmos State Space Corporation based on Information and Analysis Center for Positioning, Navigation and Timing is providing continuous online information support to GLONASS domestic and foreign civil users in accordance with the principle of transparency



Assessed characteristics of GLONASS and other GNSS



Updated GLONASS constellation status, health and almanac



Notice Advisory to GLONASS Users

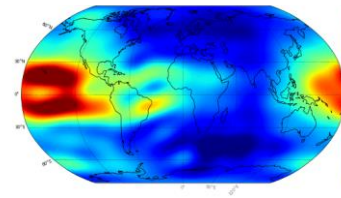


Links to GLONASS formal documents (Interface Control Documents and Open Service Performance Standard)



Global ionospheric map by IAC PNT and results of experiments on GNSS monitoring & assessment

<https://www.glonass-iac.ru>



Global ionospheric map by IAC PNT (for 05.03.2024 in TECu)



Web-site is available in Russian, Chinese, English, German & Spanish languages



GLONASS Basic (PNT) Service is provided unlimitedly, free of charge and with global guaranteed unselective availability. This policy facilitates equality of all nations' access to the satellite navigation benefits and supports developing countries

GLONASS civil services contribute to the following Sustainable Development Goals



Zero hunger



Decent work &
economic
growth



Industry,
innovation &
infrastructure



Sustainable
cities &
communities



Responsible
consumption &
production



Climate action



Life below
water



Life on land

Roscosmos State Space Corporation develops GLONASS civil services for the benefit of all mankind

Further bilateral and multilateral cooperation in satellite navigation is an utmost priority

Joint search for solutions of issues and new capabilities within bilateral and multilateral cooperation facilitates enhancing the quality of navigation for users globally



ROSCOSMOS

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