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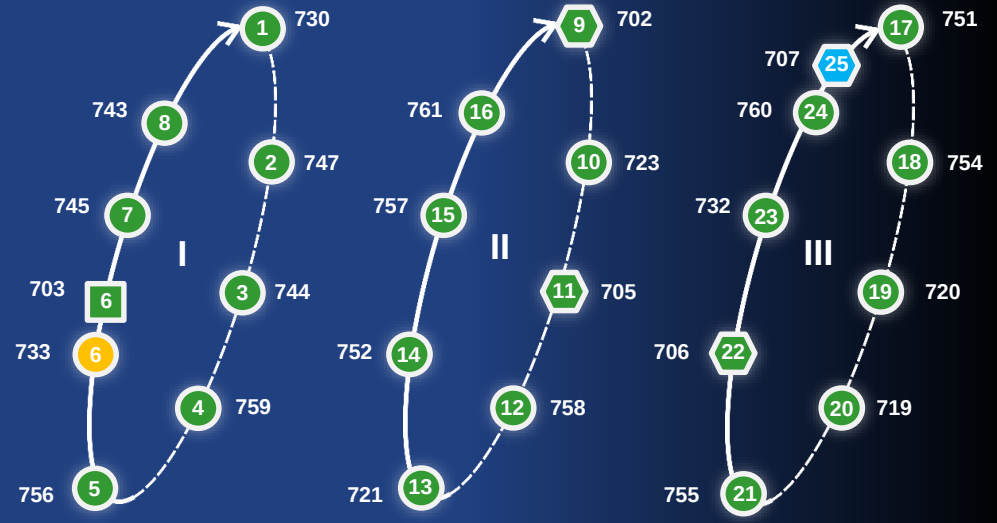
GLONASS STATUS AND PLANS OF DEVELOPMENT

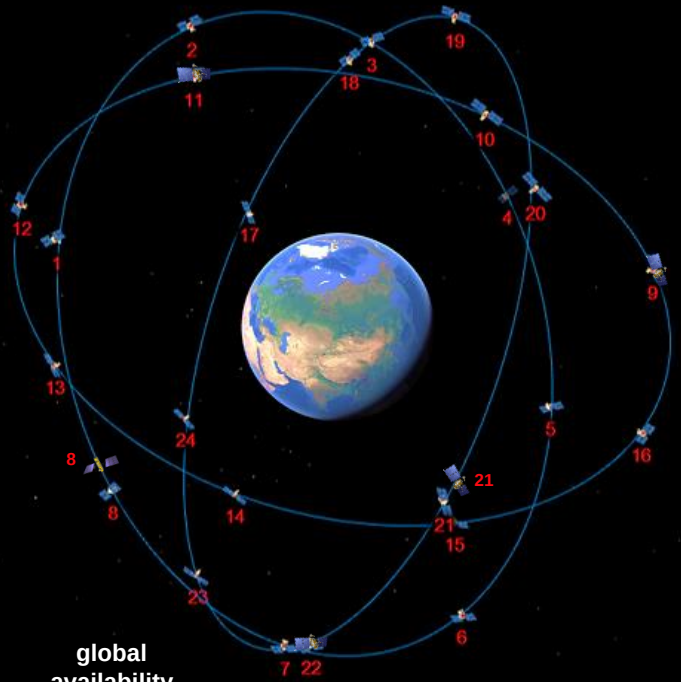
ROSCOSMOS STATE SPACE CORPORATION

Training on Global Navigation Satellite Systems
January 28, 2025

GLONASS SPACE SEGMENT STATUS

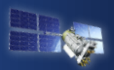
updated 27.01.2025



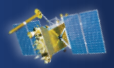


26 MEO satellites

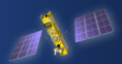
24	1	1
operational	commissioning	spares



GLONASS-M batch 21



GLONASS-K batch 4



GLONASS-K2 batch 1

global availability

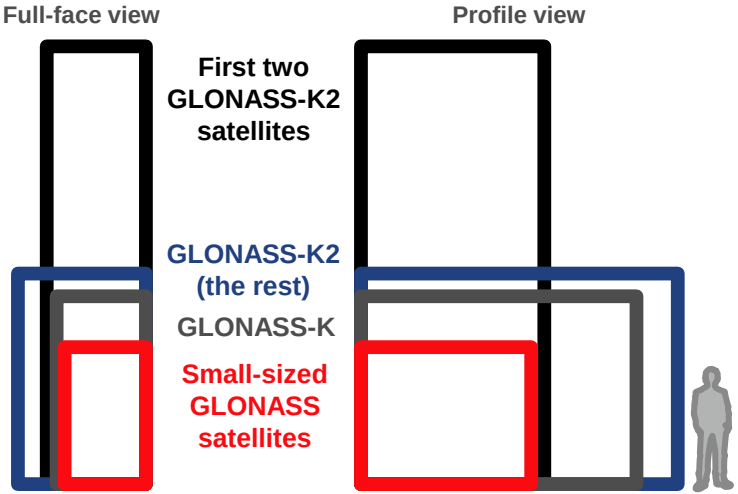
The constellation provides continuous global PNT service

GLONASS CIVIL SERVICES

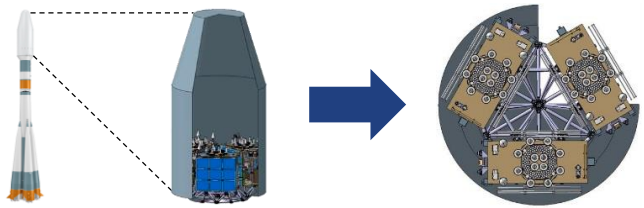
Basic Service	Service of Improved Accuracy and Reliability	Relative Navigation Service	High-Accuracy Service
Infrastructure			
GLONASS	• System for Differential Correction and Monitoring/SDCM (SBAS) based on the network of **53** measurement stations (CORS) • GBAS stations of **169** airports and **68** ports	**549** ground base RTK-stations (up to 1114 stations by 2030)	System for High-Precision Definition of Ephemeris and Clock Corrections based on the network of **40** measurement stations (CORS)
Service Area			
Global	Russia	Local service areas in Russia	Global (to be assured)
Broadcast Channels			
24 GLONASS satellites • L1OF, L2OF open signals • L1OC, L2OC, L3OC open signals as pre-operational	• 2 LUCH GEO relay satellites (SDCM) • SISNET (access via Internet) • HF & UHF radio channels of GBAS stations (coverage up to 200 km)	• ground radio channels of base stations (coverage up to 30 km) • Internet (access to post-processed corrections)	Internet, including mobile communications
Provided information			
• Ephemeris and timing information • Global ionospheric model (L1OC, L3OC)	• Real-time corrections and integrity information for GLONASS & GPS • Ionospheric corrections (VTEC)	Assistive real-time and post-processed OSR information (precise station coordinates, code and phase observations)	Precise absolute orbit & clock (SSR) real-time and post-processed PPP corrections for all GNSS

GLONASS SATELLITES

Size comparison of GLONASS satellite batches
(at launch)



Option for launching 3 small-sized GLONASS satellites by 1 Soyuz-2.1b launch vehicle



	GLONASS-K	GLONASS-K2	Small-sized GLONASS
Planned Launches	**6 satellites during 2025-2026**	**14 satellites during 2025-2030** The launch of 2 satellites by 1 Angara-A5 launch vehicle is considered	**12 satellites during 2030-2035** The launch of 3 satellites by 1 Soyuz-2 family launch vehicle
Onboard clock stability	1×10^{-13} - 5×10^{-14} s	1×10^{-14} - 5×10^{-15} s	5×10^{-15} s
Onboard frequency standards	Cs, Rb	First two satellites: Cs, Rb, H-maser The rest: 2 Cs, H-maser	H-maser
Launch mass	1 060 kg	1 683 kg	550 kg
Open CDMA signals	L3OC	L1OC, L2OC, L3OC	L1OC, L2OC, L3OC
Inter-satellite links	+	+	+

GLONASS constellation renewal with small-sized satellites will make L1OC and L2OC open signals operational since 2035

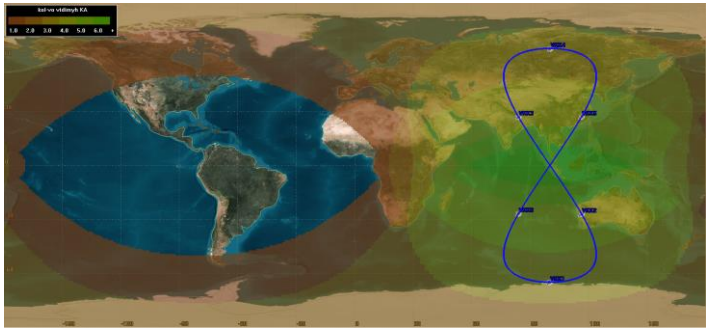
HIGH-ORBIT GLONASS SPACE COMPLEX

Planned Architecture

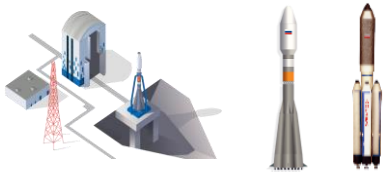
Six satellites in six circular orbits

Orbit altitudes	38 000 km
Orbital inclination	64.8°
Orbital period	86 164 s
Eccentricity	~ 0

Ground track and coverage



Launch vehicles: Soyuz-2 and Angara families



1 or 2 satellites at a time planned to be launched since 2030

Signals & Services

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

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

Planned Results

Enhanced availability in limited conditions for signal reception (elevation > 25°) by 20%

Increased availability in high latitudes, including Artic and Antarctic regions

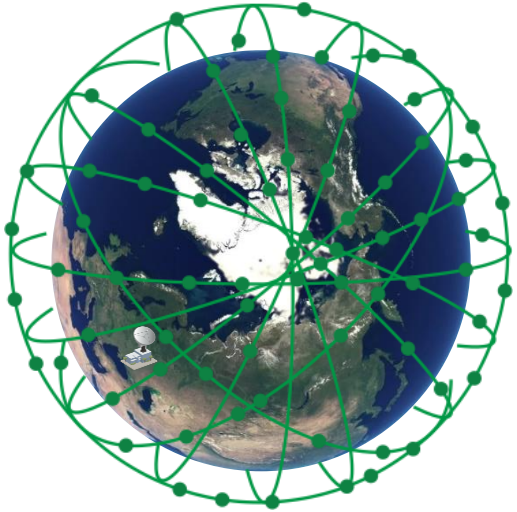
Improved PDOP leads to 29% accuracy improvement in the Eastern hemisphere

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

LOW-ORBIT GLONASS SPACE COMPLEX



240 satellites in low Earth circular orbits in 20 orbital planes

Orbit altitudes	800 km
Orbital inclination	64° - 72°
Eccentricity	~ 0

By 2030 two demo satellites are planned to be manufactured and launched to LEO

Prospective vision of the LEO satellite

- A new navigation signal in L-band
- An auxiliary navigation signal in Ku-band is considered
- Onboard GLONASS receivers in L1/L2/L3 bands
- A new technology of precise orbit determination
- Small mass (around 300 kg) and relatively short active lifetime (5 years)

Planned Results

Enhanced accuracy and the increase in global availability in limited conditions up to 100%

Increased signal power on ground and improved robustness

Continuous global monitoring of GLONASS signals

Rapid pace of production and in-orbit deployment

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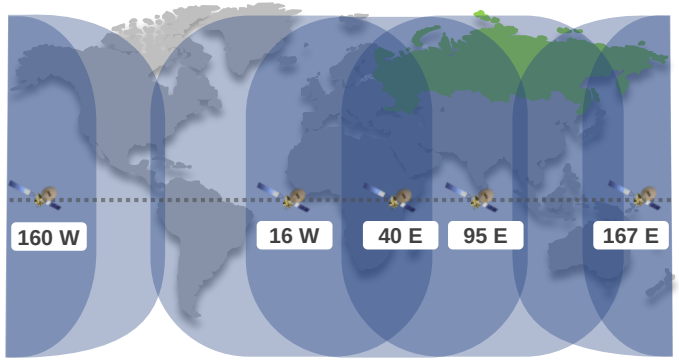
GLONASS DEVELOPMENT DIRECTIONS

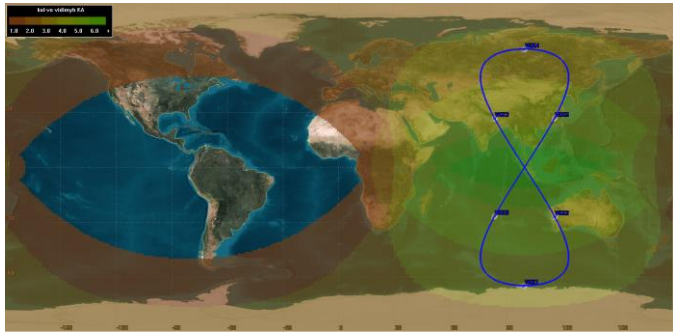
Major results of GLONASS modernization efforts	GLONASS-K2 Launches	High-Orbit GLONASS	Small-sized Satellites	Low-Orbit GLONASS
Improved GLONASS SIS Ranging Error	✓		✓	✓
Increased pace of GLONASS constellation replenishment			✓	✓
Enhanced availability in limited conditions for signal reception		✓		✓
Improved interference robustness				✓
Enhanced High-Accuracy Service performance		✓		

GLONASS HIGH-ACCURACY SERVICE

Approximate expected L3SVI signal coverage based on GEO satellites

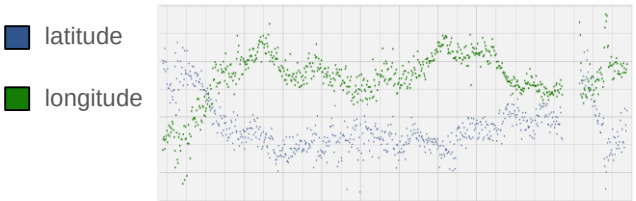


Approximate expected L3SVI signal coverage based on High-Orbit GLONASS



Service Levels	Basic Level	GEO Level (after 2030)	High-Orbit Level (after 2030)
Real-time Corrections	orbit & clock corrections	orbit & clock corrections, code & phase biases	orbit & clock corrections, code & phase biases, ionospheric corrections
Broadcast channels	Internet, mobile links	L3SVI signal (1202.025 MHz) by 5 GEO	L3SVI signal (1202.025 MHz) by High-Orbit GLONASS
Augmented GNSS	All GNSS	GLONASS & GPS	All GNSS
Service Integrity	-	-	+

GLONASS High-Accuracy Service accuracy (13-14.01.2025)

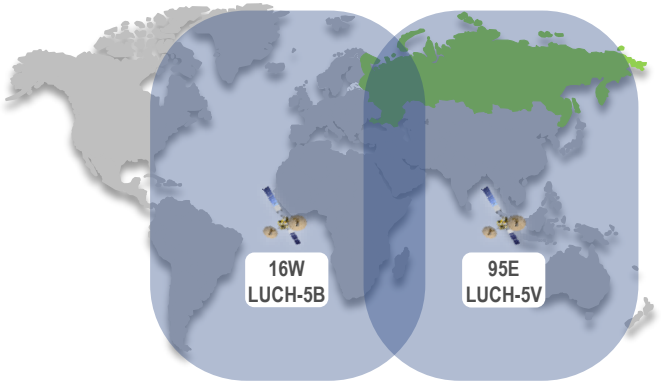


Static accuracy of GLONASS High-Accuracy Service (real-time dual-constellation solution) is within 10 cm (JSC “RPC “PSI” assessments)

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



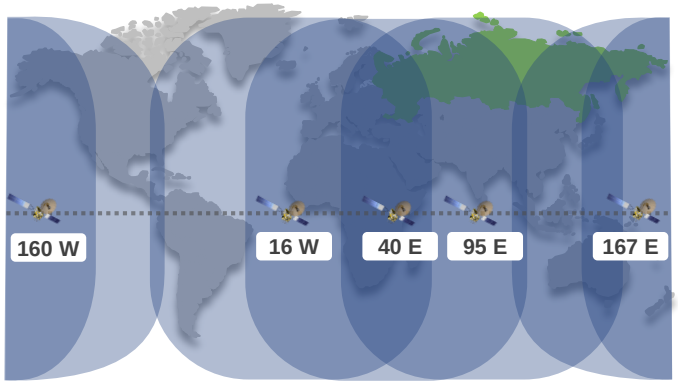
onefold coverage

twofold coverage

threefold coverage

fourfold coverage

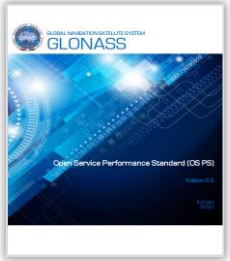
Approximate future L1/L5 signals coverage zone based on new GEO satellites



	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

GLONASS PERFORMANCE AND USER INFORMATION SUPPORT

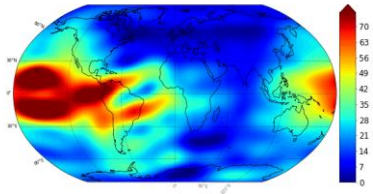
The Russian System for GLONASS Performance Monitoring and Verification is continuously collecting global observation data for real-time GLONASS characteristics assessment to confirm their correspondence to the guaranteed levels defined in GLONASS Open Service Performance Standard (edition 2.2) and ensure 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

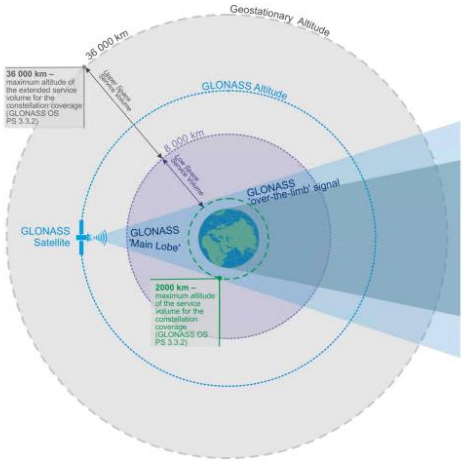
https://www.glonass-iac.ru



Global ionospheric map
by IAC PNT
(for 11.01.2025 in TECu)

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

NEW GLONASS SYSTEM DOCUMENTS

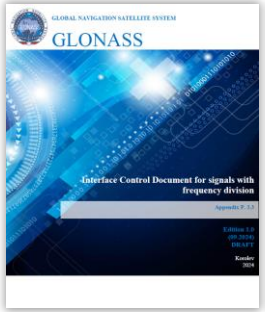


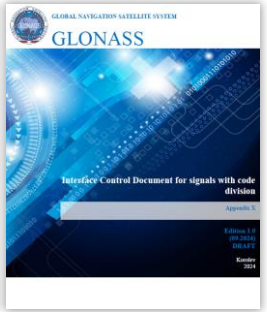
GLONASS space service volume (SSV)

New appendices to **GLONASS ICDs** for FDMA and CDMA signals have been developed and released.

These appendices contain a new model recommended for **tropospheric delay compensation**.

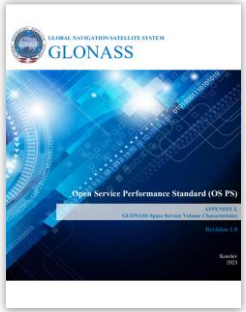
GLONASS user positioning accuracy can be improved with the help of this model used in navigation receiver.

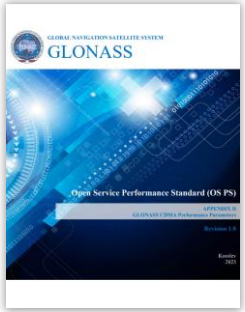




https://www.glonass-iac.ru

The appendices to Open Service Performance Standard are already available **on the web-site**. The appendices to ICDs will be also available there soon.





New appendices to **GLONASS Open Service Performance Standard** have been also developed and released.

Appendix D describes features and threshold values of GLONASS characteristics related to **CDMA signals**.

Appendix E introduces GLONASS characteristics for **extended space service volume** (2 – 36 thousand km) that is divided into low-orbit SSV (2 – 8 thousand km) and high-orbit SSV (8 – 36 thousand km).

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MAJOR CURRENT GLONASS APPLICATIONS IN RUSSIAN DIGITAL ECONOMY

Energy grid and telecom networks synchronization

Accident emergency response and smart insurance

Systems for fishing vessels monitoring and in-port maneuvering

Systems and machinery for precise agriculture

Railroad monitoring and control systems

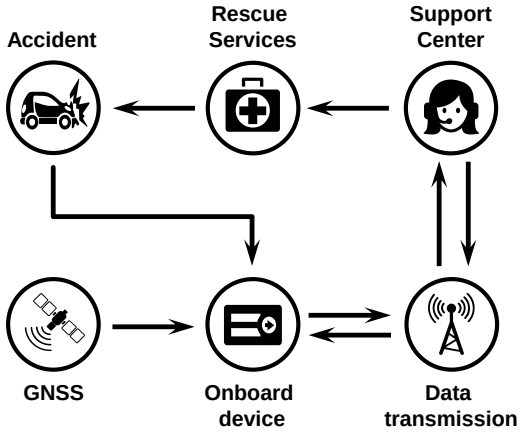
Unmanned aerial vehicles for industry and logistics

Systems for deformation monitoring of buildings and infrastructure

Self-driving and autonomous cars & trucks

Toll and fleet monitoring and control systems

GLONASS APPLICATIONS: RUSSIAN ERA-GLONASS SYSTEM



New services are provided based on ERA-GLONASS infrastructure as well as GLONASS and other GNSS:

- smart tracker-based insurance
- transport monitoring and control (over 300 thousand fleet/railroad objects monitored)
- monitoring and control of drones and aviation
- deployment of IoT systems
- indoor navigation

ЭРА-ГЛОНАСС

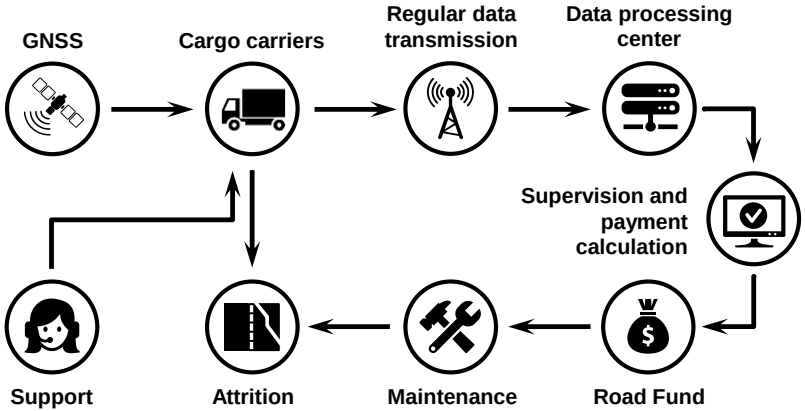
- Russian accident emergency response system based on GLONASS and other GNSS
- Operational since 2015
- A system's onboard device conveys precise vehicle position, accident time and other data either manually or automatically in case of an accident
- All new road vehicles are equipped with ERA-GLONASS onboard devices since 2017
- Accident response time of emergency services is reduced by 30%
- More than 4 thousand lives are saved annually

As of January 2025:

- over **11.99 million** onboard devices equipped and connected
- more than **434 thousand** distress calls received and relayed to emergency services
- **19 seconds** – average time to process emergency call and convey relevant information to emergency services
- **80% of emergency calls**, which turned out to need response from emergency services, were automatically sent
- the system is operating in **85 Russian regions**

Information source – the website of JSC GLONASS, national ERA-GLONASS provider: https://aoglonass.ru

GLONASS APPLICATIONS: RUSSIAN PLATON SYSTEM

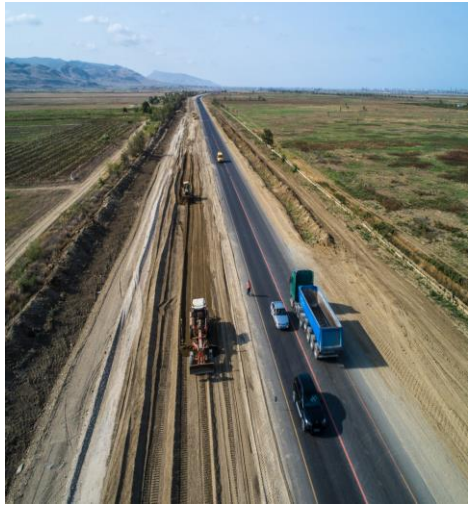


As of December 2025:

- **2.67 million** onboard devices equipped
- **1 912 231** vehicles and around **860 thousand** cargo carrier companies registered
- Approximately **311 billion Russian rubles** (circa **3 billion US dollars**) are raised for Russian Road Fund
- **130 bridges** in 44 Russian regions as well as **3300 km of highways** are repaired with the help of PLATON tolls

ПЛАТОН
система взимания платы

- PLATON is a Russian system for automatic toll collection based on **GLONASS/GPS**
- Operational since 2015
- All cargo vehicles weighing over 12 tons are equipped with onboard devices of the system
- All federal highways and roads – **50 774 km** in total



Information source – PLATON system website: https://platon.ru

GLONASS ROLE FOR SUSTAINABLE DEVELOPMENT

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

AREAS OF FURTHER COOPERATION

Roscosmos State Space Corporation is open to intensified mutually beneficial and advantageous international cooperation with like-minded nations in satellite navigation and adjacent fields

- Deployment of ground GNSS observation infrastructure and local ground stations for GNSS correction to use in various industries
- Joint monitoring and assessment of GNSS performance and information support for the benefit of civil users
- Provision of GLONASS High-Accuracy Service to ensure real-time decimeter-level positioning independent from the coverage of ground stations
- Cooperation in space geodesy, enhancement of reference frames and EOP definition as well as ionospheric delay monitoring and assessment
- GNSS applications in various industries, especially related to transport monitoring, fleet management and emergency systems

DEPARTMENT OF AUTOMATIC SPACE COMPLEXES & SYSTEMS OF DUAL AND SPECIAL USE
ROSCOSMOS State Space Corporation
42, Schepkina street., Moscow, 107996
Tel.: +7 (495) 631-90-00
info@roscosmos.ru; www.roscosmos.ru