



ROSCOSMOS

GLONASS SYSTEM DEVELOPMENT AND USE

ICG-13, XĪ'ĀN, CHINA

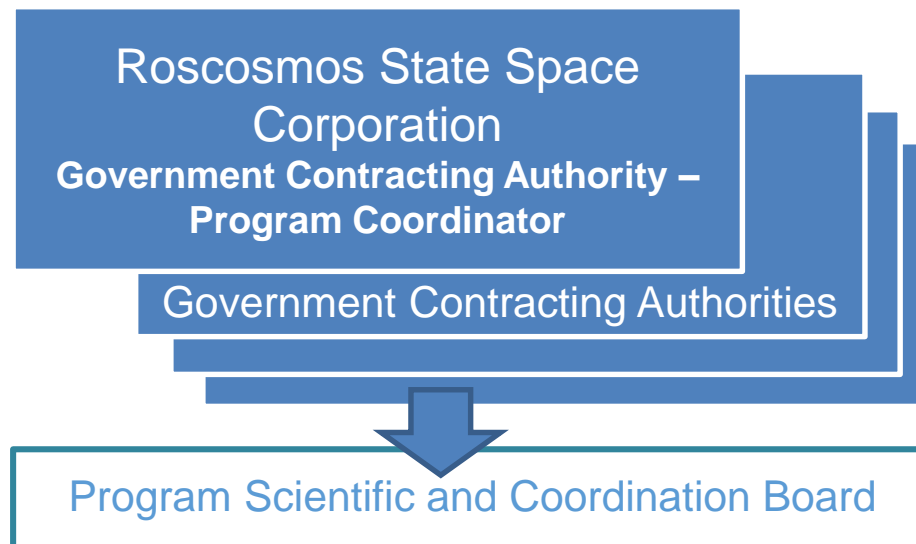
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NATIONAL SATELLITE NAVIGATION POLICY AND ORGANIZATION

- ❑ Presidential Decree of May 17, 2007 No. 638 On Use of GLONASS (Global Navigation Satellite System) for the Benefit of Social and Economic Development of the Russian Federation
- ❑ Federal Program on GLONASS Sustainment, Development and Use for 2012-2020 – planning and budgeting instrument for GLONASS development and use
- ❑ Budget planning for the forthcoming decade – up to 2030

GLONASS Program governance:



GLONASS Program Goals:

- ❑ Improving GLONASS performance – its accuracy and integrity
- ❑ Ensuring positioning, navigation and timing solutions in restricted visibility of satellites, interference and jamming conditions
- ❑ Enhancing current application efficiency and broadening application domains



Accuracy Improvement by means of:

- Ground Segment modernization
- introduction of new onboard atomic frequency standards with enhanced performance
- introduction of advanced satellite control and command, orbit and clock determination technologies based on intersatellite crosslinks in RF and optical bands
- transition to PZ-90.11 Geodetic System aligned to the ITRF with mm error level
- synchronization of GLONASS Time Scale with UTC(SU) at less than 2 ns





GLONASS STATUS (AS OF 05.11.2018)

GEO satellites

In total	3 SV
Operational	2 SV
Maintenance	1 SV



MEO satellites

In total	27
Operational	24 
Under Commissioning	1 
Maintenance	1 
Flight testing	1 



AUGMENTATIONS of ROSCOSMOS
39 stations in Russia
11 stations abroad



REGIONAL AND MUNICIPAL AUGMENTATION STATION NETWORKS
Over 4181 stations

GROUND CONTROL COMPLEX

- System Control Center
- One-way Reference Stations
- Uplink Stations
- Laser Ranging Stations

FUNDAMENTAL FACILITIES

- 3 Telescopes (32 m)
- 2 Telescopes (7 m)
- 3 Correlators
- 1 Cold-atom Optical Frequency Reference
- 50 Astronomic and Geodetic Network Stations

The constellation provides global continuous navigation

Glonass-M satellites launches

- 2 Glonass-M satellites were launched in 2016 (February 7th and May 29th)
- 1 Glonass-M satellite was launched in 2017 (September 22nd)
- 1 Glonass-M satellite was launched 17rd of June 2018
- **1 Glonass-M satellite was launched 3rd of November 2018**

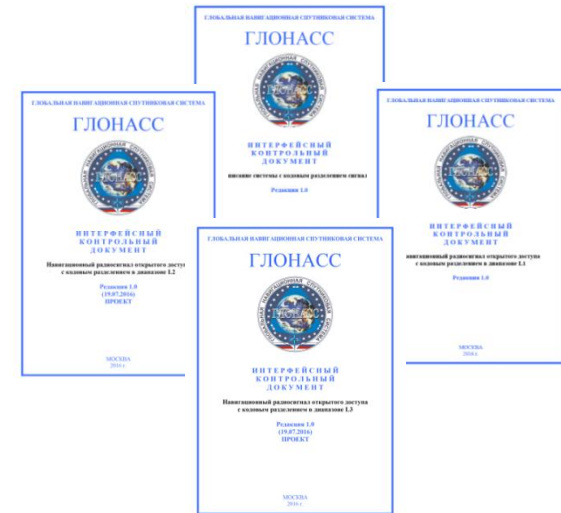


Glonass-M Launch
on 3rd of November 2018

GLONASS INTERFACE CONTROL DOCUMENTS

Released at <http://russianspacesystems.ru>

- Interface Control Document “General Description of the GLObal NAVigation Satellite System with the Code Division Multiple Access Signals”
- Interface Control Document “GLONASS L1 Open Service Code Division Multiple Access Signal”
- Interface Control Document “GLONASS L2 Open Service Code Division Multiple Access Signal”
- Interface Control Document “GLONASS L3 Open Service Code Division Multiple Access Signal”



Type of difference	FDMA signal reference documents	CDMA signal reference documents
Variable number of SVs	0 to 24	0 to 63
Message structure	Fixed structure “superframe/frame/string”	Continuous sequence of strings, non-fixed length, variable composition depending on the number of operational SVs, types of strings can be added, backward compatibility with receivers currently in use
Time stamp length	30 bits	12 bits
Value of LSB	0.4 m	0.001 m
Signal health status periodicity	1 per 4 sec	1 per 2 sec for L1 and L2 1 per 3 sec for L3

GLONASS AUGMENTATIONS

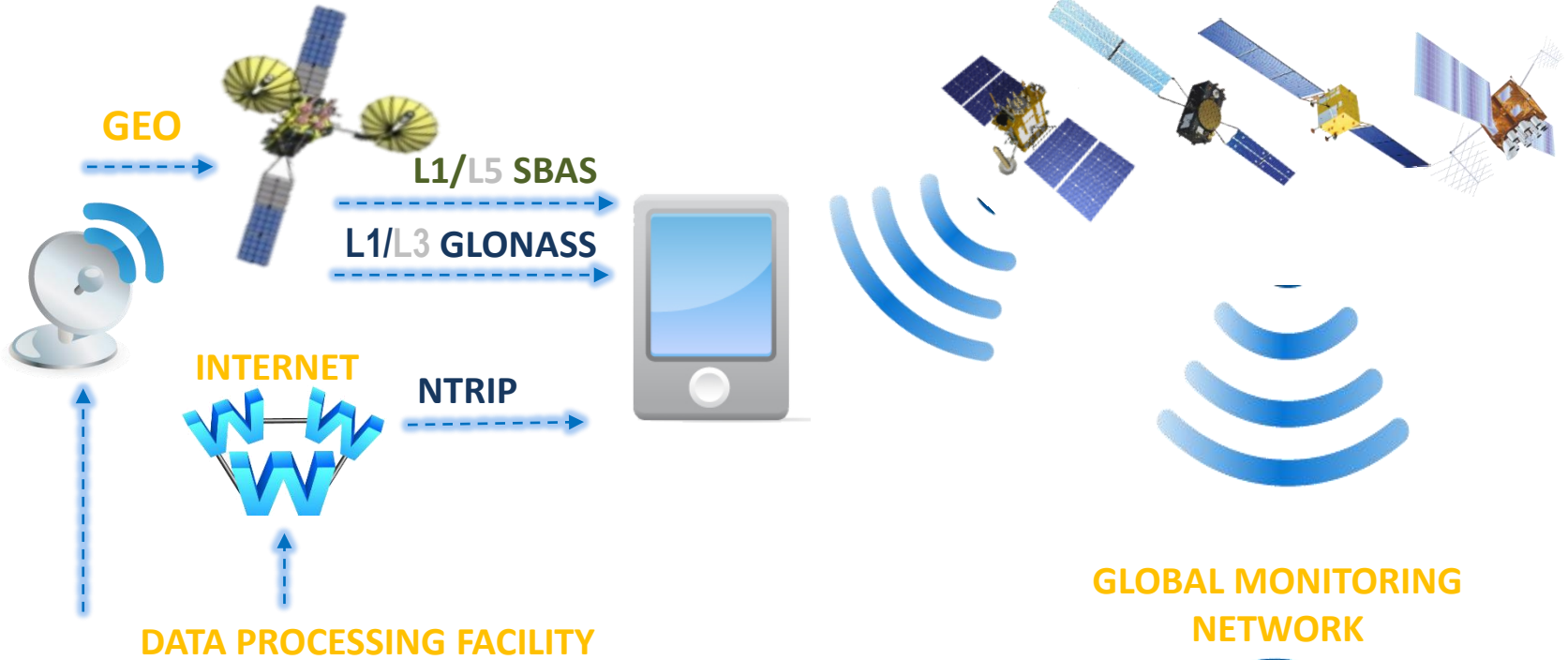
- All types of augmentations to support all types of high accuracy services developed and continue to expand



- network densification
- space segment modernization
- coverage extension

BROADCASTING FACILITIES

GNSS CONSTELLATION

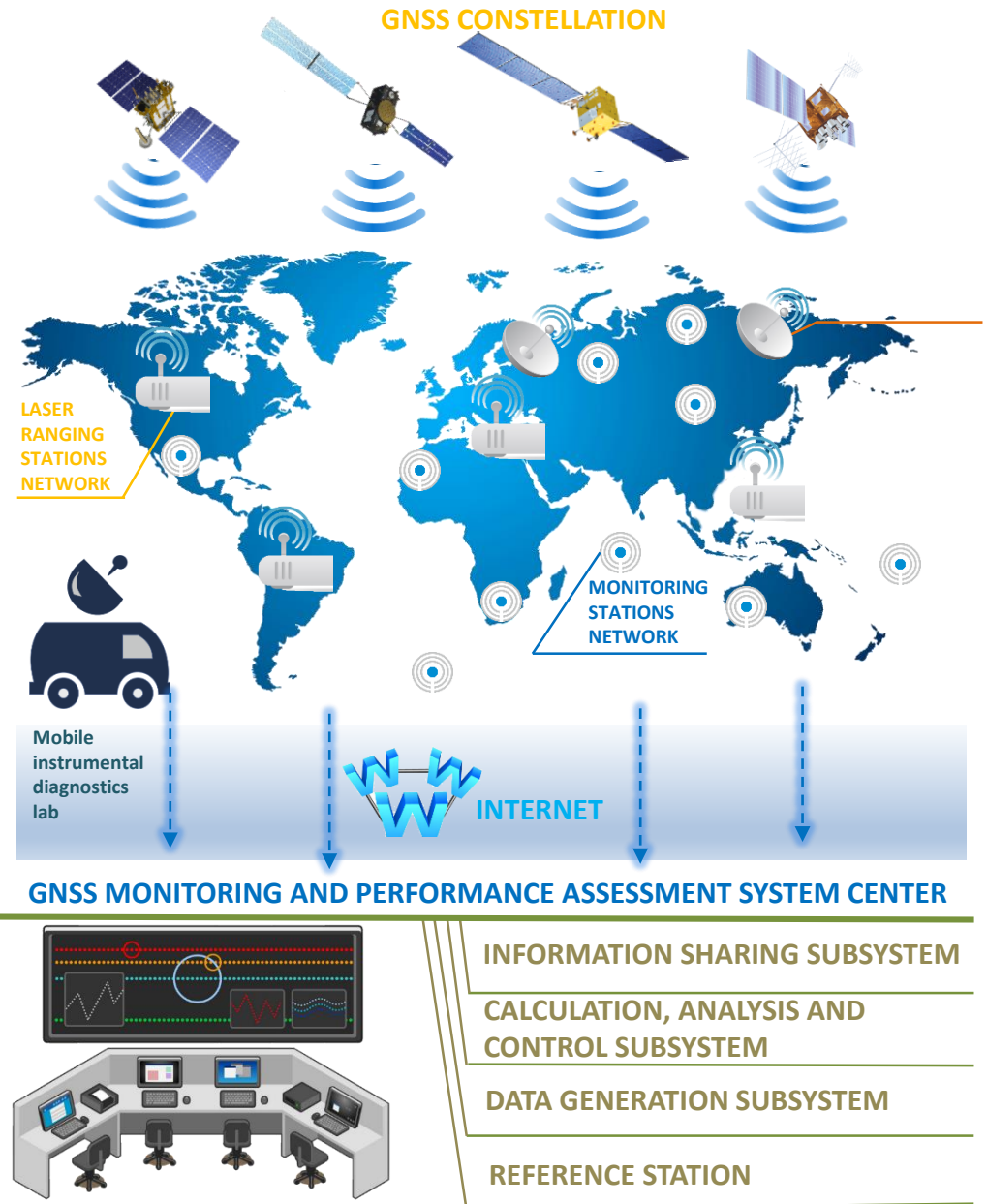


- Master Center
- Back-Up Center







GNSS MONITORING AND PERFORMANCE ASSESSMENT SYSTEM

- Independent monitoring and verification of performance characteristics against system requirements
- Generating input data to assess GLONASS Program KPIs
- Measuring user level GLONASS performance
- Providing input data for GLONASS certification



GLONASS CIVIL SERVICES

Name	Users	Current value	Means
<p>1 BASIC OPEN SERVICE</p> <p>Navigation in absolute regime based on code measurements using open signals</p>		2 m	SPACE SEGMENT
<p>2 SERVICE OF IMPROVED RELIABILITY AND ACCURACY</p> <p>Navigation in absolute regime based on code measurements and augmentations from regional and local augmentation systems</p>		1 m	SYSTEM FOR DIFFERENTIAL CORRECTION AND MONITORING
<p>3 RELATIVE NAVIGATION SERVICE</p> <p>Navigation in relative regime using phase measurements and a reference receiver (reference station)</p>		0,03 m	NATIONAL SYSTEM FOR HIGH-ACCURACY POSITIONING
<p>4 HIGH-PRECISION SERVICE</p> <p>Navigation in absolute regime using phase measurements (PPP) on a commercial basis</p>		0,1 m	HIGH-PRECISION SYSTEM FOR OBTAINING THE NAVIGATION AND EPHEMERIS-AND-TIME INFORMATION

PROVIDING USERS WITH GLONASS-BASED SERVICES



KEY GLONASS APPLICATION PROJECTS DURING GLONASS FEDERAL PROGRAMS REALIZATION IN 2002-2017



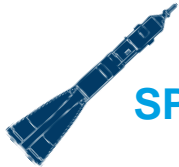
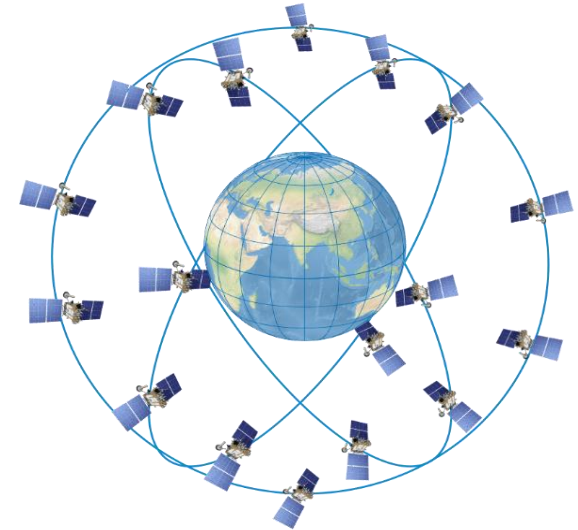
GROUND ROAD TRANSPORT

- ~2.6 million of cars is GNSS-equipped
- 52 regional navigation-informational systems
- ERA-GLONASS – plan for 100% coverage of car fleet in Russia:
 - up to 42 million onboard GNSS-terminals;
- PLATON– all cargo trucks exceeding 12 tons of gross vehicle weight:
 - up to 2 million onboard GNSS-terminals



RAILROAD TRANSPORT

- 14 thousand of rolling stock is GNSS-equipped
- 49 ground local reference stations for differential correction to support high-precision coordinate systems and shunting



SPACE

- GLONASS-based technologies have become primary navigation tool for put-into-orbit operations of:
 - Progress-MS cargo SC;
 - Soyuz-MS manned SC;
 - Resurs Earth Remote Sensing SC;
 - Kanopus Earth Remote Sensing SC.
- GLONASS technologies are used at:
 - Kondor-E SC;
 - Meteor-M SC and others.



MARINE TRANSPORT

- Over 40 control and correction stations at the sea and river ports



AGRICULTURE

- 3 thousand of agriculture machinery is GNSS-equipped



AIR TRANSPORT

- 100 civil airports equipped with GLONASS ground-based augmentations systems (GBAS)

STATE EMERGENCY SYSTEM FOR AUTOMOBILE TRANSPORT – ERA-GLONASS



- In operation since January 1, 2016, nation-wide
- All domestically manufactured or imported vehicles are to be equipped with ERA-GLONASS since January 1, 2017
- 30% reduction of time emergency services respond to an accident
- 1.7 million calls processed, 2.6 million vehicles equipped since start of operation
- Social-and-economic effect: saving more than 4 thousand people annually
(an estimation provided that 100% of the Russian vehicle fleet is equipped)
- Emergency call is free of charge
- Commercial application potential: smart insurance, property and crime protection, traffic monitoring, toll collection, distant diagnostics and etc.



ERA-GLONASS – integration of the opportunities provided by telecommunication, navigation, information technologies and microelectronics aimed at people's life and health safety

FEDERAL TOLL COLLECTION SYSTEM FOR COMMERCIAL CARGO TRUCKS – PLATON

- PLATON – nation-wide GLONASS/GPS based automatic toll collection system
- In operation since November 15, 2015
- All trucks over 12 tons
- All Federal-owned highways – 50,774 km in total
- 90% of the total fleet – 410 thousand cargo companies and 1.05 million trucks registered
- 54.8 billion rubles collected for road infrastructure support



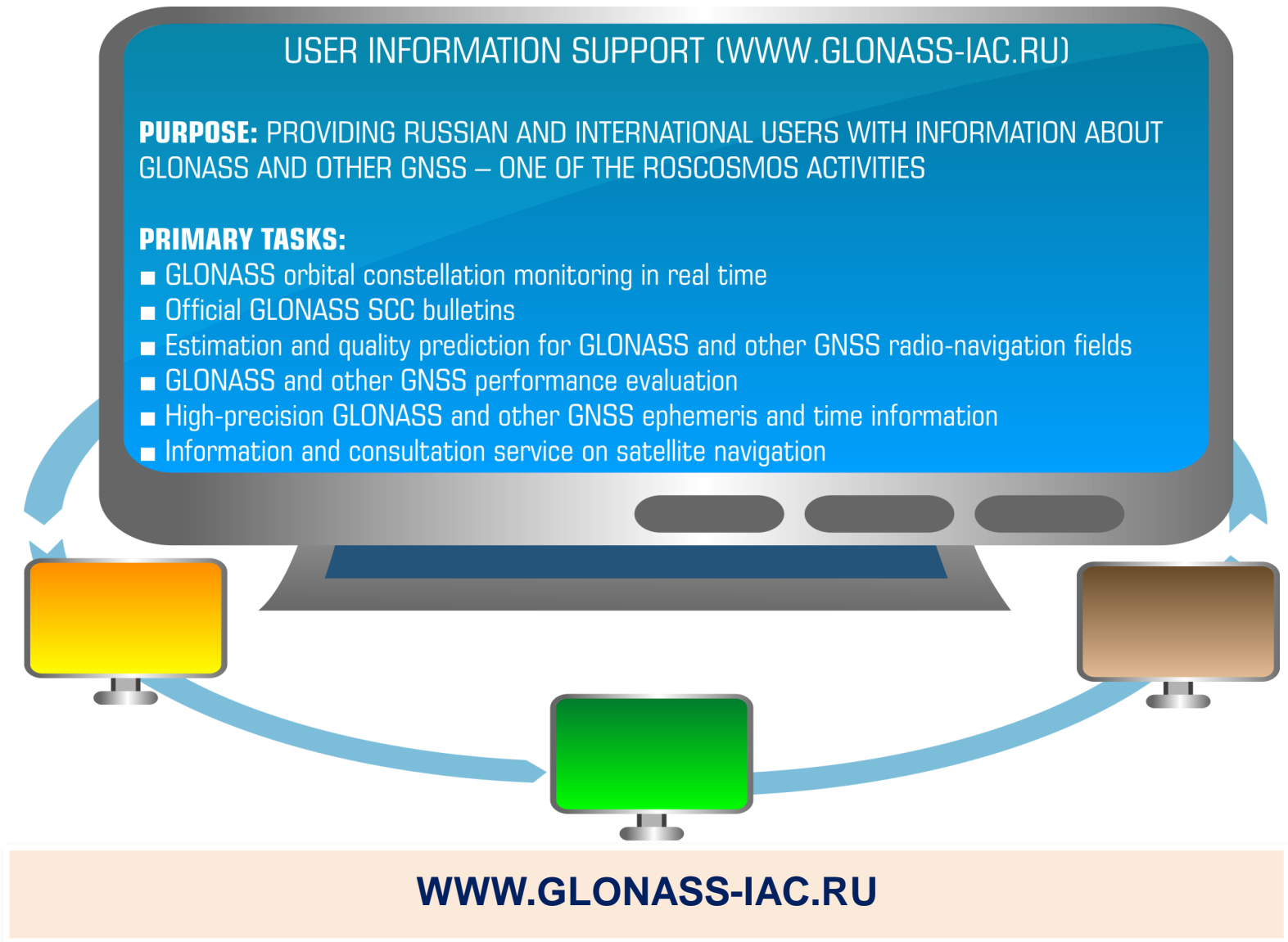
GLONASS USER INFORMATION SUPPORT

USER INFORMATION SUPPORT (WWW.GLONASS-IAC.RU)

PURPOSE: PROVIDING RUSSIAN AND INTERNATIONAL USERS WITH INFORMATION ABOUT GLONASS AND OTHER GNSS – ONE OF THE ROSCOSMOS ACTIVITIES

PRIMARY TASKS:

- GLONASS orbital constellation monitoring in real time
- Official GLONASS SCC bulletins
- Estimation and quality prediction for GLONASS and other GNSS radio-navigation fields
- GLONASS and other GNSS performance evaluation
- High-precision GLONASS and other GNSS ephemeris and time information
- Information and consultation service on satellite navigation



**Thank you for your
attention!**

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