GLONASS and SDCM Status and Development

ROSCOSMOS State Space Corporation

Ivan Revnivykh

Head of GLONASS Application Division

ICG-14, Bengaluru, India

December 8-13, 2019

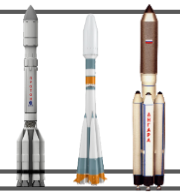
PROVIDING USERS WITH GLONASS-BASED SERVICES

ORBITAL CONSTELLATION

ROSCOSMOS — SATELLITES DESIGN AND MANUFACTURING

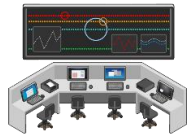
LAUNCHERS

ROSCOSMOS — LAUNCHERS DESIGN AND MANUFACTURING, LAUNCH SERVICES



GROUND CONTROL COMPLEX

ROSCOSMOS — DESIGN, MANUFACTURING, MAINTENANCE



OPERATION

SERVICES

GLONASS UNION

JSC GLONASS

+ PRIVATE COMPANIES

USER RECIEVERS

ROSCOSMOS

Rostec

Almaz – Antey Air and Space Defense Corporation

+ PRIVATE COMPANIES

USERS

Transport

Precise Agriculture

Energy

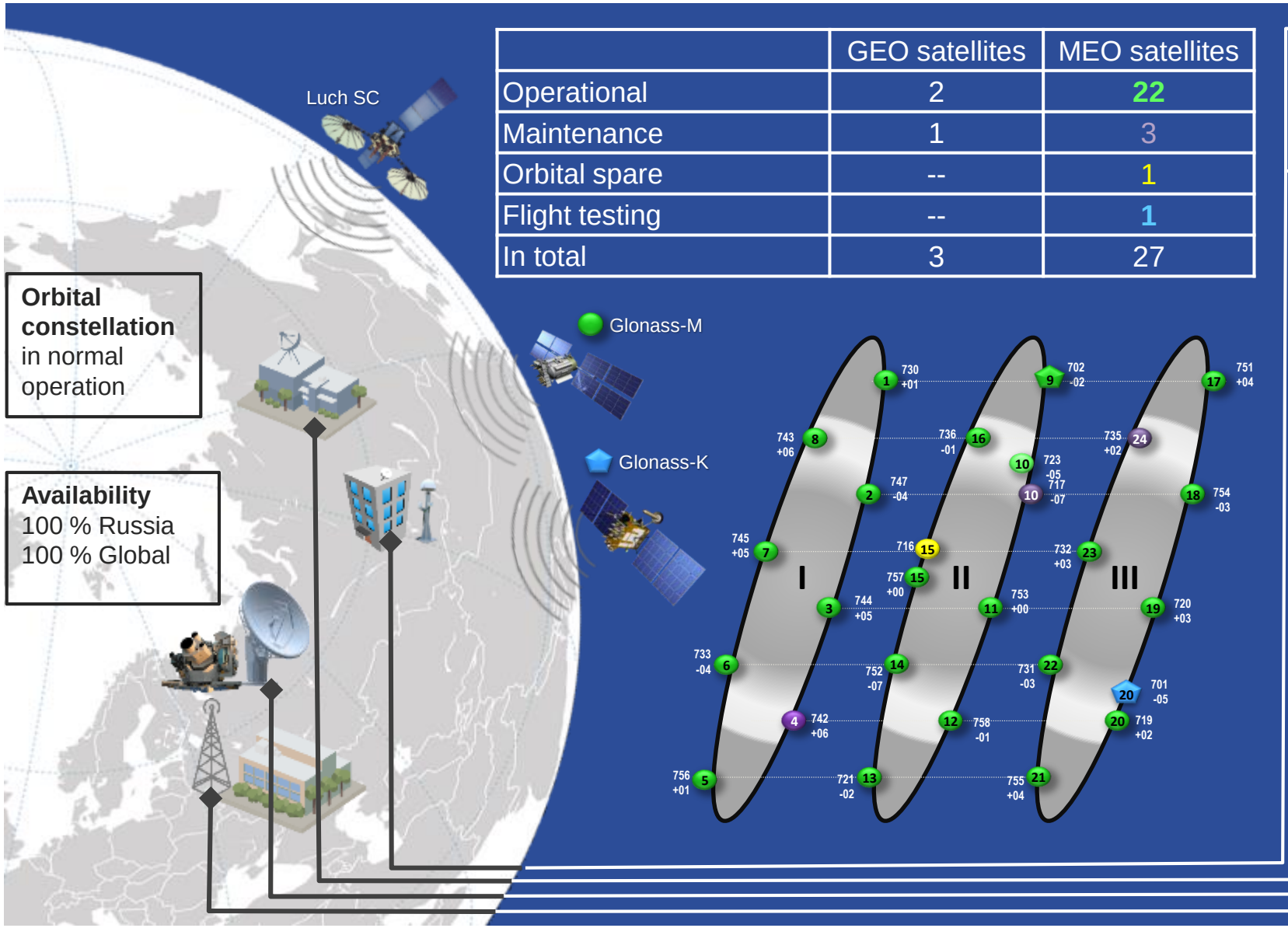
Geodesy, Mapping

Construction

Recreation

GLONASS STATUS (as of 9th of December 2019)

	GEO satellites	MEO satellites
Operational	2	22
Maintenance	1	3
Orbital spare	--	1
Flight testing	--	1
In total	3	27



Orbital constellation
in normal operation

Availability
100 % Russia
100 % Global

AUGMENTATIONS of the ROSCOSMOS STATE SPACE CORPORATION
35 stations in Russia
10 stations abroad

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

REGIONAL AND MUNICIPAL AUGMENTATION STATION NETWORKS
Over 4000 stations

Current constellation provides continuous global navigation

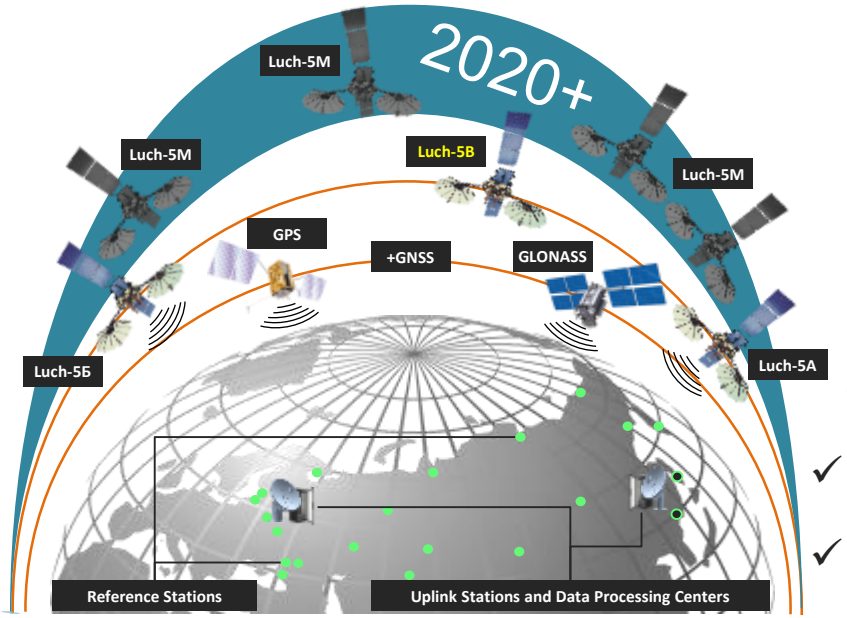
CONSTELLATION SUSTAINMENT

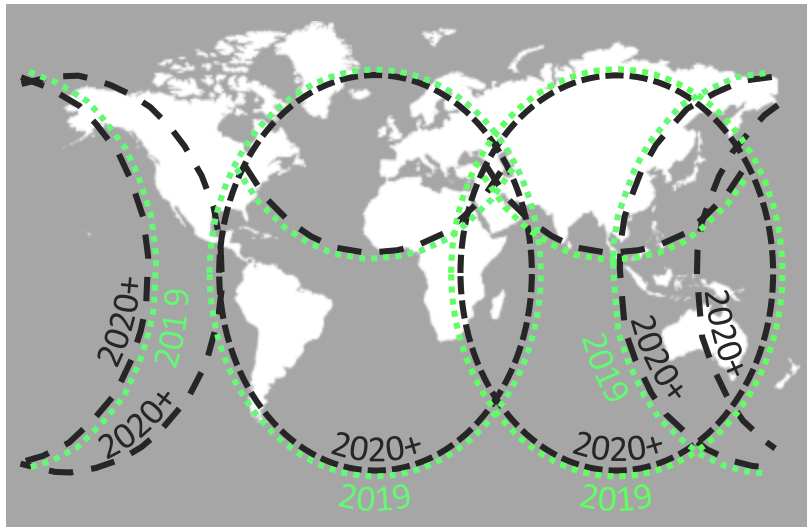
Glonass-M Satellites launched for operational necessity to sustain nominal constellation

- 9 Sep 2017
- 17 Jun 2018
- 3 Nov 2018
- 27 May 2019

Glonass-M launch May 27, 2019

SYSTEM for DIFFERENTIAL CORRECTION AND MONITORING





Current Status:

- ✓ SDCM testing complete
- ✓ System is at the initial stage of certification

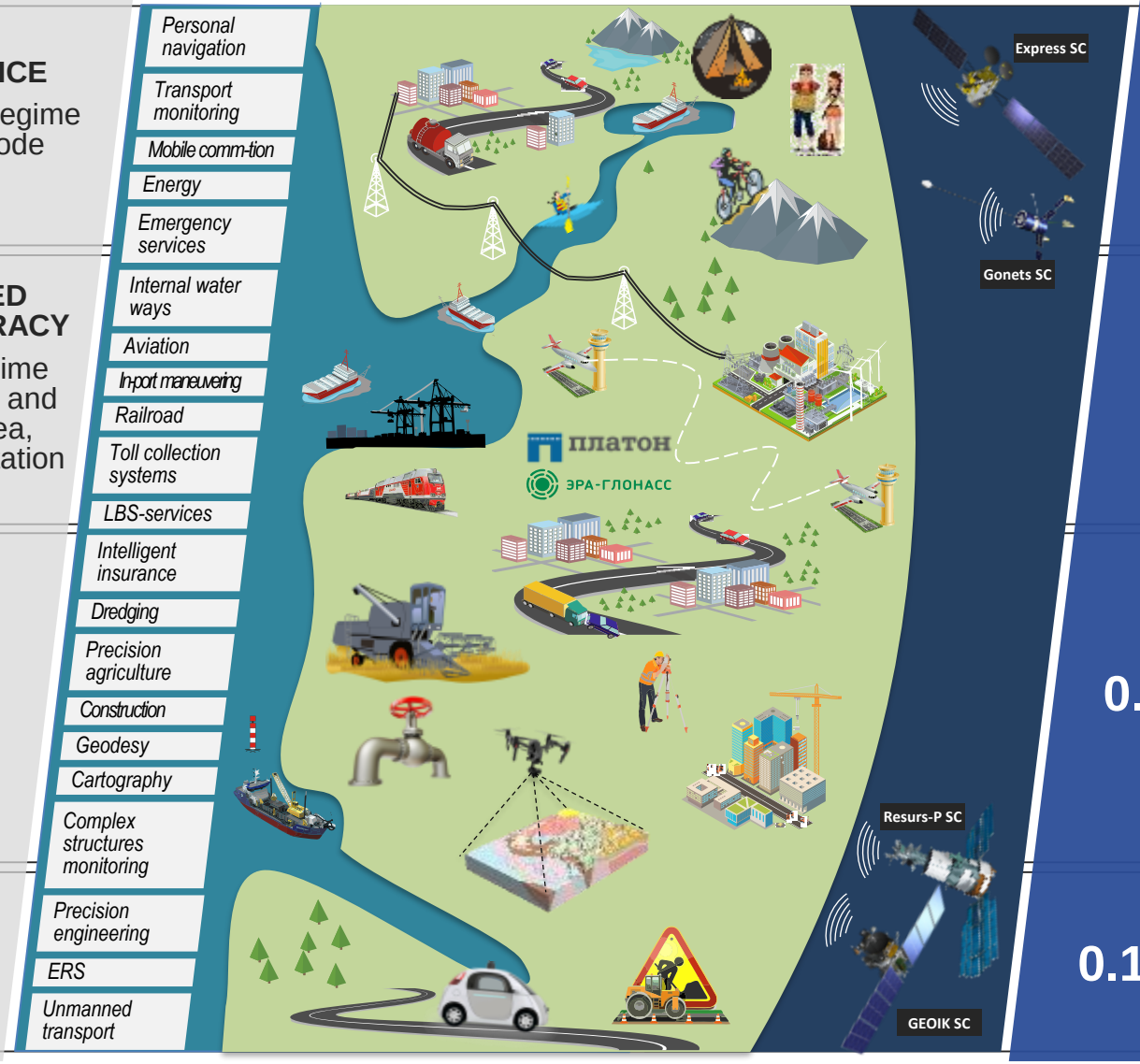
Modernization:

- ✓ Stations network expansion
- ✓ Luch-5M GEO sats to broadcast SBAS data in L1 and L5

	2019	2020+
Stations	25 in Russia 10 abroad	**45 in Russia** **12 abroad**
Coverage	Russian Federation + CIS countries	
Systems	GLONASS, GPS, Galileo, BeiDou	
Correction signals	L1	**L1, L5**
Luch SC	5A* 167E 5Б 16W 5B 95E	**5M** 16W 95E 167E 160W
Integrity	6 seconds	
Accuracy	1 m	**0.5 m**

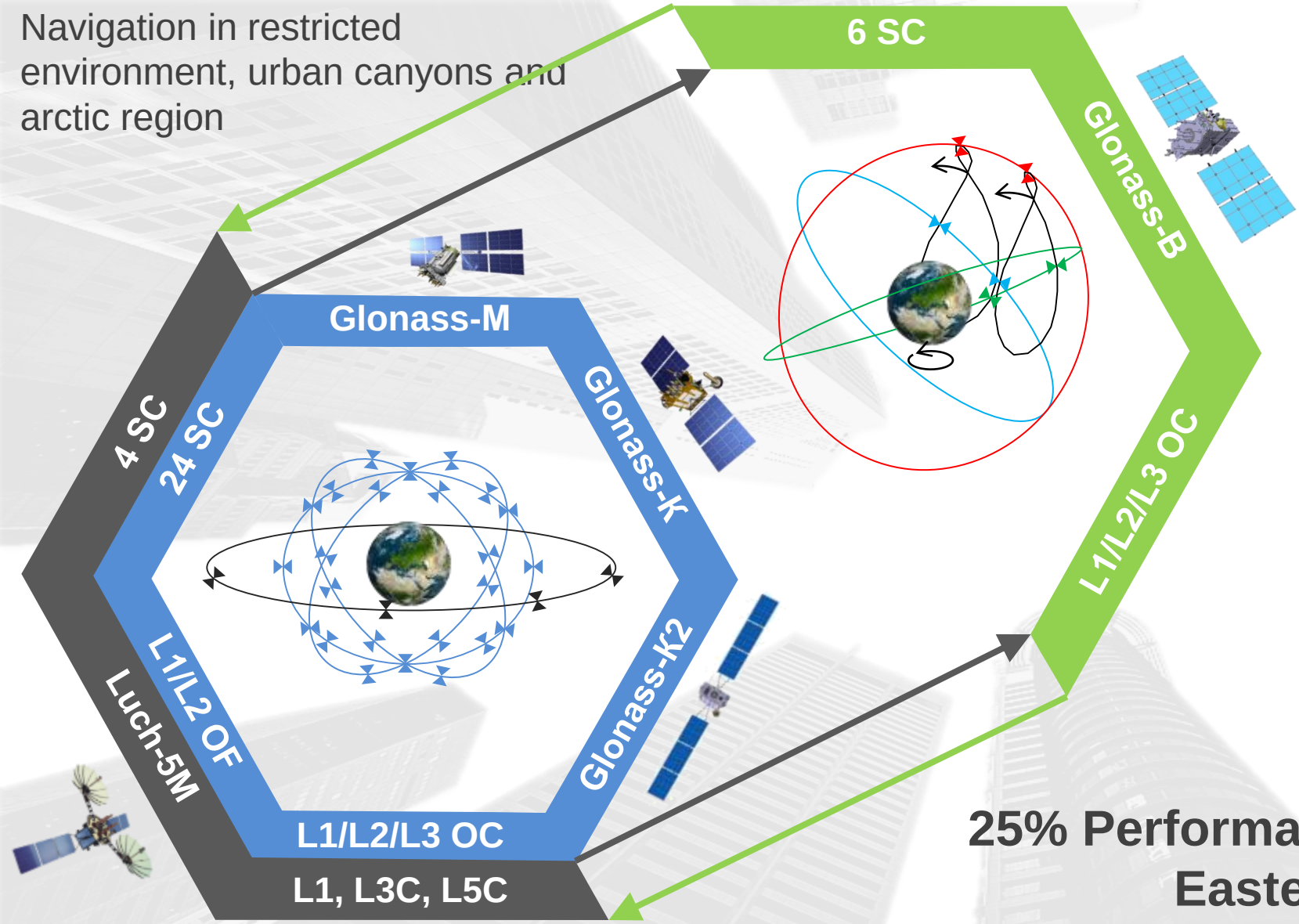
GLONASS CIVIL SERVICES

Services	Users	Characteristics	Means
BASIC OPEN SERVICE Navigation in absolute regime using open signals code measurements	Personal navigation Transport monitoring Mobile comm-tion Energy Emergency services	≤ 5 m (horizontal) ≤ 9 m (vertical)* *95% Global Average Position Error (2 m target)	SPACE SEGMENT
SERVICE OF IMPROVED RELIABILITY AND ACCURACY Navigation in absolute regime using code measurements and information from wide area, regional and local augmentation systems	Internal water ways Aviation In-port maneuvering Railroad Toll collection systems LBS-services	1 m	SYSTEM FOR DIFFERENTIAL CORRECTION AND MONITORING
RELATIVE NAVIGATION SERVICE Navigation in relative regime using carrier phase measurements and a reference receiver (reference station)	Intelligent insurance Dredging Precision agriculture Construction Geodesy Cartography	0.03 m	NATIONAL SYSTEM FOR HIGH-ACCURACY POSTIONING
HIGH-PRECISION SERVICE Navigation in absolute regime using phase measurements (PPP) on a commercial basis	Complex structures monitoring Precision engineering ERS Unmanned transport	0.1 m	HIGH-PRECISION SYSTEM FOR PRECISE ORBIT AND CLOCK DETERMINAION



HIGH ORBIT GLONASS

Navigation in restricted environment, urban canyons and arctic region

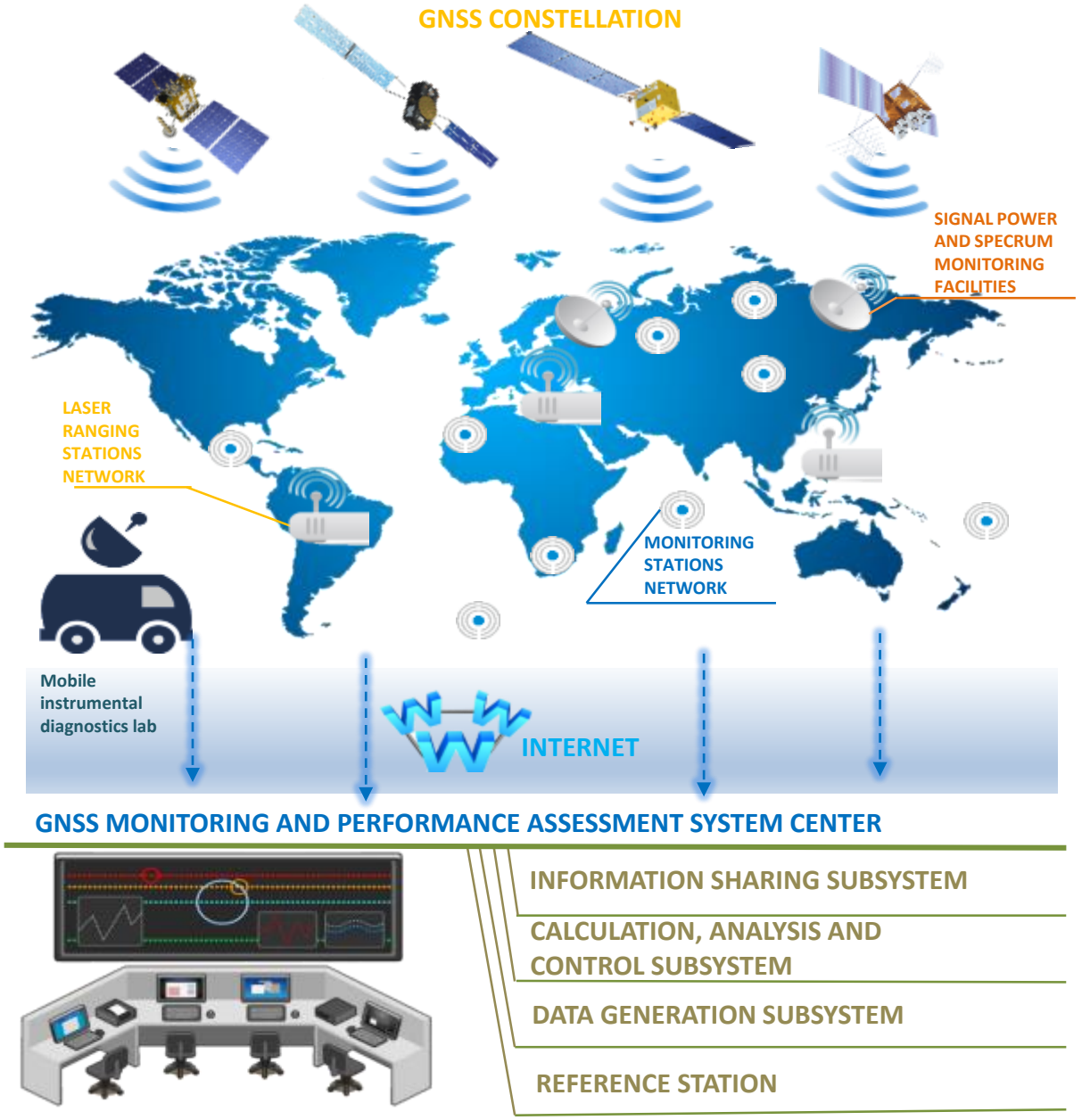


Initial design	2019
Platform	Glonass-K
Number of Sats	6
Orbital Planes	3
Ground Tracks	2
Inclination	64.8°
Eccentricity	0.072
Period	23.9 h
Launch	2023
Signals	L1 OC, L2 OC, L3 OC
Deployment Period	end of 2025
Launch Method	Dual
Launch Vehicle	Angara-A5
Launch Sites	Plesetsk, Vostochny

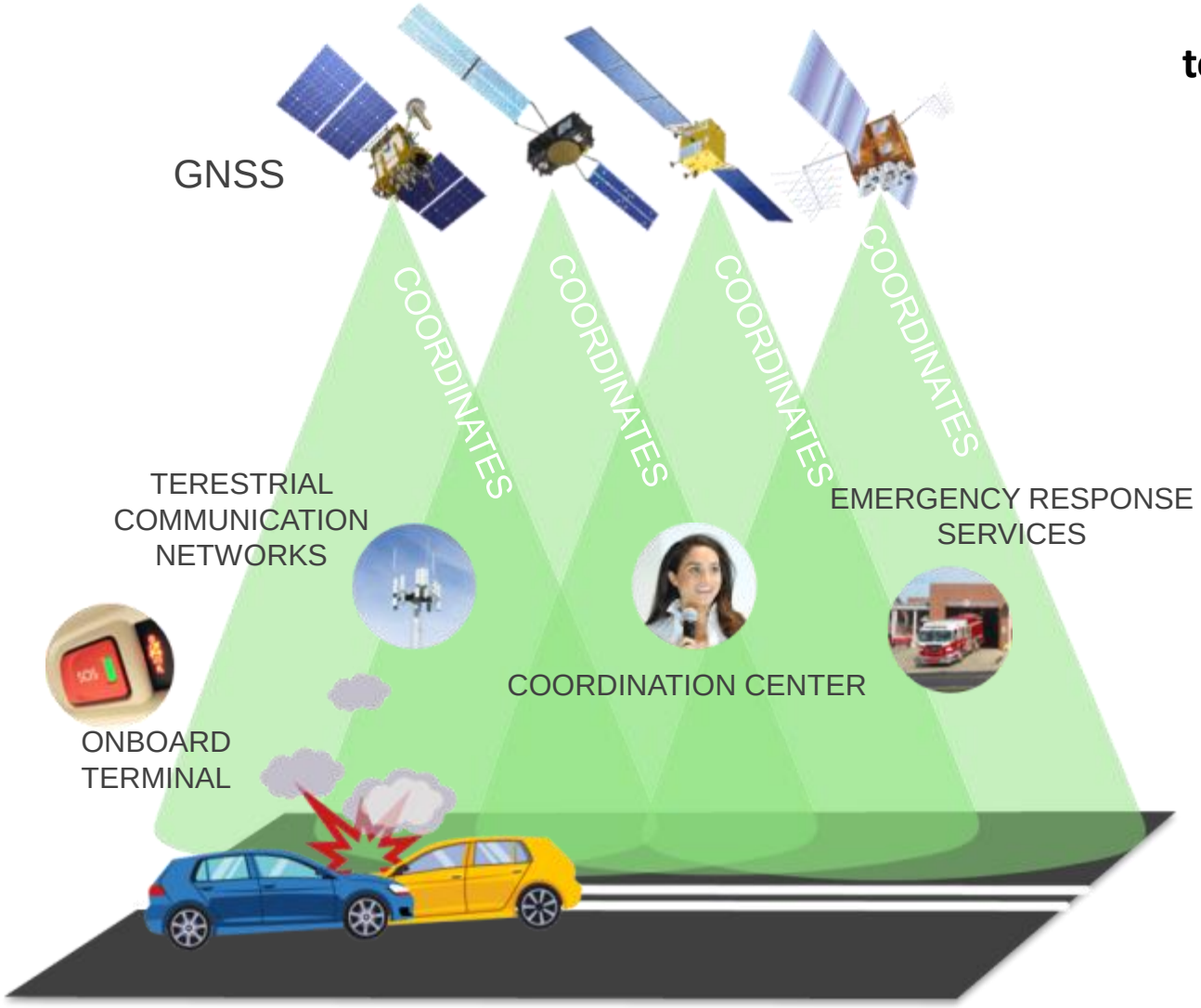
25% Performance Improvement in the Eastern Hemisphere

GNSS MONITORING AND PERFORMANCE ASSESSMENT SYSTEM

- Independent monitoring and verification of performance characteristics against system requirements and standards
- Input data to assess GLONASS Federal Program KPIs
- Assessment user level GLONASS performance
- Input data for GLONASS certification



FEDERAL EMERGENCY RESPONSE SYSTEM FOR AUTOMIBILE TRANSPORT ERA-GLONASS

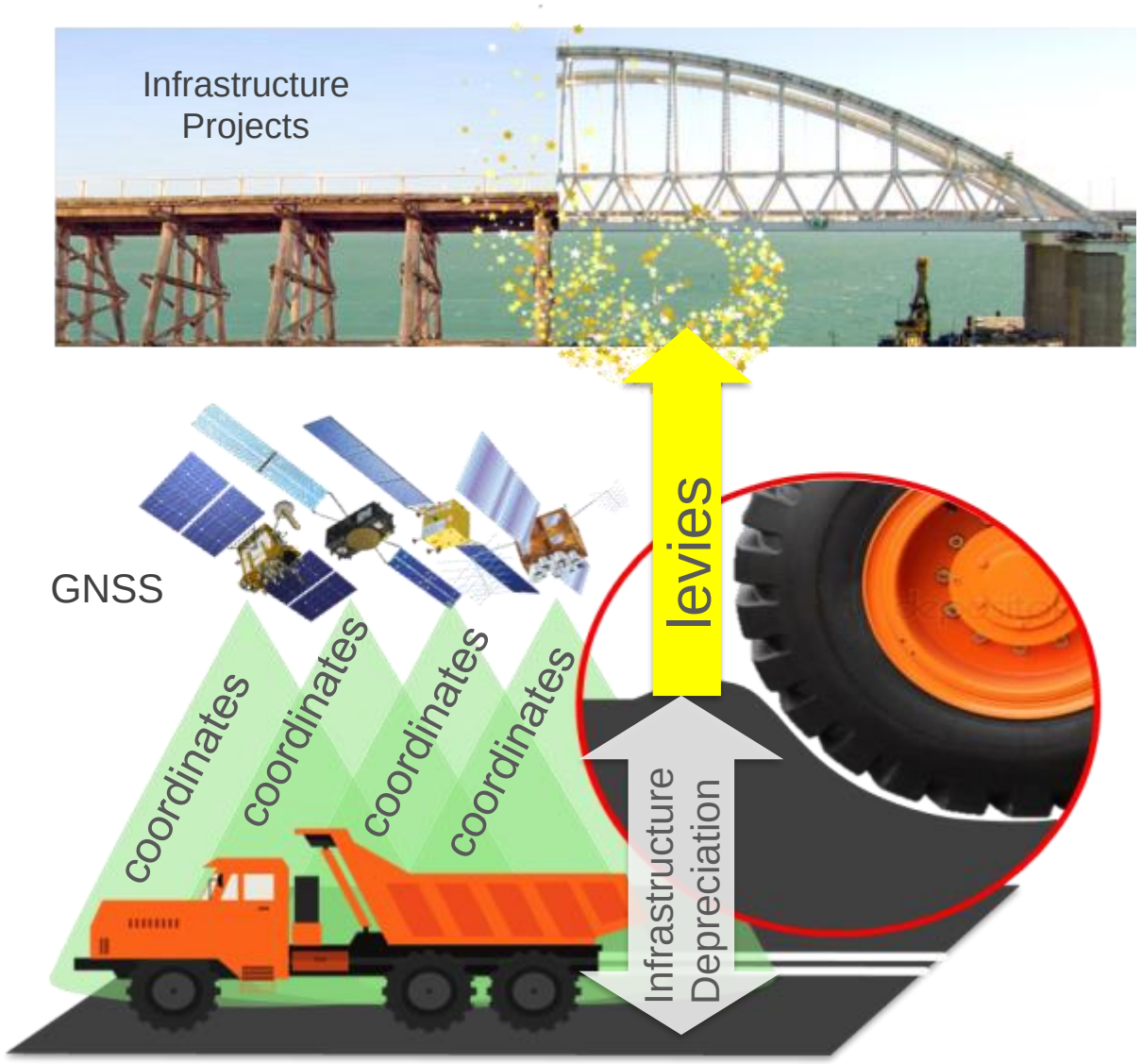


Integration of telecom, navigation, and information technologies and microelectronics for people's security and safety

ЭРА-ГЛОНАСС

- In operation since January 1, 2016
- All new vehicles are equipped with ERA-GLONASS since January 1, 2017
- 30% reduction of time to respond to an accident
- 2.8 million calls processed
- 3.55 million vehicles equipped
- Saving more than 4 thousand lives annually (if 100% fleet equipped)
- Emergency call is free of charge
- Commercial application potential: **smart insurance, property and crime protection, traffic monitoring, toll collection, distant diagnostics and etc.**

FEDERAL TOLL COLLECTION SYSTEM FOR CARGO TRANSPORT PLATON



платон
система взимания платы

- PLATON – nation-wide GLONASS/GPS based toll collection system
- In operation since 15 November 2015
- All trucks over 12 tons
- All Federal-owned highways – 50,774 km in total
- 90% of the total fleet – 467 thousand cargo companies and 1.14 million trucks registered
- 68.6 billion rubles collected to support infrastructure projects

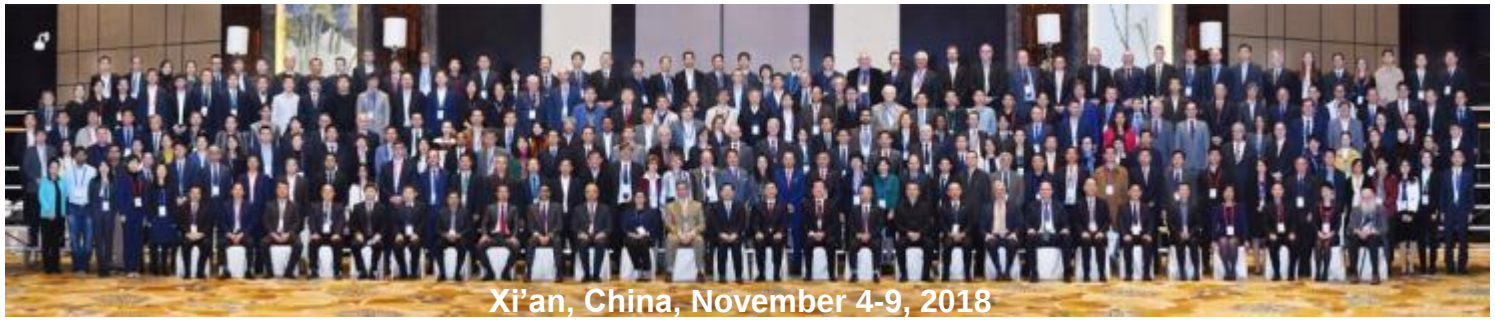
INTERNATIONAL COOPERATION

TARGET

GLONASS Compatibility and Interoperability

MULTILATERAL

Annual Meetings of the International Committee on Global Satellite Navigation Systems



Xi'an, China, November 4-9, 2018

BILATERAL

6th Meeting of the Russia-China Project Committee on Strategic Cooperation in Satellite Navigation
Kazan, Russia, August 28-30, 2019

4 Working Groups, 10 joint projects in:

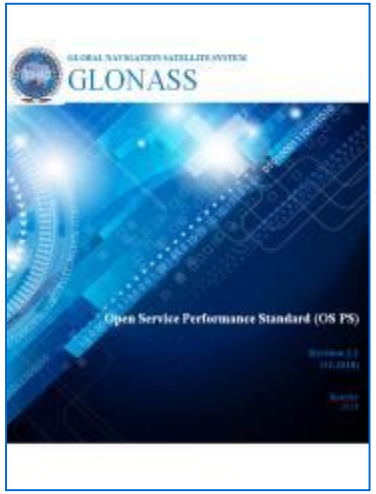
- Compatibility and operability of GLONASS and BeiDou
- Augmentations and measuring stations
- GNSS characteristics monitoring and assessment
- GNSS technologies application

GLONASS TECHNICAL DOCUMENTATION

- INTERFACE CONTROL DOCUMENT Navigational radiosignal in bands L1, L2 (Edition 5.1) - 2008
- Interface Control Document “General Description of the GLObal NAvigation Satellite System with the Code Division Multiple Access Signals” - 2017
- Interface Control Document “GLONASS L1 Open Service Code Division Multiple Access Signal” - 2017
- Interface Control Document “GLONASS L2 Open Service Code Division Multiple Access Signal” - 2017
- Interface Control Document “GLONASS L3 Open Service Code Division Multiple Access Signal - 2017

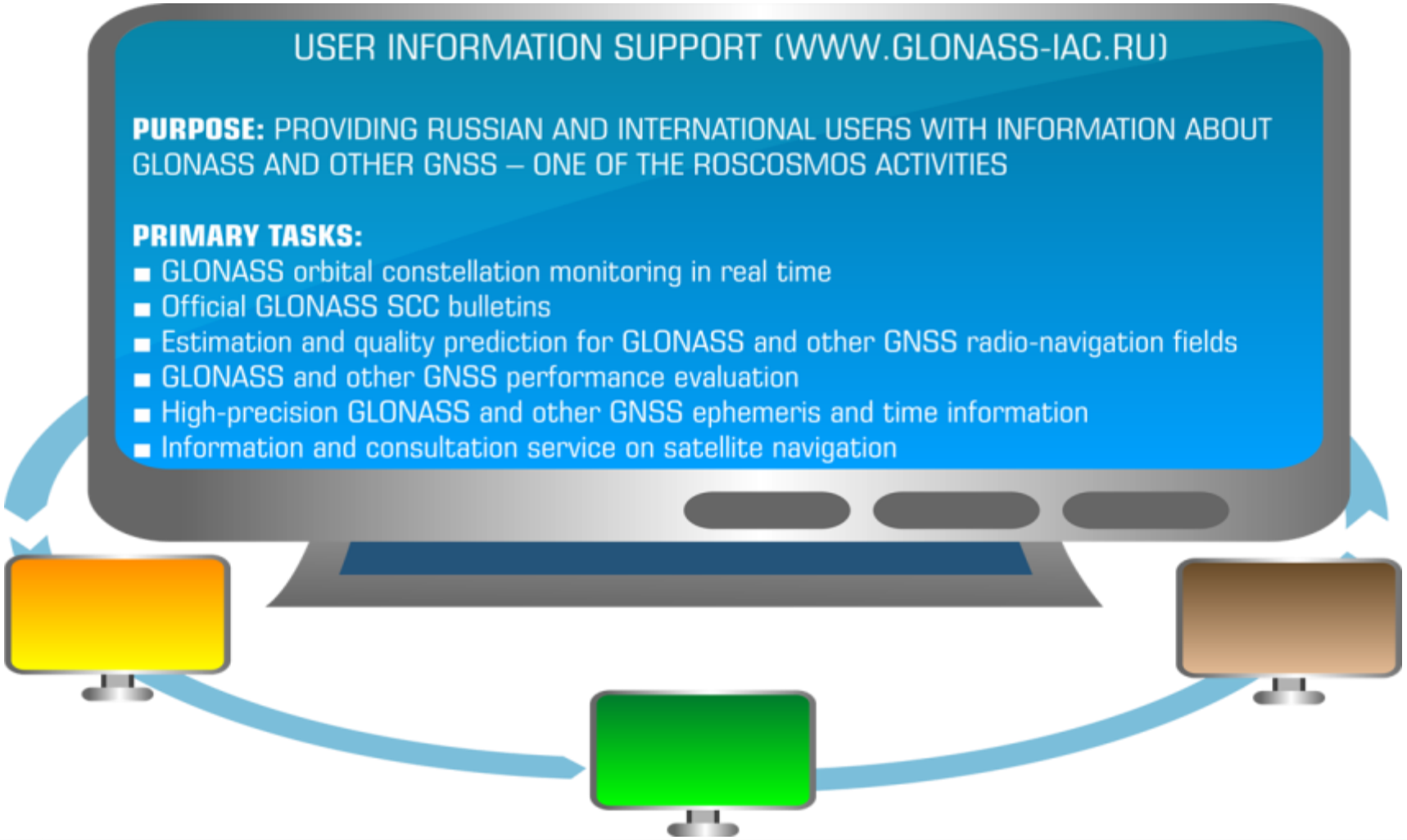
+

- GLONASS Open Service Performance Standard (OS PS) – 2019
  - Defines the levels of performance the Russian Government makes available to GLONASS users
  - English language version is pending release



https://www.glonass-iac.ru/GLONASS/documents.php

GLONASS USER INFORMATION SUPPORT



WWW.GLONASS-IAC.RU

NAVIGATION SPACE SYSTEMS (GLONASS) DEPARTMENT
ROSCOSMOS State Space Corporation
42, Schepkina str., Moscow, GSP-6, 107996
Tel./fax: +7 (495) 631-90-00 (ext. 31-36) ; fax: +7 (495) 688-9063
Revnivykh.IS@roscosmos.ru; www.roscosmos.ru