

# THE CREATION OF DIFFERENTIAL CORRECTION SYSTEMS AND THE SYSTEMS OF GLOBAL NAVIGATION SATELLITE SYSTEM MONITORING

**G. M. Polishchuk, V. I. Kozlov, Y. M. Urlichich,  
V. V. Dvorkin, and V. V. Gvozdev  
Russian Aviation and Space Agency  
Federal State Unitary Enterprise  
Russian Institute of Space Device Engineering  
53 Aviamotornaya St., Moscow 111250, Russia  
Tel: 095-273-9601; Fax: 095-273-1131**

## Abstract

*One of the directions of work, for promoting the development of the GLONASS system, its ground infrastructure, and its efficiency improvement, is the creation of a uniform differential system for the Russian Federation and a system of global navigation satellite system monitoring. These projects are some of the basic ones in the Federal program "Global Navigation System," aimed at maintenance and development of the GLONASS system. This report describes the state of work on the creation of the uniform differential system and the monitoring system and their application in most important economic spheres. It also gives information on the industry centers created by the Russian Aviation Space Agency which are to take part in GLONASS development, expand its capabilities, promote satellite navigation technologies, and form a user's market of navigation equipment and services.*

The global navigation satellite system GLONASS remodeling and its ground infrastructure development are the main tasks of the federal target program "Global Navigation System."

The program states that the creation of a single differential system for the Russian Federation and a GNSS integrity monitoring system are priority directions of GLONASS ground infrastructure development.

GLONASS functional supplements are created with the aim of:

- increasing the effectiveness of GLONASS exploitation
- providing information based on GLONASS exploitation with the aim to:
  - expand the service area
  - guarantee necessary features for users
  - analyze claims concerning GLONASS performance.
- creating an informational and analytic database for:
  - GLONASS improvement

- development of advanced user navigation equipment
- an introduction to new navigation technologies.

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A single differential system for the Russian Federation is being created to solve the following tasks  
:

- generation of correction data and its provision to users
- creation of an atmosphere monitoring system and specification of ionosphere model parameters
- calculation and specification of navigation satellite orbit parameters.

The program of GNSS and radionavigation integrity monitoring has been created to solve the following tasks:

- detecting abnormal performance by GNSS and differential systems, and early informing of users
- forecasting navigation situations
- comparatively analyzing GNSS navigation features and developing recommendations on increasing GLONASS's effectiveness, refining GLONASS, and expanding its fields of application.

Functional supplement data are intended to be provided to the users both through already existing communication channels and in a navigation message from the navigation spacecraft GLONASS-K in the L3 band.

The work on GLONASS functional supplement creation are organized as follows:

- head organization – federal state unitary enterprise (FSUE) “Russian Research Institute of Space Device Engineering” (RISDE)

● leading Russian engineering and scientific organizations participating in the work:

- FSUE “NPO PM named after M. Reshetneva”
- FSUE “CNII MASH”
- FSUE “RIRV”
- SE “VNII FTRI”
- FSUE “CNIIGAiK named after F. Krasovsky”
- FSUE “Gosakademkadastrsyemka”
- Moscow State University named after Lomonosov
- Moscow State Technical University named after Bauman, etc.

The main users of functional data supplements are the following institutions:

- RF Ministry of Transport
- RF Ministry of Communication and Information
- RF Ministry of Railways
- Federal Service of Land Surveying
- Russian Space Agency
- Federal Service of Geodesy and Mapping of the RF
- State Committee on Standardization and Metrology of the RF
- Ministry of the RF on Civil Defense, Emergency Conditions, and Liquidation of the Consequences of Natural Calamities.

Priority application fields of functional supplements are:

- provision of navigation data to authorized users
- development of the state service of time and frequency
- land registry formation
- creation of high precision geodetic network
- geology
- geodynamics
- creation of intelligence transport systems
- improvement of GLONASS geodetic provision
- navigation of different means of transportation :

- air traffic
- railway transport
- marine and river transport

- geodesy.

Informational cooperation between the following components of GLONASS ground infrastructure and international ground navigation infrastructure is anticipated to secure the effectiveness of functional supplement operation:

- network of data collection sites
- GLONASS system control center
- global network IGLOS (IGS) tracking stations of GNSS GLONASS
- international centers of navigation data analysis and precise GNSS GLONASS ephemeris calculation
- official centers of GNSS data provision
- International services:

- International Earth Rotation Service (IERS)
- International Laser Ranging Service (ILRS).

To secure informational cooperation between functional supplements, between functional supplements and data users, and between functional supplements and international services and centers, with the aim of developing GLONASS ground infrastructure, a multifunctional navigation information “Rosaviakosmos” center has been established in the FSUE “RISDE.”

This Multifunctional Navigation Information Center (MNIC) “Rosaviakosmos” consists of: the Center of GNSS Integrity Monitoring and the Russian Differential System Center. Informational cooperation with data users and data sources will be conducted through the Processing Center of Multifunctional Navigation Information. The main part of Rosaviakosmos MNIC informational cooperation consists of cooperation with:

- international services and centers
- GLONASS control and management subsystem
- functional supplements
- users.

The functional supplements being created will secure GLONASS conformity with the features stated in navigation and international standards, ensure independent evaluation and control over these features, and expand GLONASS exploitation in the future.

**QUESTIONS AND ANSWERS**

**JIM ROMBERG (Boeing):** Are your differential signals coming down through the GLONASS satellites or other satellites that are augmentation satellites? And is it a free system?

**YAKOV VOROKHOVSKY (Morion, Inc.):** Now the differential correction uses different channels, not GLONASS satellites. But they will start using GLONASS satellites beginning from GLONASS K, not GLONASS M.

**ROMBERG:** Is this a free service for everybody or is it somehow limited?

**VOROKHOVSKY:** No, it is not free of charge. His center provides this service, but on a commercial basis.