NIS GLONASS national navigation services provider

Economic benefits of using industry-sector monitoring systems based on GNSS

United Nations/Croatia Workshop on the Applications of Global Navigation Satellite Systems
21 April 2013, Baska, Krk Island, Croatia

Olga Nugaeva

State Policy Basic Principles

- Presidential Decree, May 17, 2007

“On Use of GLONASS Global Navigation Satellite System for the Benefit of Social and Economic Development of the Russian Federation”

Basic Principles:

- Access to GLONASS civil signals is free and unlimited for both Russian and international users
- Use of GLONASS in critical industries and Government economic sector
- Promotion of GLONASS worldwide commercial use
- Providing GLONASS compatibility and interoperability with other GNSS

- GLONASS sustainment, development and use are carried out under the **Federal GLONASS Program**

GLONASS Program Results

NIS national navigation services provider GLONASS

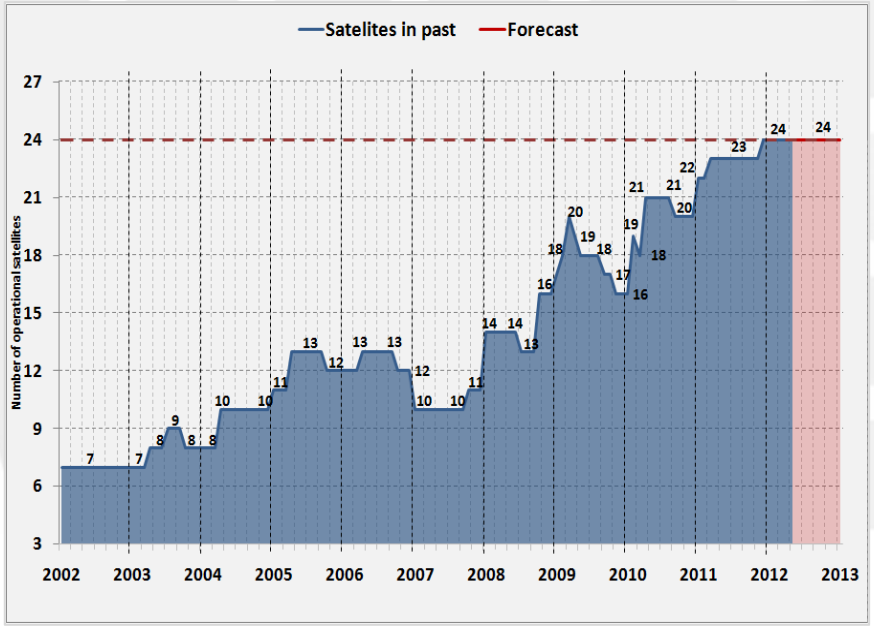
Constellation recovery

- 2002 6-7 SV operational
- 2011 24 SV operational

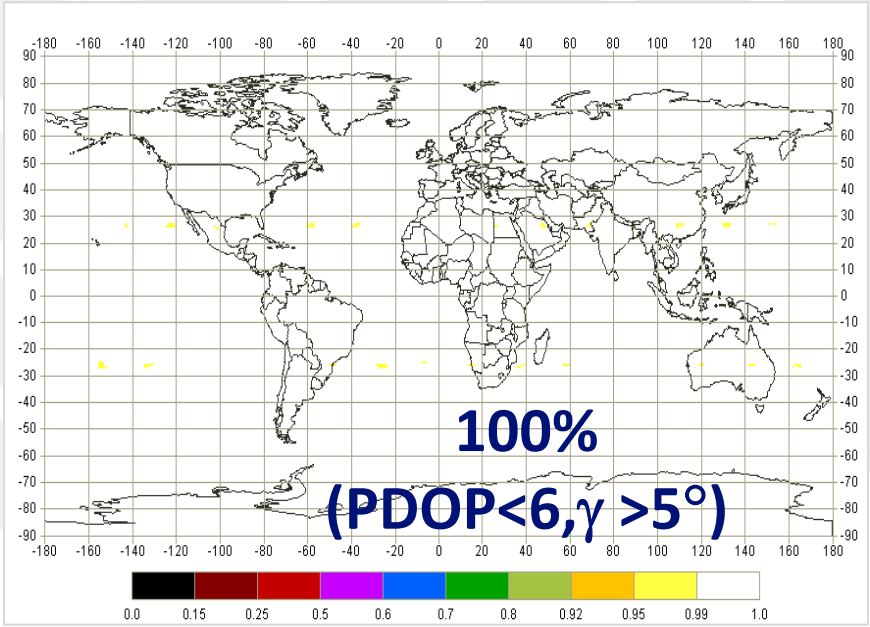
Availability improvement

- 2002 18%
- 2012 100%

Number of operational satellites



Average daily availability



GLONASS recognized worldwide

GLONASS Constellation Status

NIS national navigation services provider GLONASS

GLONASS constellation status, 20.04.2013

Total satellites in constellation	29 SC
Operational	24 SC
In commissioning phase	-
In maintenance	1 SC
Spares	3 SC
In flight tests phase	1 SC

GLONASS Constellation Status at 20.04.2013 based on both the almanac analysis and navigation messages received at 19:00 20.04.13 (UTC) in IAC PNT TsNIImash

Orb. slot	Orb. pl.	RF chnl	# GC	Launched	Operation begins	Operation ends	Life-time (months)	Satellite health status		Comments
								In almanac	In ephemeris (UTC)	
1	1	01	730	14.12.09	30.01.10		40.2	+	+ 18:15 20.04.13	In operation
2	1	-4	728	25.12.08	20.01.09		51.8	+	+ 19:00 20.04.13	In operation
3	1	05	744	04.11.11	08.12.11		17.5	+	+ 19:01 20.04.13	In operation
4	1	06	742	02.10.11	25.10.11		18.6	+	+ 17:59 20.04.13	In operation
5	1	01	734	14.12.09	10.01.10		40.2	+	+ 17:59 20.04.13	In operation
6	1	-4	733	14.12.09	24.01.10		40.2	+	+ 17:59 20.04.13	In operation
7	1	05	745	04.11.11	18.12.11		17.5	+	+ 17:59 20.04.13	In operation
8	1	06	743	04.11.11	20.09.12		17.5	+	+ 17:45 20.04.13	In operation
9	2	-2	736	02.09.10	04.10.10		31.6	+	+ 19:01 20.04.13	In operation
10	2	-7	717	25.12.06	03.04.07		75.9	+	+ 19:00 20.04.13	In operation
11	2	00	723	25.12.07	22.01.08		63.9	+	+ 17:59 20.04.13	In operation
12	2	-1	737	02.09.10	12.10.10		31.6	+	+ 17:59 20.04.13	In operation
13	2	-2	721	25.12.07	08.02.08		63.9	+	+ 17:59 20.04.13	In operation
14	2	-7	715	25.12.06	03.04.07		75.9	+	+ 17:59 20.04.13	In operation
15	2	00	716	25.12.06	12.10.07		75.9	+	+ 18:15 20.04.13	In operation
16	2	-1	738	02.09.10	11.10.10		31.6	+	+ 19:01 20.04.13	In operation
17	3	04	746	28.11.11	23.12.11		16.7	+	+ 19:00 20.04.13	In operation
18	3	-3	724	25.09.08	26.10.08		54.8	+	+ 19:00 20.04.13	In operation
19	3	03	720	26.10.07	25.11.07		65.9	+	+ 19:01 20.04.13	In operation
20	3	02	719	26.10.07	27.11.07		65.9	+	+ 19:01 20.04.13	In operation
21	3	04	725	25.09.08	05.11.08		54.8	+	+ 17:59 20.04.13	In operation
22	3	-3	731	02.03.10	28.03.10		37.6	+	+ 17:59 20.04.13	In operation
23	3	03	732	02.03.10	28.03.10		37.6	+	+ 17:59 20.04.13	In operation
24	3	02	735	02.03.10	28.03.10		37.6	+	+ 17:59 20.04.13	In operation
21	3	-5	701	26.02.11			25.8			Flight Tests
14	2		722	25.12.07	25.01.08	12.10.11	63.9			Spares
17	3		714	25.12.05	31.08.06	19.12.11	87.9			Spares
8	1		712	26.12.04	07.10.05	22.11.12	99.8			Spares
8	1		729	25.12.08	12.02.09	10.09.12	51.8			Maintenance

The constellation provides global continuous navigation

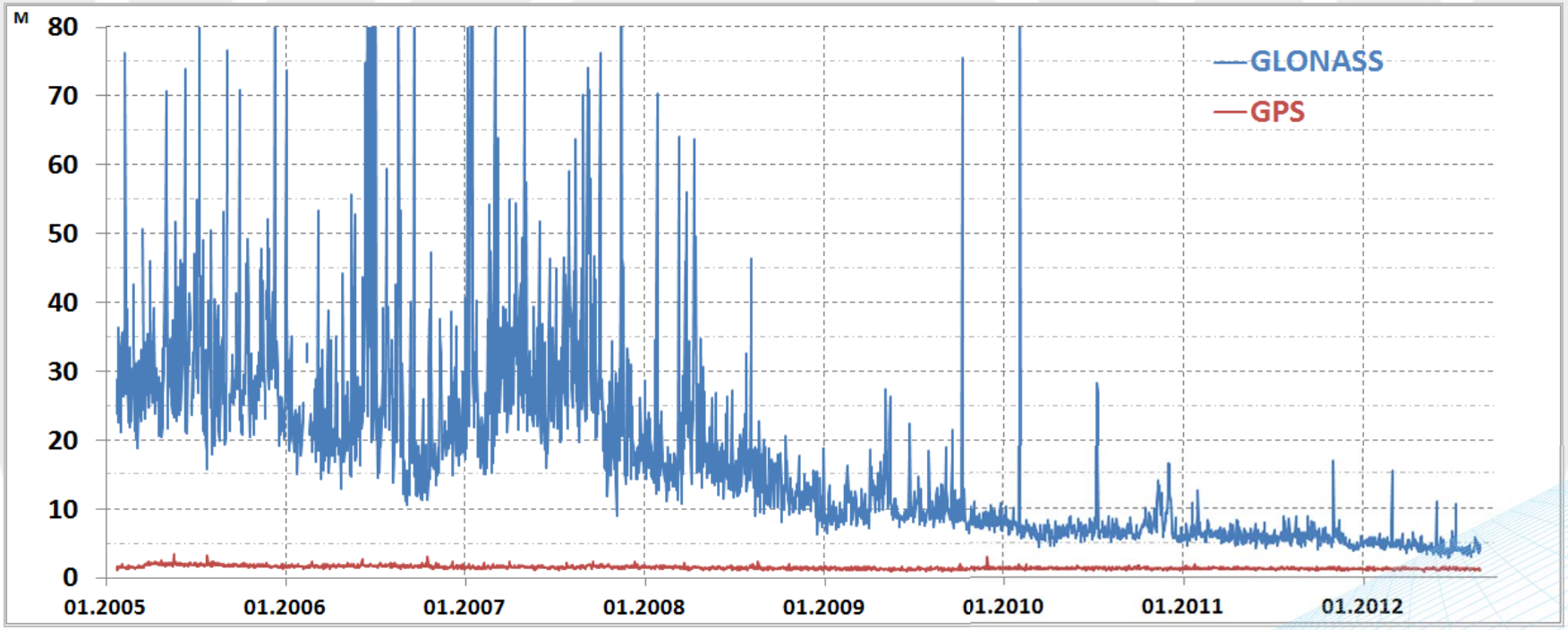
GLONASS Program Results

NIS national navigation services provider GLONASS

Accuracy improvement

- 2002 35 m (1 σ)
- 2012 2,8 m (1 σ)

User position accuracy, m



Performance is comparable to that of GPS

Federal Program for GLONASS Sustainment, Development and Use for 2012-2020

- Federal Program for GLONASS Sustainment, Development and Use for 2012-2020 approved March, 3 2012
- Budget for 9 years and workplan defined (2012-2020)

Федеральное космическое агентство

Федеральная целевая программа "Поддержание, развитие и использование системы ГЛОНАСС на 2012 - 2020 годы"

Проект Программы разработан ФГУП Центральный НИИ машиностроения по заказу Федерального космического агентства. Государственный контракт № 851-Г003/09 от 16.02.2009 г.

Утверждена постановлением Правительства Российской Федерации 3 марта 2012 г. № 189

Program Goals

- **Maintaining the GLONASS performance at a level comparable to that of other GNSSs**
- **Further development of GLONASS aimed at:**
  - improved performance to be competitive with other GNSSs
  - pursuing leadership in satellite navigation
  - consolidated evolution of system's components
- **Promotion of GLONASS global use**

Key Quality Indicator of Program –
guaranteed provision of announced GLONASS performance characteristics

Solutions for performance improvement

- Space segment modernization
  - new signals
  - new clocks
  - accurate attitude control
  - cross links
  - predictable SV behavior
- Ground control segment modernization
  - new OD&TS Software
  - expanded monitoring stations and up-link network
  - more stable system time scale steered to UTC (SU)
  - more accurate geodesy reference PZ-90.11 adjusted to ITRF within cm level (introduced for navigation by the Government Regulation of 28 December 2012)
- Space-based and ground-based augmentations
- Advanced user receivers
- Real-time system performance monitoring system

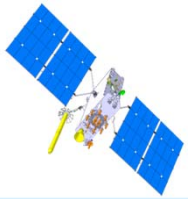
GLONASS is a Russian Space System with unique features and global coverage

NIS national navigation services provider GLONASS

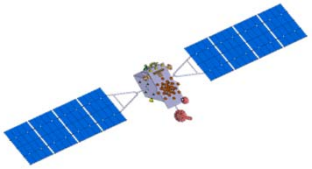
GLONASS (1982 - 2006)

GLONASS-M (from 2003)

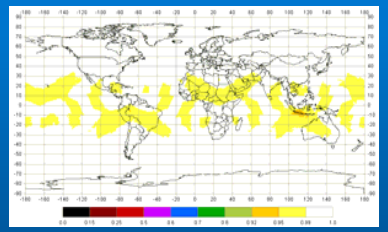
GLONASS-K1 (from 2011)



GLONASS-K2 (from 2014)



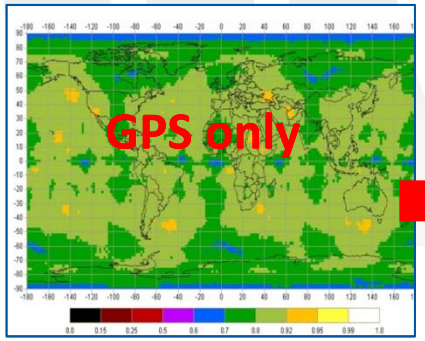
Enhanced reliability → Improved precision → More signals

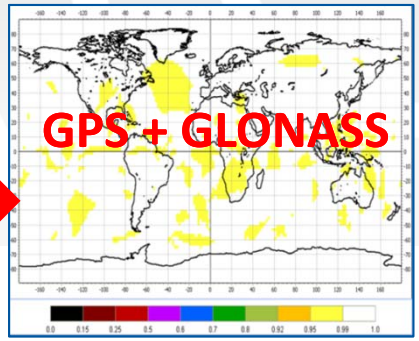


GLONASS 2013:
active satellites provide 100% global coverage

City navigation: two systems are better than one!

Global service availability





GLONASS/GPS mainstream consumer equipment

2010

- Russian vendors only
- For automobile transport only: **100,000 units**

2011

- Russian & Chinese vendors
- For fleets of over 400,000 vehicles
- MTC/ZTE/Qualcomm is the first smartphone
- First PND models

2012

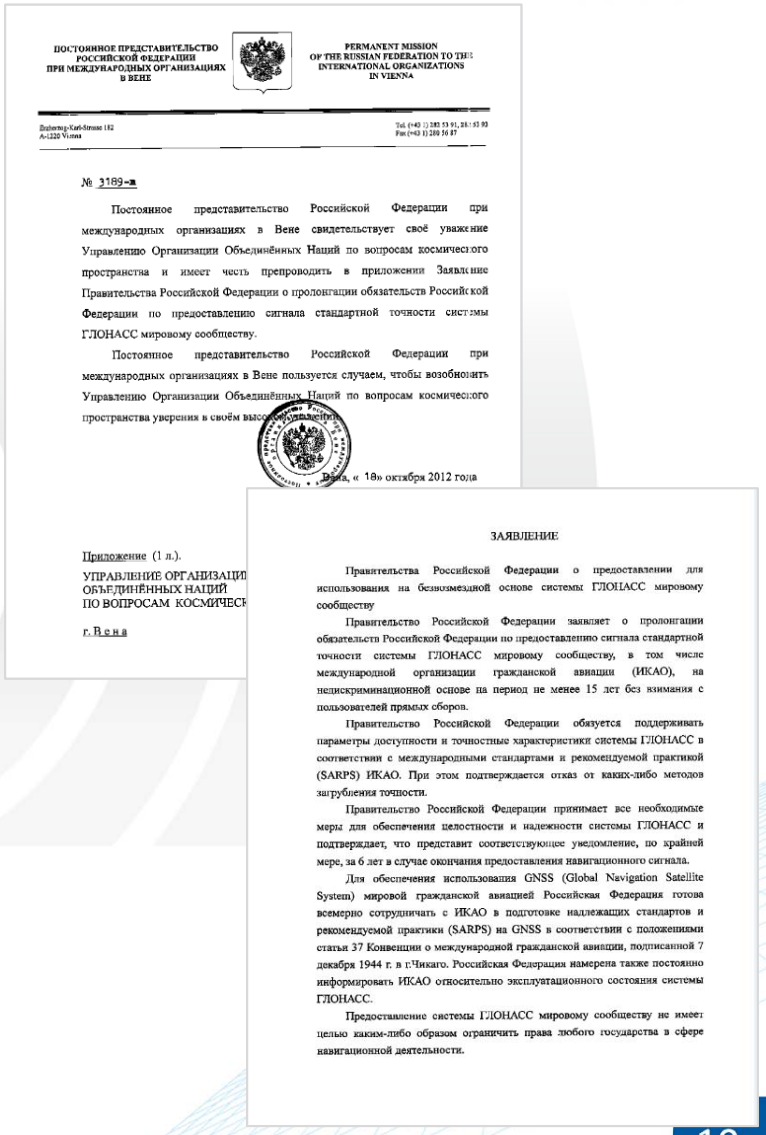
- 2012 is the year that GLONASS/GPS devices from all global brands expand on mass consumer market

GLONASS satellite constellation has been deployed. Next objective is implementation of GLONASS technologies.

Official Declaration of the Russian Government

October 18, 2012

- Extension of the Russian Government commitments on provision of GLONASS open service signals on a non-discriminatory and free basis with no intentional signal degradation for at least next 15 years
- Commitments of the Russian Government to keep GLONASS performance compliant with ICAO SARPs



ПОСТОЯННОЕ ПРЕДСТАВИТЕЛЬСТВО РОССИЙСКОЙ ФЕДЕРАЦИИ ПРИ МЕЖДУНАРОДНЫХ ОРГАНИЗАЦИЯХ В ВЕНЕ

PERMANENT MISSION OF THE RUSSIAN FEDERATION TO THE INTERNATIONAL ORGANIZATIONS IN VIENNA

№ 3189-в

Постоянное представительство Российской Федерации при международных организациях в Вене свидетельствует своё уважение Управлению Организации Объединённых Наций по вопросам космического пространства и имеет честь препроводить в приложении Заявление Правительства Российской Федерации о пролонгации обязательств Российской Федерации по предоставлению сигнала стандартной точности системы ГЛОНАСС мировому сообществу.

Постоянное представительство Российской Федерации при международных организациях в Вене пользуется случаем, чтобы возобновить Управлению Организации Объединённых Наций по вопросам космического пространства уверения в своём высоком уважении.

Вена, «18» октября 2012 года

Приложение (1 л.).

УПРАВЛЕНИЕ ОРГАНИЗАЦИИ ОБЪЕДИНЁННЫХ НАЦИЙ ПО ВОПРОСАМ КОСМИЧЕСКОГО

г. Вена

ЗАЯВЛЕНИЕ

Правительства Российской Федерации о предоставлении для использования на безвозмездной основе системы ГЛОНАСС мировому сообществу

Правительство Российской Федерации заявляет о пролонгации обязательств Российской Федерации по предоставлению сигнала стандартной точности системы ГЛОНАСС мировому сообществу, в том числе международной организации гражданской авиации (ИКАО), на недискриминационной основе на период не менее 15 лет без взимания с пользователей прямых сборов.

Правительство Российской Федерации обязуется поддерживать параметры доступности и точностные характеристики системы ГЛОНАСС в соответствии с международными стандартами и рекомендуемой практикой (SARPS) ИКАО. При этом подтверждается отказ от каких-либо методов загрубления точности.

Правительство Российской Федерации принимает все необходимые меры для обеспечения целостности и надежности системы ГЛОНАСС и подтверждает, что представит соответствующее уведомление, по крайней мере, за 6 лет в случае окончания предоставления навигационного сигнала.

Для обеспечения использования GNSS (Global Navigation Satellite System) мировой гражданской авиацией Российская Федерация готова всемерно сотрудничать с ИКАО в подготовке надлежащих стандартов и рекомендуемой практики (SARPS) на GNSS в соответствии с положениями статьи 37 Конвенции о международной гражданской авиации, подписанной 7 декабря 1944 г. в г.Чикаго. Российская Федерация намерена также постоянно информировать ИКАО относительно эксплуатационного состояния системы ГЛОНАСС.

Предоставление системы ГЛОНАСС мировому сообществу не имеет целью каким-либо образом ограничить права любого государства в сфере навигационной деятельности.

International Cooperation

NIS national navigation services provider
GLONASS

- GLONASS is an element of the global GNSS infrastructure
- Compatibility and Interoperability provision
- Development of common GNSS standards
- Promotion of GLONASS worldwide use for all user benefit

Multilateral cooperation in the framework of ICG and Working Groups,
Bilateral working contacts with USA, EU, India, China and other countries on GNSS compatibility and interoperability and global use

2012: Multi-constellation – global standard

NIS national navigation services provider GLONASS

Multi-constellation in space

GPS

- Global system – market standard

+

GLONASS

- Global system since 8 Dec. 2011

+

Galileo

- Launch of 2 satellites (October 2011) and their commissioning

+

Compass

- Test mode as a regional system since December 2011

Multi-constellation on earth

before 2010

- GLONASS/GPS – only Russian producers
- Only for motor transport (2010 – 100 thousand psc)

2011

- All world leaders announced about working on GLONASS/GPS chipsets
- All world leaders announced about GLONASS/GPS equipment production for different purpose

since 2012

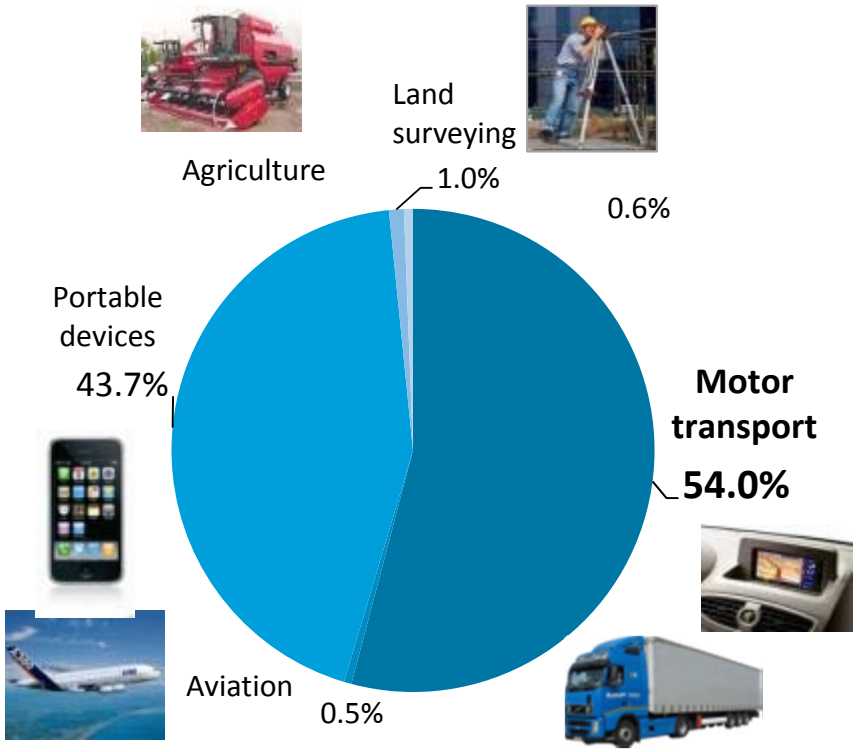
- GLONASS/GPS – mass-market standard in all price segments

Multi-constellation is a benefit for users:
better product for the same price – higher reliability, higher accuracy

Navigation market: forming, fast growing, global, high-tech

World navigation market is more than $100 bln

Industry segments 2013-2020



Source: European commission, May 2012

Growth drivers of the Russian market:

1. **Major state and industry projects:** «ERA-GLONASS», equipping of passenger transport, Ministry of the Interior of Russia, "Russian Post" transport, Transneft

2. **Regional projects:** regional special-purpose programs (school busses, emergency ambulance, housing and utilities infrastructure), Intelligent Transport Systems(ITS Moscow), etc.

3. **Consumer navigation:** systems, equipment and services for car drivers, passengers and foot passengers

Basic conditions for implementation of navigation technologies have been provided : legislative framework, prepared and approved industry solutions for different tasks

Development and implementation of GLONASS-based technologies

Government agencies
Agency programs (Ministry of Interior, EMERCOM, Federal Penitentiary Service and others)

Russian regions
Comprehensive regional GLONASS implementation projects, intelligent transportation systems for cities and national motorways

For industries
Russian Post, Transneft, Rosneft and others, road tolling systems (for vehicles over 12 tons)

Olympics 2014 project
Development of logistics and transportation center

Government projects
- ERA-GLONASS
- GLONASS-based transportation tolling system
- Hazardous freight transportation monitoring
- Digital tachographs (work-rest regime)

Further development of regulatory and legal framework

Legal framework has been established for implementation of GLONASS technologies
Refinement of regulatory and legal framework will accelerate the development of navigation information systems sector and adoption of GLONASS technologies

Globalization of GLONASS technologies

Russian companies actively promote GLONASS technologies on international market
GLONASS-based systems, equipment and services, tested and proven in Russia, are offered for export

GLONASS/GPS technologies should be used for modernization of transport system and transportation security

NIS national navigation services provider GLONASS

Size of the problem:
damage from road accidents - 2,5 % GDP, 27 953 people died

Systems in interest of safety

- State system «ERA-GLONASS»
  after 12.2013 - 40 mio vehicles
- Monitoring system of dangerous, bulky and heavy-weight cargo transportation
  after 2013 - 150 thousand vehicles
- Control and dispatch systems (regional, urban)
- Drivers' schedule of work and rest control system (digital tachographs)
  after 2013 - 900 thousand vehicles
- Police patrol /EMERCOM monitoring and control systems
  after 2015 - 5 mio vehicles
- Heavy truck tolling system
  since 2011 - 200 thousand vehicles
- Intelligent transport systems and transport streams
  after 2014 - 1,5 mio vehicles

Systems in interest of effectiveness

13 megapolis, 19 cities with a population more than 500 thousand people

Basic requirements to the systems: federal or regional scale, combination with each other and with federal safety systems and international systems

Commercial potential: prepared service platform and the most popular navigation device

NIS national navigation services provider GLONASS

ERA-GLONASS

Safety and security on the roads

Social effect: 4 thousand saved lives annually

Testing: since 12/2011
Operation: after 12/2013

State service consumers:
Drivers and passengers

Insurance telematics

Social effect:
Road discipline growth

Testing: since 9/2012
In the market: after 6/2013

Commercial service consumers:
cars' owners

Tolling systems

Fair recovery of damages

Economic effect:
Replenishment of Federal and regional road funds

Testing: since 12/2012
Operation: after 07/2014

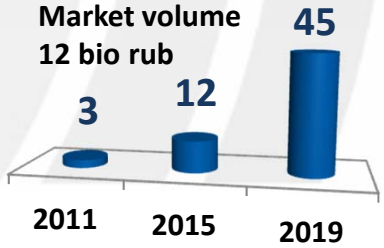
State service consumers (1st stage):
1,5 mio trucks (> 12 tonnes)

Services for car drivers

Ease and comfort on the road

Economic effect: new big market

Testing: after 10/2012
In the market: after 8/2013



Commercial service consumers:
cars' owners

Key and necessary market growth condition – functional expansion of «ERA-GLONASS» terminal

Industry solutions

NIS national navigation services provider
GLONASS

Precision farming

Agriculture with GNSS:

- 10% annual income increase
- 52% fuel cost reduction
- 67% labor cost reduction

High-precision integrated sensors

- Observation and control of forest fire danger

- Forest crime monitoring

- Identification of areas of low, medium and high forest pathology threat

Control systems for mining equipment

- > 12% increase of traffic volume
- 8% fuel consumption reduction
- 50% downtime reduction

Signal-searching device with self-contained power supply

- Signal-searching device sends signals on a user's mobile phone or to the dispatch center while attempting to open the property or to take away the device.

Most mobile devices already have functions of satellite navigation

Navigation helmet for bikers

Photo and video cameras

Tourist navigator with a satellite communication channel

Ski sunglasses

Navigation tracker for sport shoes

Navigation gadget for golf playing

Baggage tracker

Tracker for animals

Coming soon «Google glasses»

New navigation gadgets and based on them services – new opportunities for people

Satellite navigation for children and handicapped people

NIS national navigation services provider GLONASS

Navigation for wheelchair users

I know how to get there!

Voice and tactile navigation for visually impaired people

Ease of movement!

Children, sick and elderly relatives monitoring

We ALWAYS know where our family and friends are!

Telemedicine (patient's monitoring)

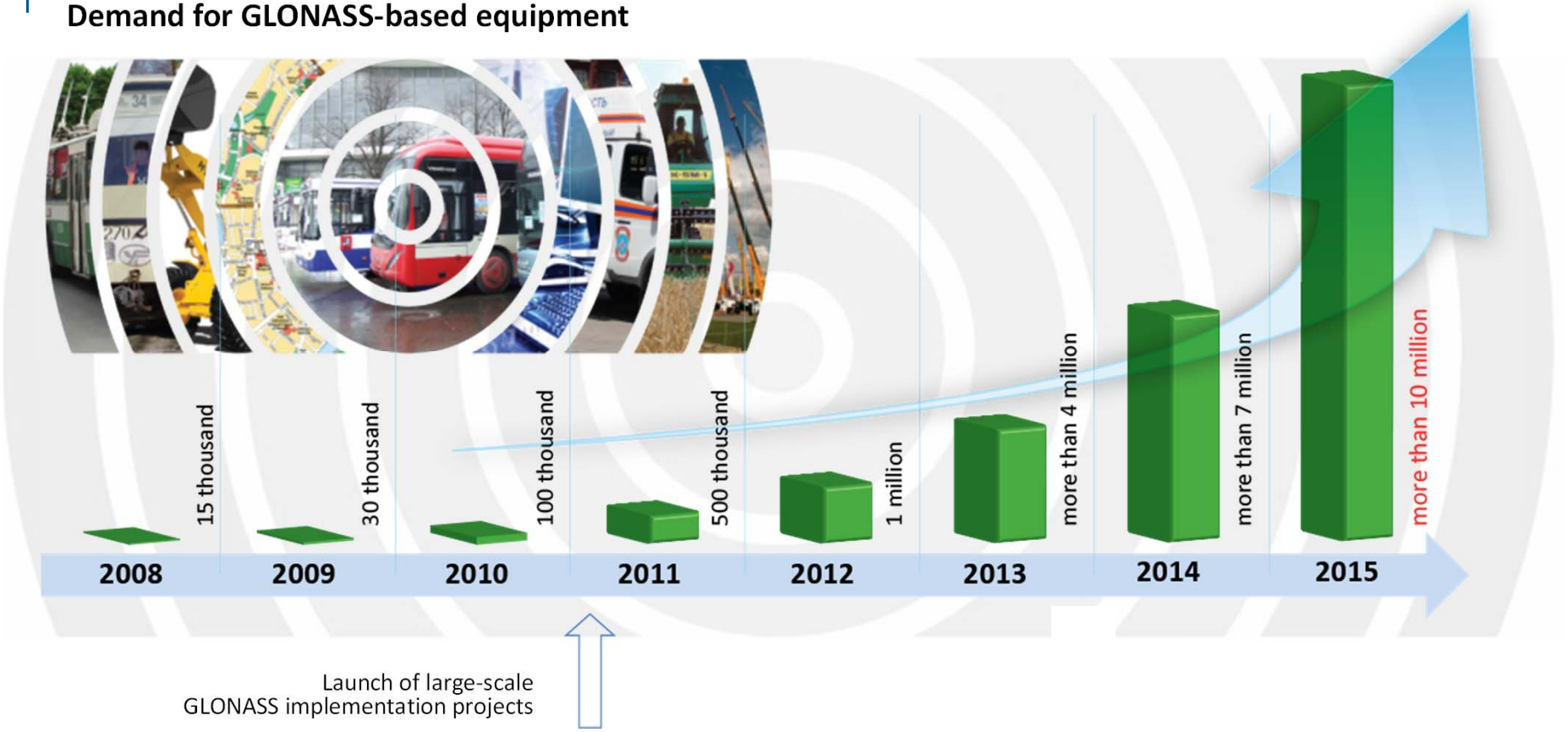
Help will come on time!

Navigation services provide additional safety and improvement of quality of life of the least socially protected groups

Effects on domestic GLONASS technology market

NIS national navigation services provider GLONASS

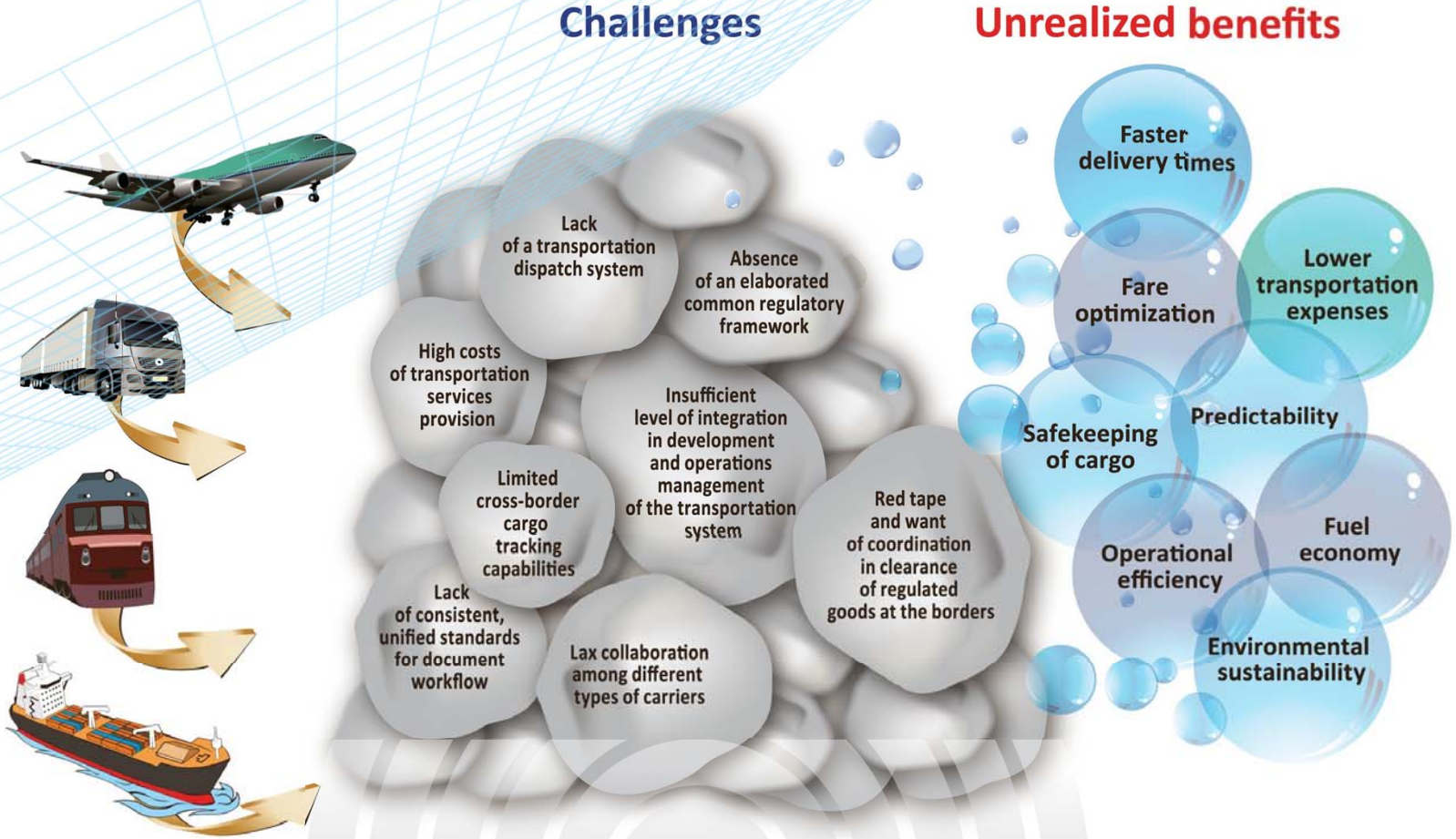
Demand for GLONASS-based equipment



GLONASS-based projects and programs create a multiplicative effect on growth in Russian innovation sector, a nd contribute to greater efficiency in various sections of national and regional economy.

Transportation monitoring and dispatch system

NIS national navigation services provider
GLONASS



Primary effects from development of navigation systems

NIS national navigation services provider GLONASS

Primary effects from development of navigation systems (freight transportation):

Transportation service purchasers (cargo owners):

- ✓ Effective control over the freight transportation process
- ✓ Continuous monitoring of fright location
- ✓ Prompt response in critical situations
- ✓ Objective information on compliance with transportation contract terms

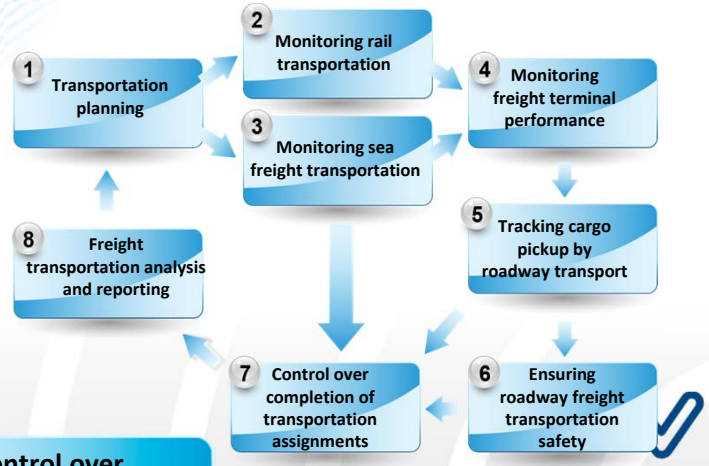
Transportation companies and individual haulers:

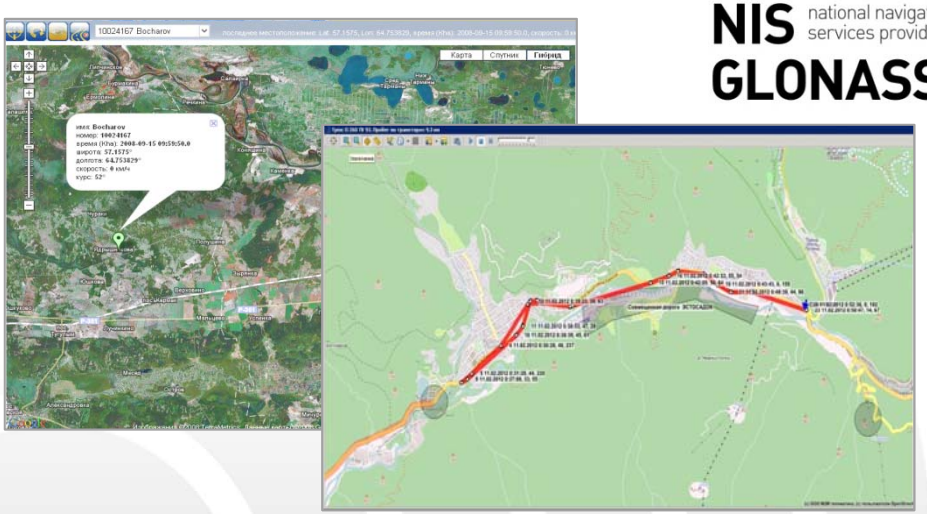
- ✓ Automation of planning and control of shift assignments
- ✓ Efficient utilization of freight transport
- ✓ Enhanced transportation route safety
- ✓ Objective control of compliance with transportation contract terms

Dispatch services:

- ✓ Continuous monitoring of vehicle location with electronic map display capability
- ✓ Automatic control of routes and timetables
- ✓ Prompt correction of deviations from transportation timetables
- ✓ Real-time communication with drivers
- ✓ Automated reporting of timetable performance and transportation volumes

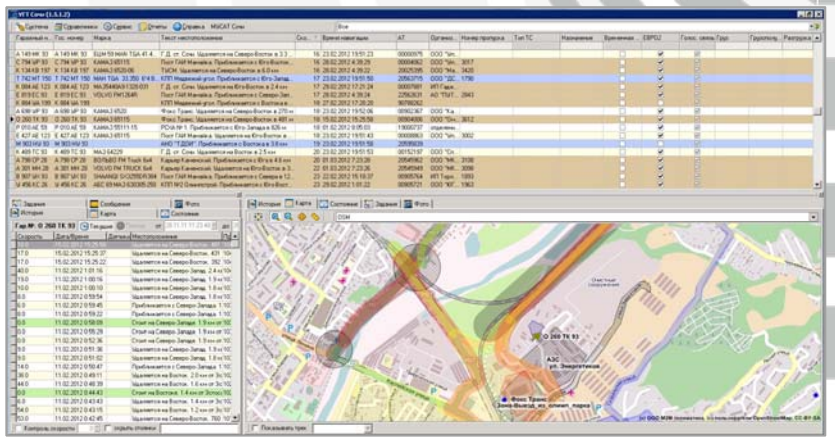
Control over completion of road freight transportation assignments using GNSS





7 Control over completion of road freight transportation assignments

- Reception, processing, and storage of telematics data from navigation communication equipment
- Integration with road transportation companies' telematics platforms
- Road freight transportation planning
- Monitoring road freight transportation vehicles
- Operational control over vehicles
- Analysis of road freight transportation vehicle performance



Cumulative effectiveness

NIS national navigation services provider
GLONASS

- Transportation transparency
- Faster freight movement
- Efficient tracking
- Enhanced transportation safety
- Capability to clearly delimit responsibility for delays
- Simplicity of customs processing
- Accompanying operational services
- Integration with marine, seaport, and railway systems

Implementation mechanism

NIS national navigation services provider GLONASS

Establishment of an international coordination consul
Signing of a framework cooperation agreement

Preparation of internationally coordinated design specification, taking
Into account requests and interests of all potential participants

Drafting of international formats for approval and operational regulation of monitoring & logistics platform

Defining implementation, investment, and control mechanisms

Navigation systems implementation challenges

- **Various navigation systems:**
  - Utilize different standards
  - Differences in navigation data exchange protocols
  - Differences in data composition and structure
- **Various navigation equipment manufacturers:**
  - Differences in design
  - Differences in functionality
  - Differences in reliability
- **Large number of transportation companies (corporate navigation systems) – quantity transforms into quality**

Standardization of utilized navigation technologies is a key factor for assuring operability of the navigation system for optimized logistics

Summary

- GLONASS Program is among priorities of the Russian Government policy
- GLONASS open service is free for all users
- GLONASS Program (2002-2011) completed, goal achieved
  - Performance are comparable with GPS
  - Full constellation (24 sats) deployed
- New GLONASS Program (2012 – 2020) approved 3 March 2012
  - Government commitments for major performance characteristics
  - GLONASS sustainment, development, use
- GLONASS will continue
  - Keep the GLONASS traditional frequency bands
  - Transmit existing FDMA signals
  - Introduce new CDMA signals
- International cooperation – make GLONASS as one of key elements of the international GNSS infrastructure for worldwide user benefits

NIS GLONASS national navigation services provider

Thank you for your attention!

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