РОСКОСМОС

FEDERAL SPACE AGENCY

GLObal Navigation Satellite System (GLONASS)

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PNT Center

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- **System description**
  - **Space segment**
  - **Ground segment**
  - **Signals**
  - **Performance**
  - **Timetable for system deployment. System Modernization**
- **Services provided and provision policies**
- **International cooperation**

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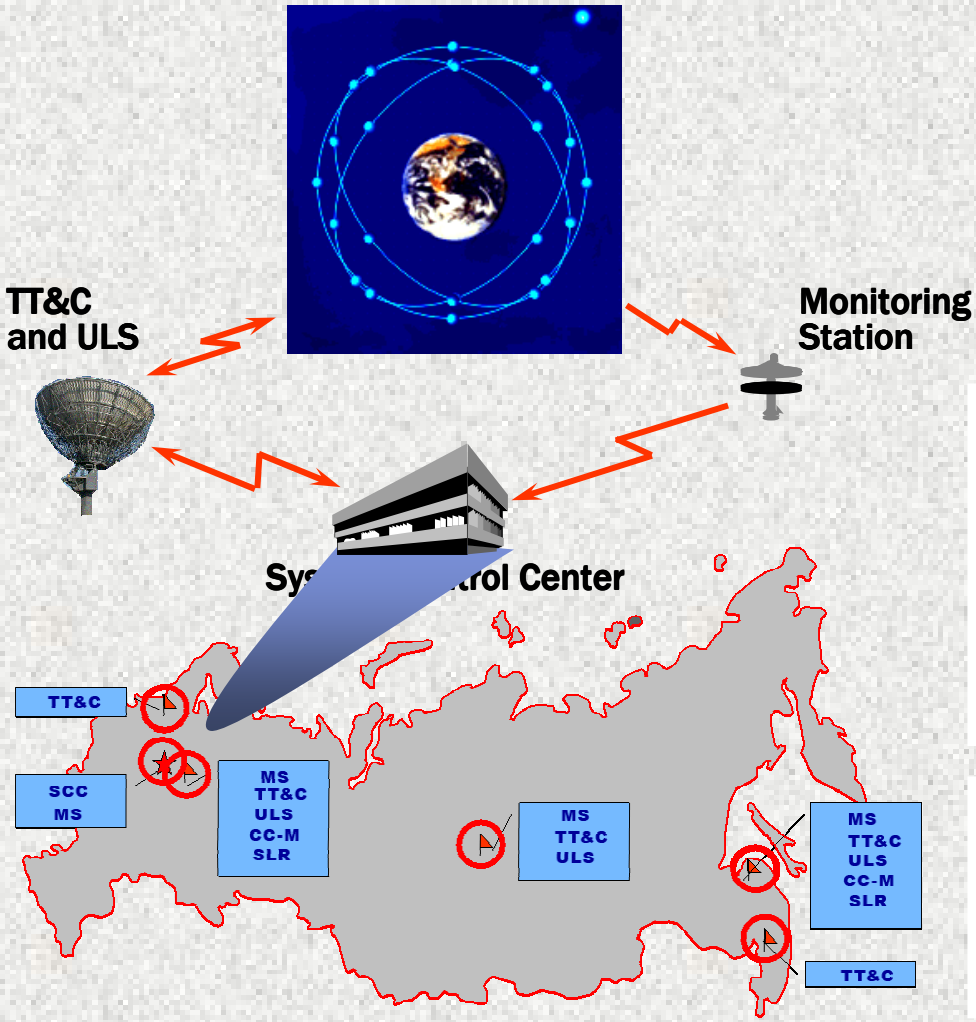
System Description
GLONASS Overview



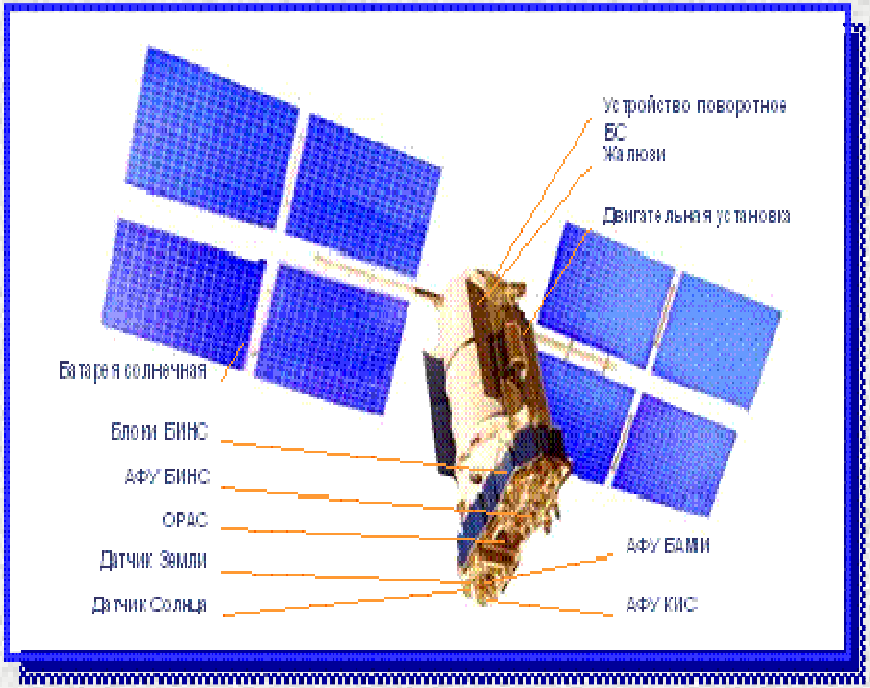
- **Orbit constellation:**
  - 24 satellites, 3 planes by 8 satellites
  - Orbit shift by 120 ° along the equator
- **Orbit parameters**
  - orbit – circular
  - height 19100 km
  - inclination 64.8°
  - revolution 11h15min
- **Two types of signal:**
  - Standard (open)
  - Special (authorized)

System Description. Space Segment

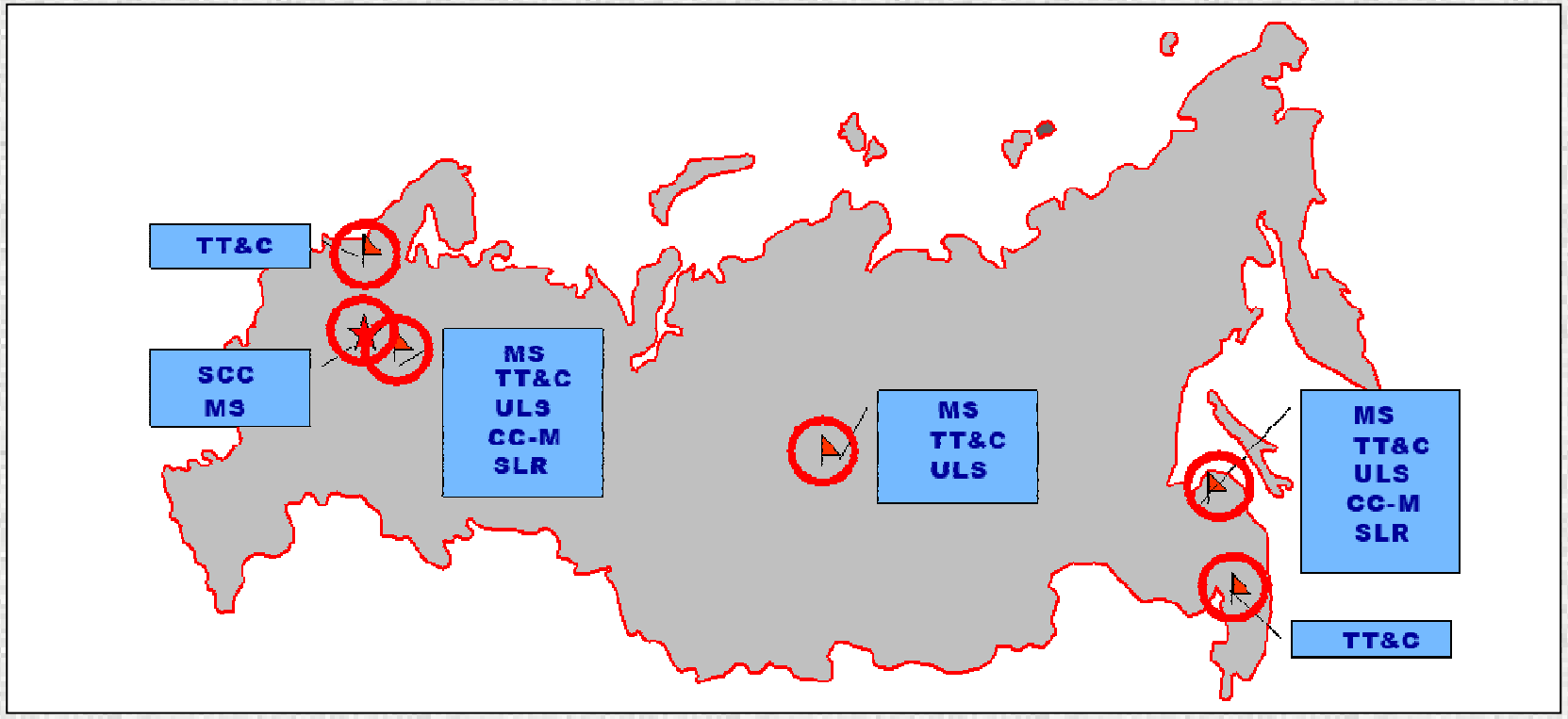
Navigation satellite "Glonass-M"

Main features

- Extended life time
- Second civil signal L2
- Increased board clock stability
- Improved attitude and the solar panel pointing accuracy
- Improved dynamic model
- Using Inter Satellite Link (ISL) measurements for improvement ephemeris and clock navigation data (test mode)



System Description.
Ground Control Segment



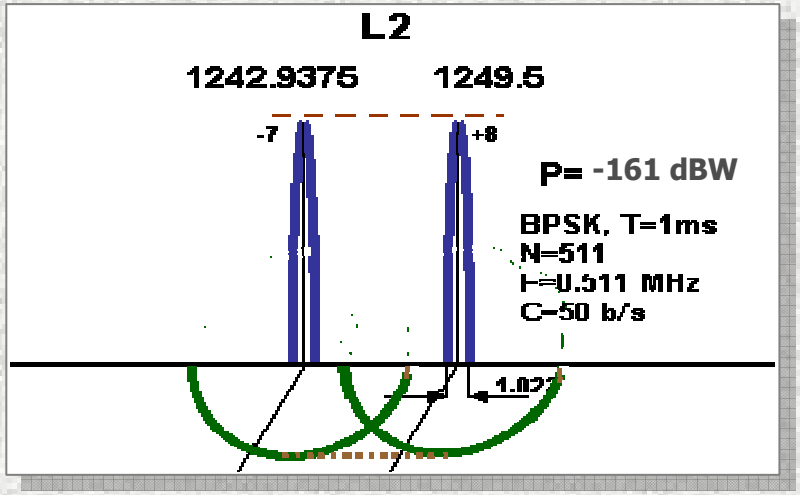
- SCC – system control center
- TT&C – telemetry, tracking, commanding station
- ULS – upload station
- MS – monitoring and measuring station
- CC – central clock
- SLR – laser tracking station
- Operational stations

GLONASS Improvement Events

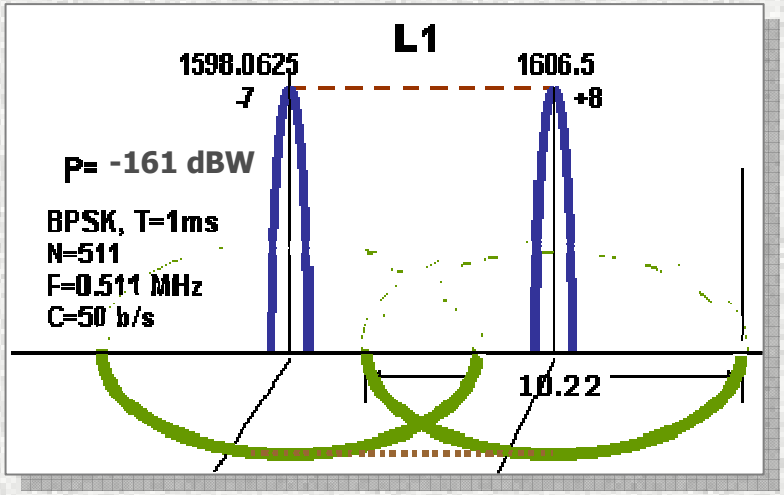
- 1st phase of Ground Control modernization
- Refined geodesy reference implemented (PZ-90.02)
- 21 GLONASS-M Satellites in orbit (two civil signals in L1 и L2)
- Latest launch:
  - March 2, 2010
    - ✓ 3 "Glonass-M" sats

Existing GLONASS FDMA Signals

- **L2**
  - **L2 open FDMA**
  - **L2 authorized FDMA**

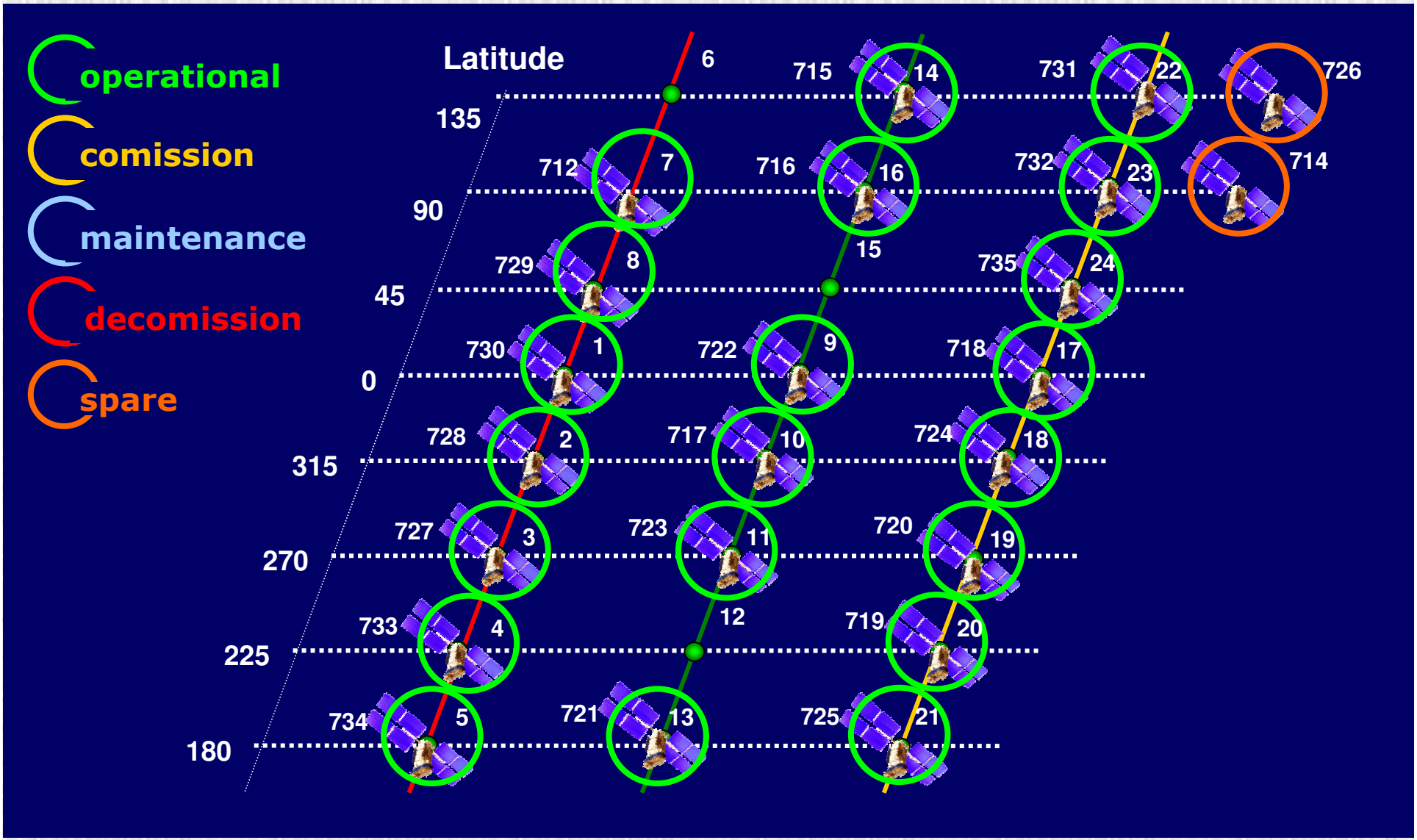


- **L1**
  - **L1 open FDMA**
  - **L1 authorized FDMA**

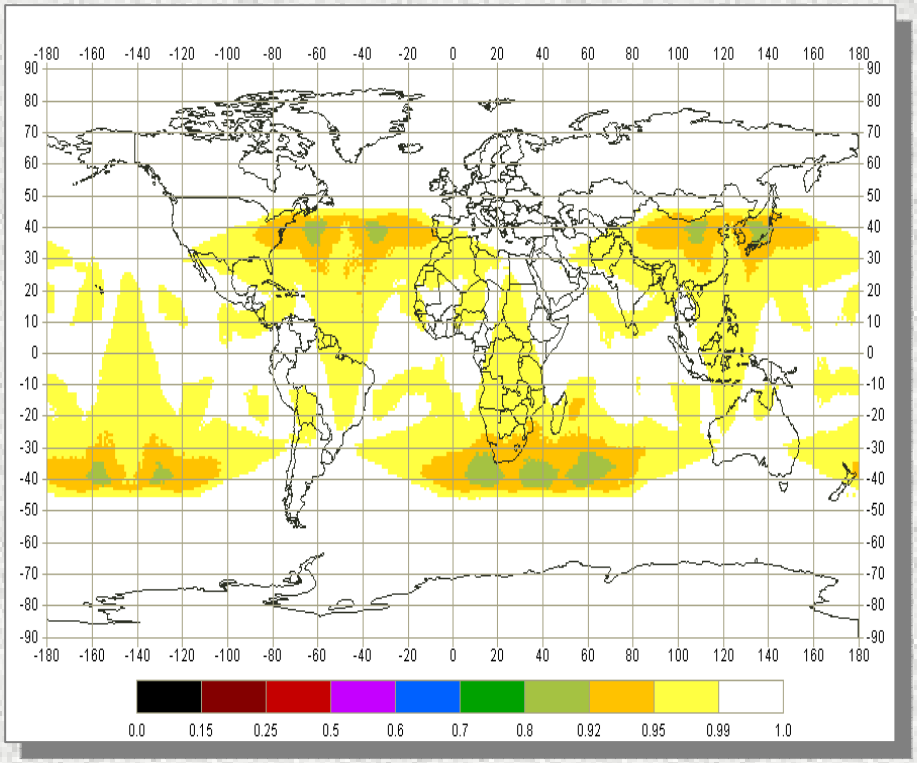


GLONASS will continue transmitting existing FDMA signals for the future

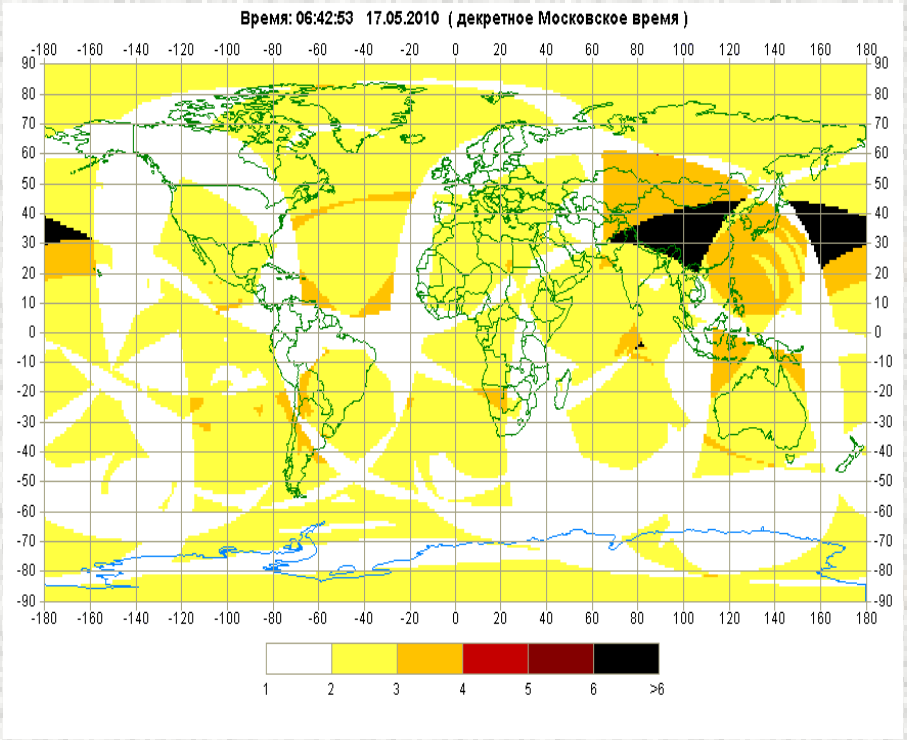
GLONASS Constellation Status (17.05.2010)
21 satellites operational



GLONASS Availability
(17.05.2010)



Mean availability for a day

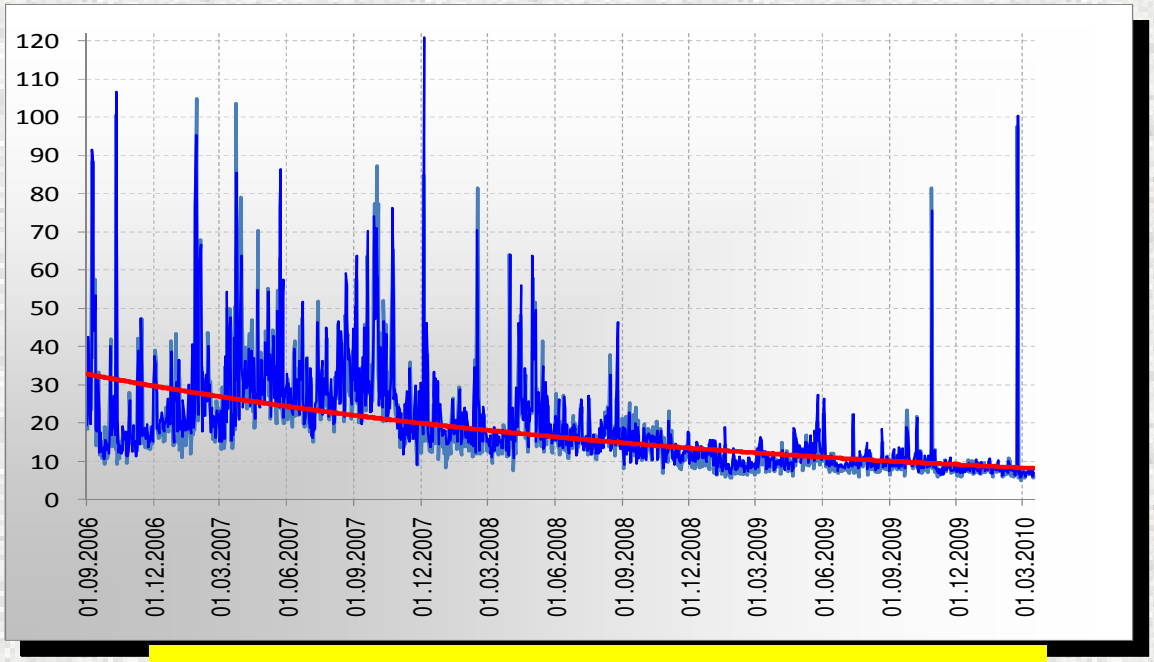


Instant availability (PDOP)

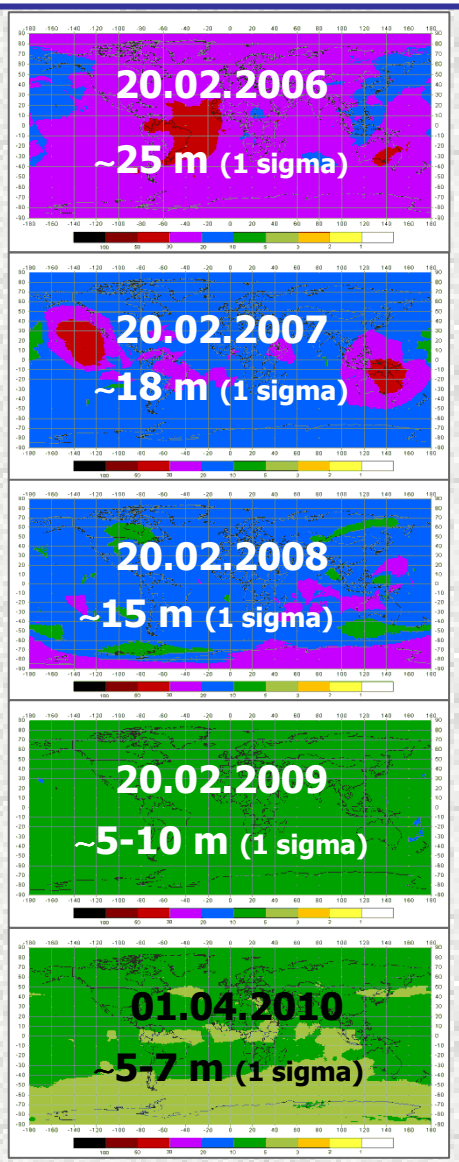
Global availability is 99% (PDOP<6, γ>5°)

GLONASS Accuracy

- GLONASS accuracy has 5 time improved for last three years
- Now it is the same order of GPS
- Next improvement phase is expected by 2011



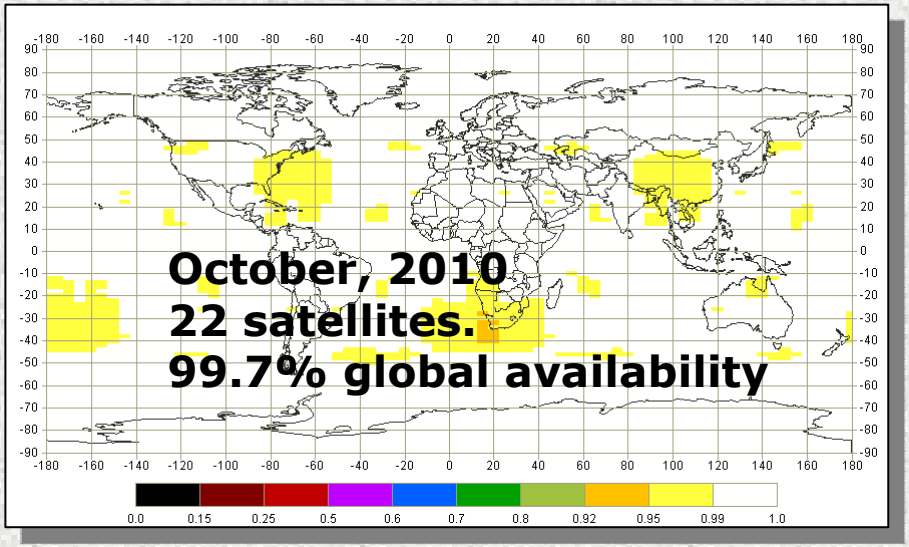
Ideal receiver positioning accuracy

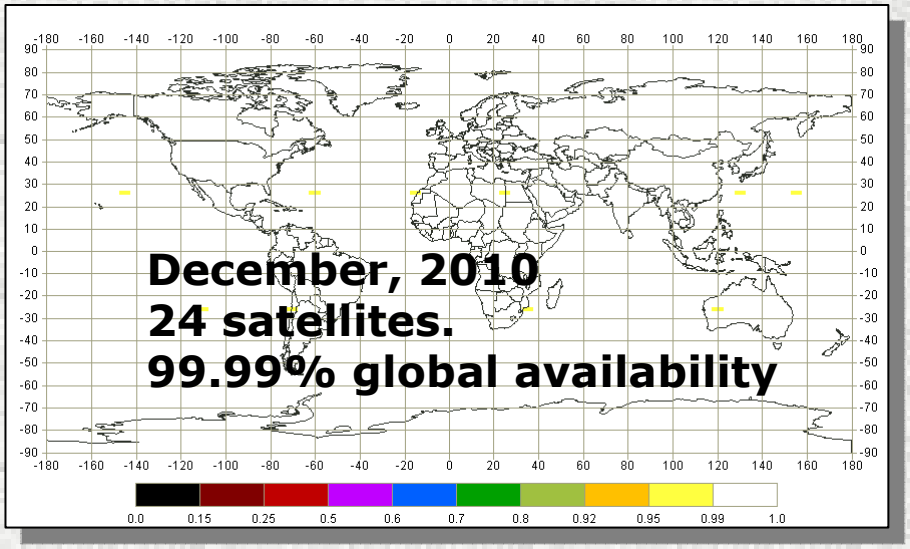


GLONASS Deployment Program

Next launches:

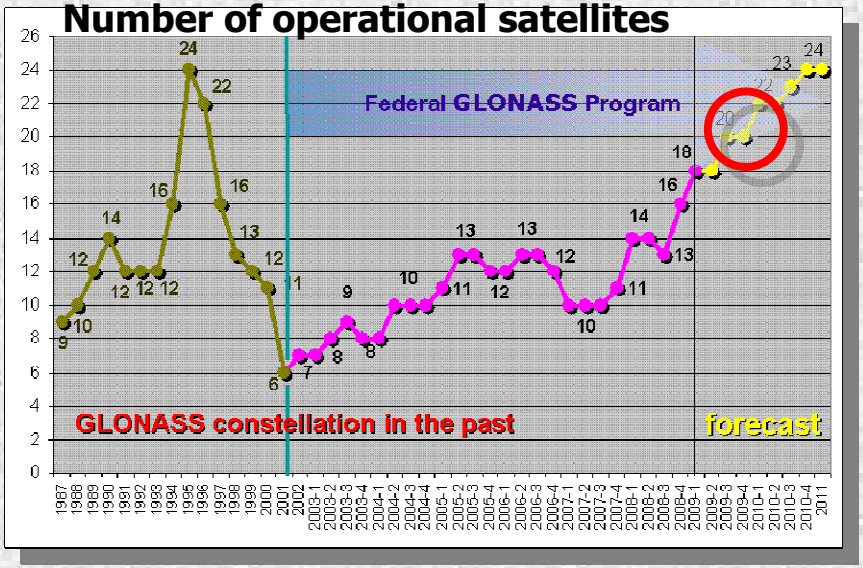
- **Block 42 (3 Glonass-M)**
  - **III quarter 2010**
- **Block 43 (3 Glonass-M)**
  - **IV quarter 2010**

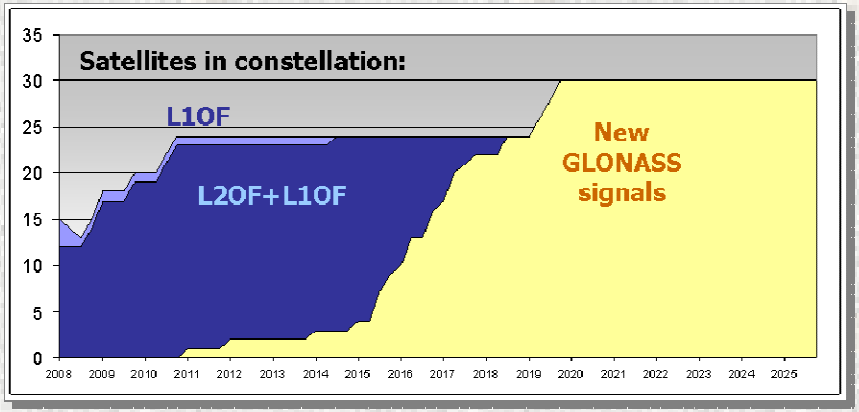




GLONASS Planning

- **Full constellation deployment in 2010**
- **Ground Control Segment modernization**
- **New GLONASS-K satellite (with improved performance) IOV start by 2010**
- **GLONASS will continue transmitting existing FDMA signals**
- **Additional new CDMA signals since GLONASS-K deployment**
- **GLONASS performance competitive ability provision plan**
- **GLONASS Federal Program extension until 2020**

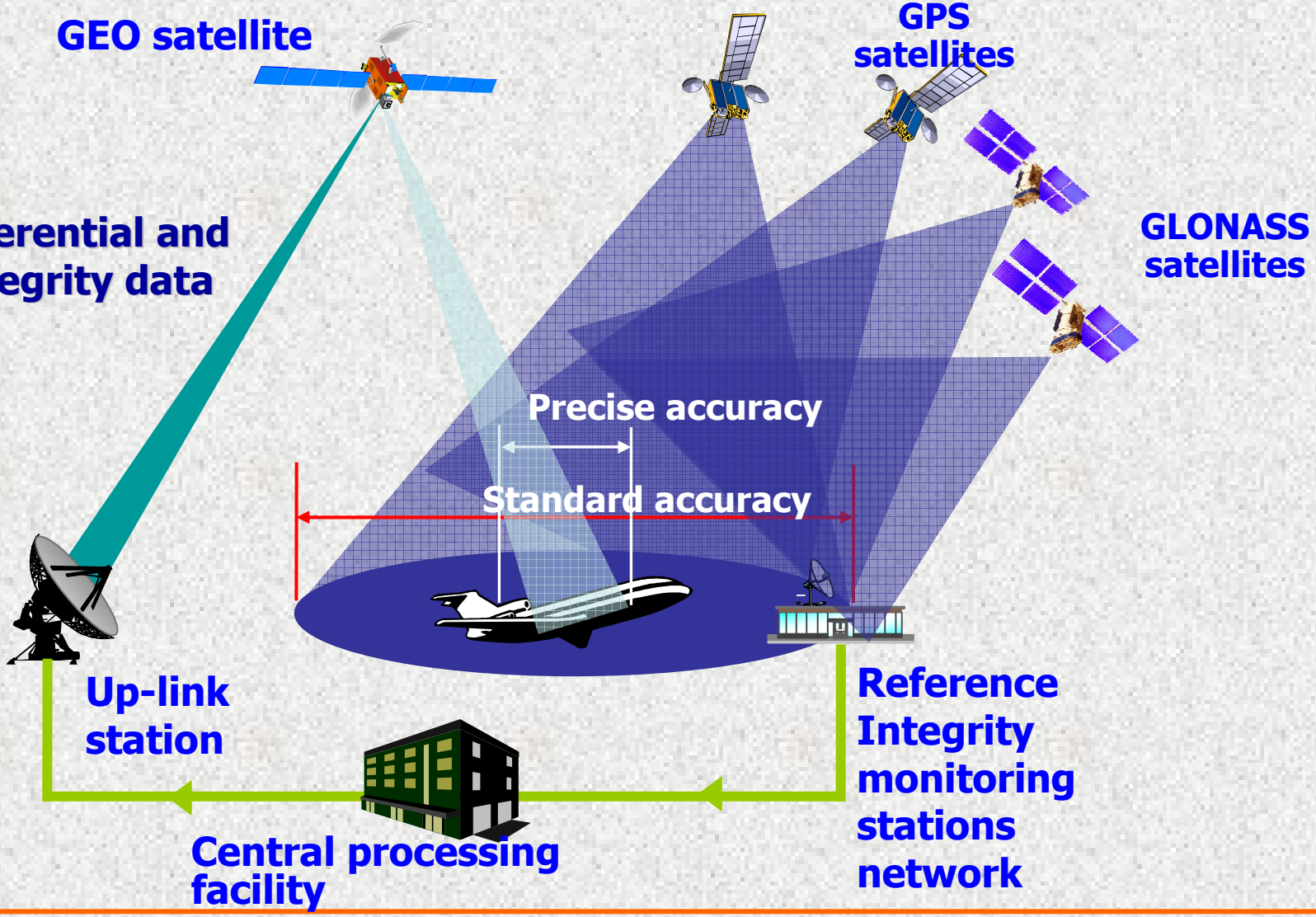




Constellation Update based on GLONASS-K

GLONASS-K Flight Tests

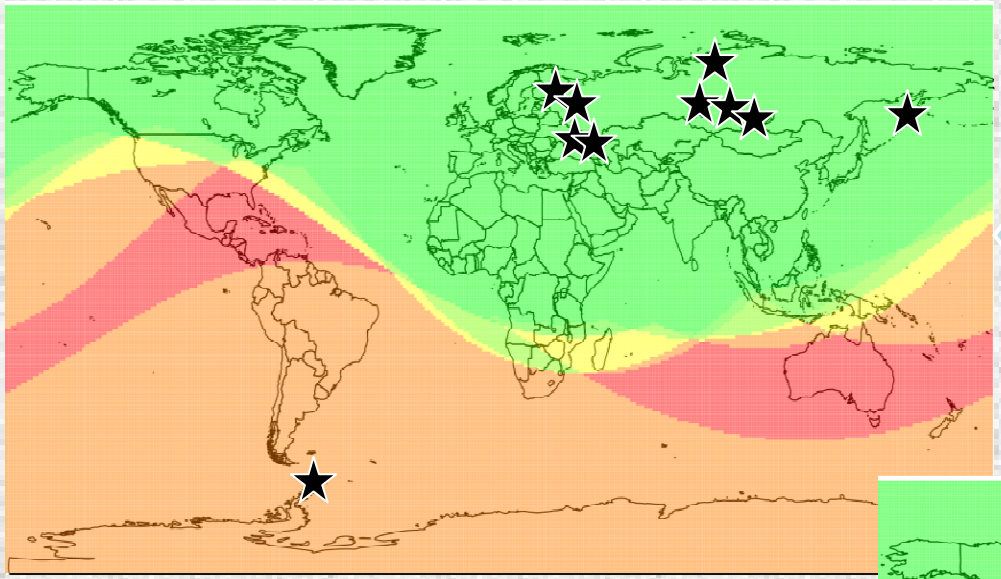
SDCM General Architecture



SDCM Objectives

- **GNSS Monitoring**
  - **Integrity monitoring**
  - **A posteriori detail analysis of system performance**
- **Differential corrections**
- **Service area – the Russian Federation**

Locations of SDCM stations

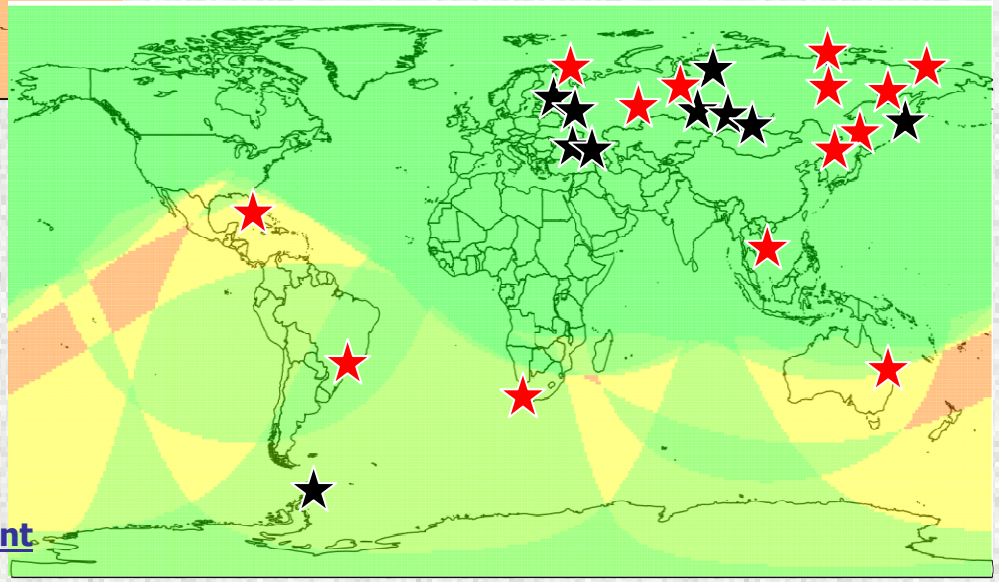


Active network

9 stations in Russia and 1 in Antarctica

Plans for future

9 stations in Russia
5 stations abroad



Tracking satellite by several stations at the same moment

>3	2	1	0

SSI-01 monitoring station installation and commissioning (Bellingshausen, Antarctica, 2010)

Main view of the SSI-01

Off-site equipment

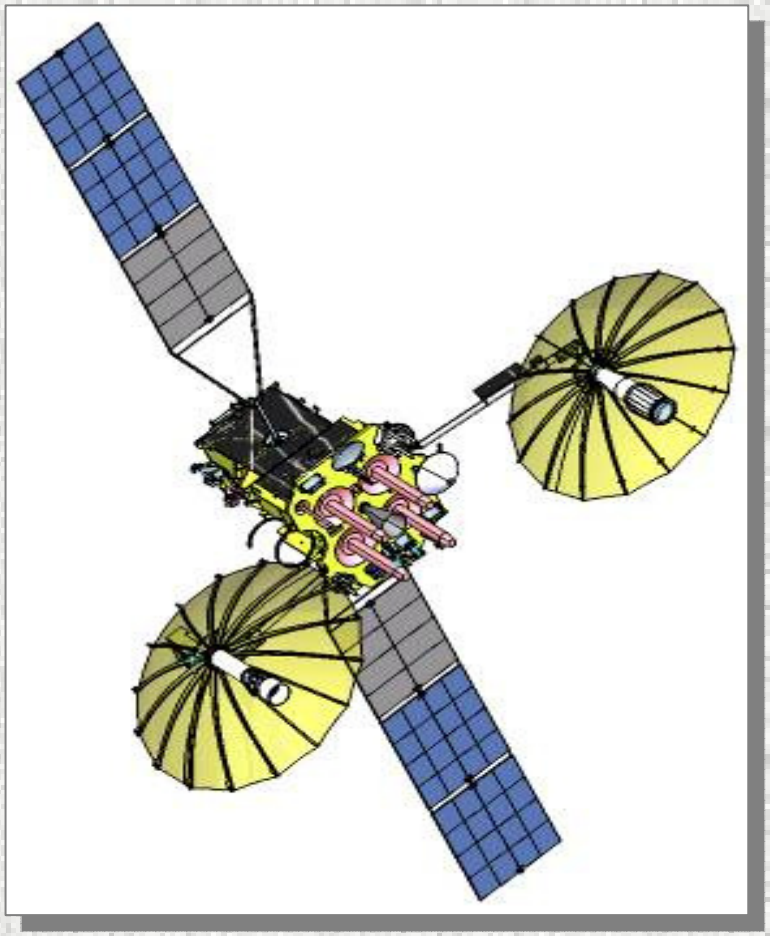
GLONASS/GPS antenna + Vaisala weather station

Satellite communication channel antenna

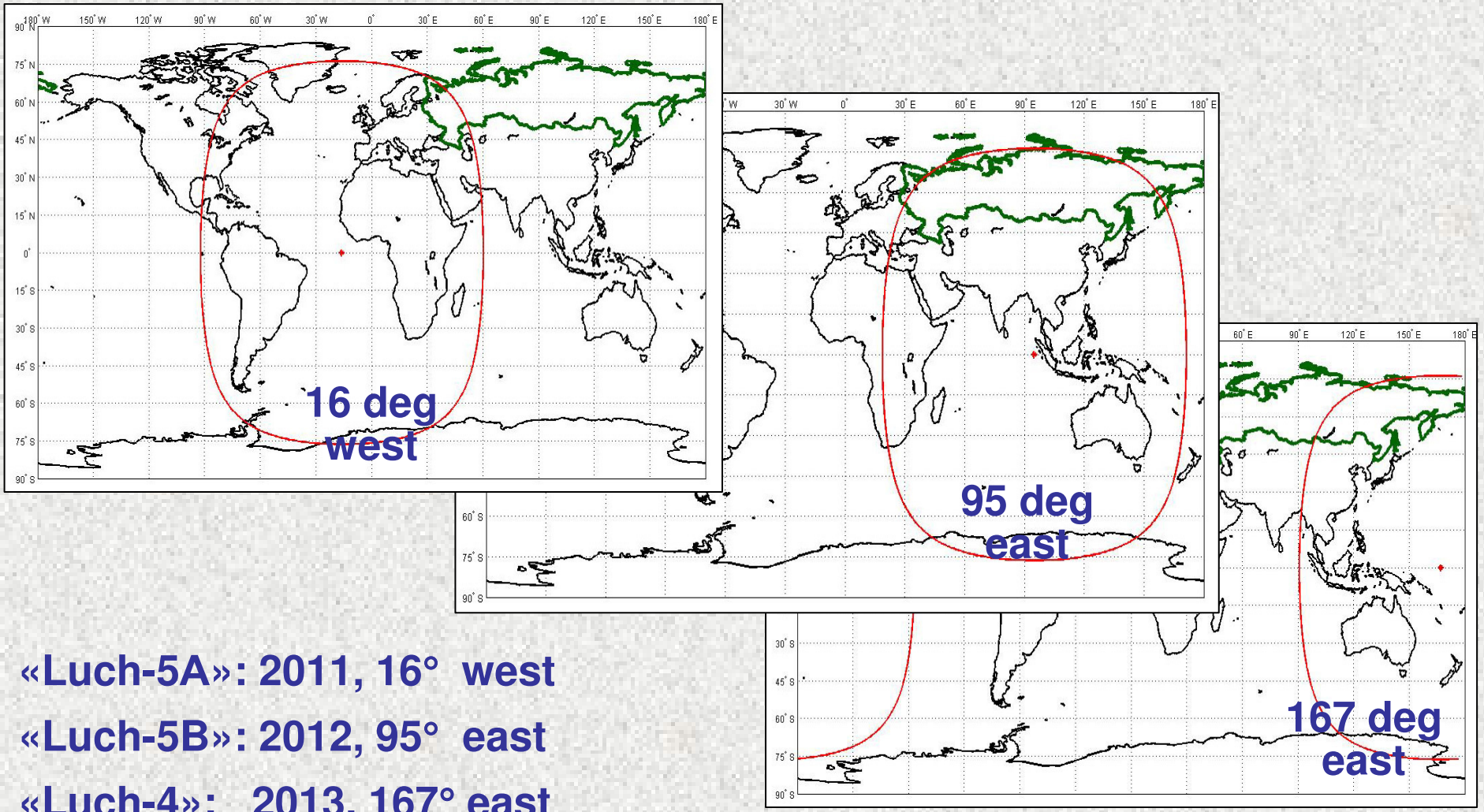
SDCM Space Segment

- **Mass**
  - 1000 kg
- **Life-time**
  - 10 years
- **Antenna pattern:**
  - Narrow
  - Re-steering
  - Omni directional
- **Longitudes:**
  - Luch-5A: 16° west
  - Luch-5B: 95 ° east
  - Luch-4: 167 ° east

GEO «Luch – 5A» with L1 transponder



Envisaged locations for GEOs "Luch" with SDCM payload (2011-2013 timeframe)



«Luch-5A»: 2011, 16° west

«Luch-5B»: 2012, 95° east

«Luch-4»: 2013, 167° east

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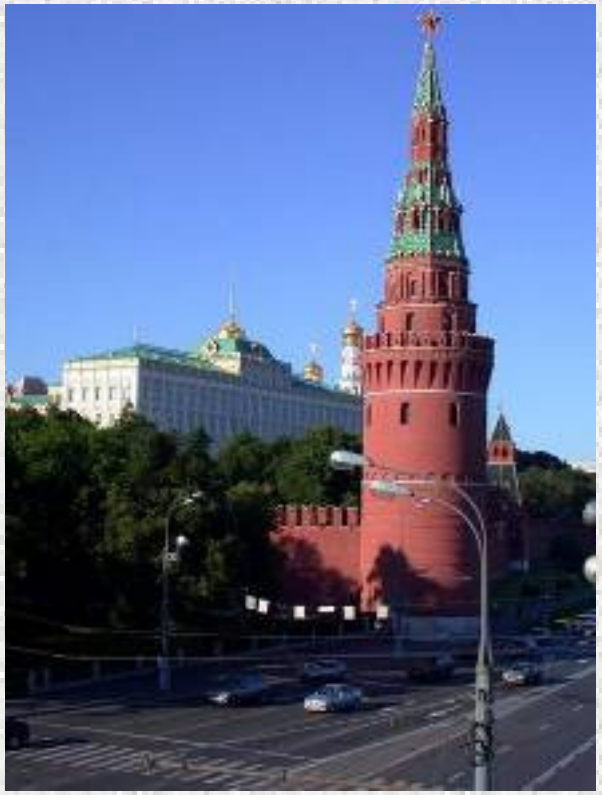
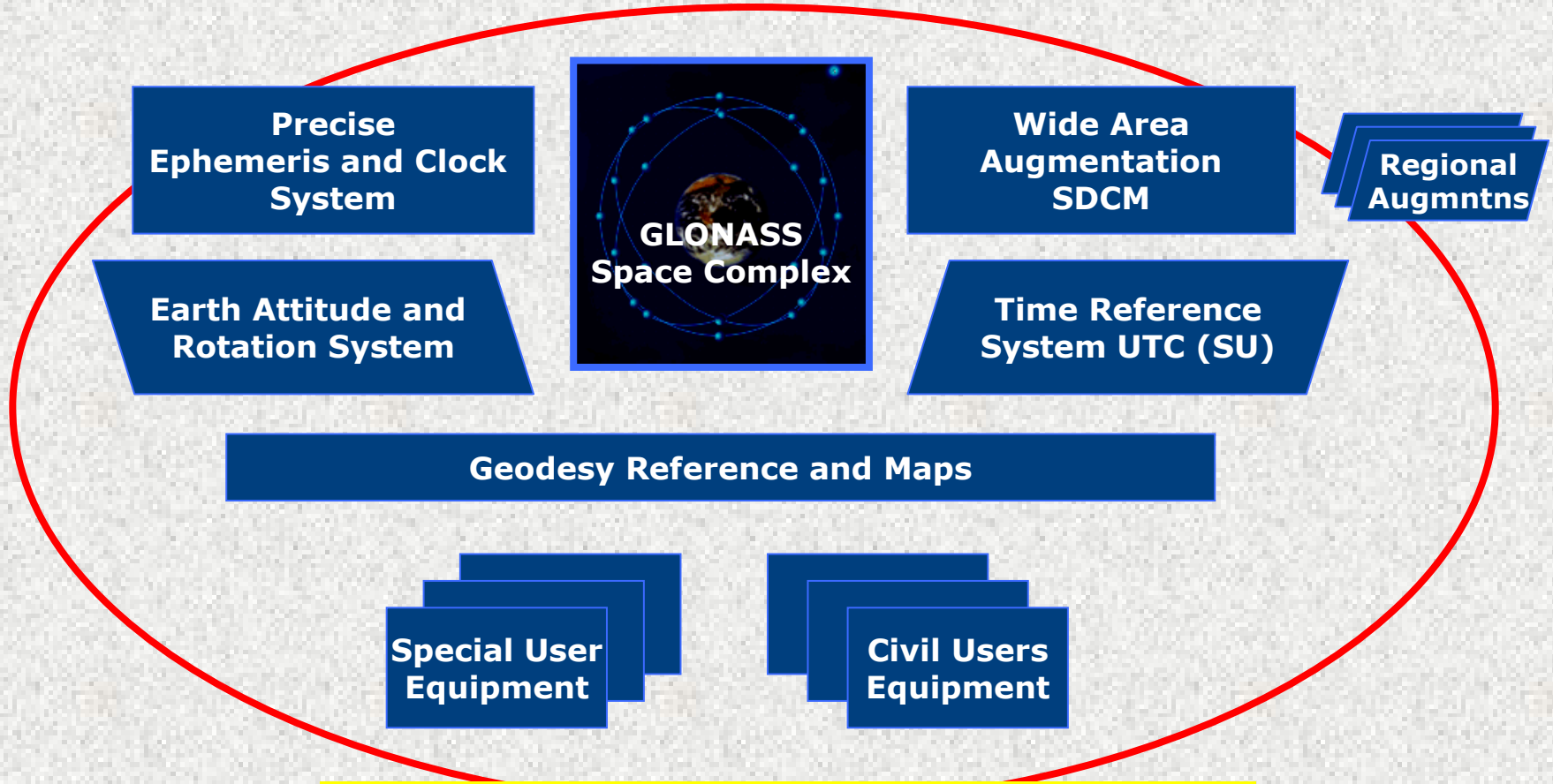
State Policy Basic Principles

- GLONASS is a part of the critical state PNT infrastructure providing national security and economy development
- Creating, developing and sustaining the PNT infrastructure is a State responsibility
- No direct user fees for civil GLONASS services
- Open, free access to GLONASS information necessary to develop and build user equipment
- GLONASS is used in combination with other GNSS, terrestrial radio navigation, other navigation means to increase reliability of navigation
- International cooperation on GNSS compatibility and interoperability



Federal GLONASS Program is a basis for GLONASS sustainment, development and use

Extended PNT Architecture of Russia



Synergy of performance and requirements

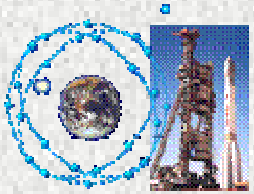
Federal GLONASS Program 2002-2011

- Provide full constellation of 24 satellites by 2010
- Improve GLONASS performance
- Implement new GLONASS signals
- Encourage the GLONASS worldwide use

Update of September 12, 2008

Subprograms

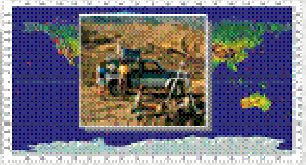
1. GLONASS sustainment, development and deployment



2. User equipment development for civil users

3. Satellite navigation technique implementation in transport areas

4. Geodesy reference improvement



5. User equipment development for authorized users

Concept of Program Extension to 2020 is under interagency coordination

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International Cooperation

- **Goals:**
  - Promote GLONASS worldwide use
  - Provide GNSS compatibility and interoperability
  - Integrate GLONASS into the Global GNSS Infrastructure
- **Cooperation with GNSS providers**
  - The United States – GPS/GLONASS compatibility and interoperability
  - European Union – Galileo/GLONASS and augmentations compatibility and interoperability
  - India – GLONASS deployment support, augmentations interoperability
  - UN GNSS Providers Forum
- **GLONASS Use Cooperation**
  - Former USSR countries
  - Middle East, Australia, Latin America…
  - UN ICG

Summary

- **GLONASS Program is the high priority of the Russian Government policy**
- **GLONASS Program is in progress, will be extended to 2020**
- **GLONASS improvement is a major objective:**
  - **Performance to be comparable with GPS by the end of 2011**
  - **Full constellation (24 sats) by the end of 2010**
  - **New signals implementation to improve the service for both military and civil users**
- **Compatibility and interoperability are the goals of international cooperation, as well as the GLONASS worldwide use**

The 4th International
Satellite Navigation Forum

1-2 June, 2010

Expocentre Fairgrounds

Moscow, Russia

www.GLONASS-FORUM.RU

FEDERAL SPACE AGENCY

Thank you for your attention!

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