

# **GLONASS Global Satellite Navigation System**

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## About the presentation

- This presentation was developed in the scope of the EuropeAid funded project:  
**“Certification of the Global Satellite Navigation System (GNSS) - creation of a unified system to certify GNSS equipment and a certification centre”**
- Project duration: 7 June 2000 - 7 August 2002
- Project leader: **SGS-Belgium**
- Consortium Members:
  - International Institute of Air and Space Law (IIASL) - NL
  - IMEC - B, Aero-DB - B
  - Russian and CIS experts from: **GeoTSUP, RAKA, Rostelecom, Gosstandard of RF, Morsvyazsputnik, SDB Kamerton -BR, MinTran - Ukraine, Temir Zholy - KZ**

# GLONASS System Architecture

## Orbital Constellation:

24 satellites  
(3 planes x 8 satellites)

## Orbit type:

circular,  
 $H = 19\,100\text{ km}$ ,  
 $i = 64.8^\circ$

## Orbital period:

11 hr 15 min

The orbits are shifted by  $120^\circ$  along the equator



## Normative documents of the GLONASS development

### Directive of the RF President ? 38-rp as of February 18th, 1999

- GLONASS is treated as a dual-purpose space technology.
- It is allowed to attract foreign investments to finance works on GLONASS through making the system available for the implementation of an international global satellite navigation system.

### Resolution of the RF Government ? 346 as of March 29th, 1999

- Decision on making GLONASS available for the implementation and development of international global satellite navigation systems.
- Regulation validated on sharing responsibilities on maintenance, operation and development of GLONASS between the Federal Executive Agencies.
- Responsibility for the international co-operation on GLONASS entrusted to the Russian Space Agency.

### Resolution of the RF Government ? 896 as of August 3rd, 1999

- Obligatory use of GLONASS and GPS combined navigation equipment by the State services.

### Resolution of the RF Government ? 587 as of August 21st, 2001

- Obligatory use of GLONASS and GPS combined navigation equipment by the State Agencies.
- Validated the Target Program “Global Navigation System”.
- Defined the amount of funding GLONASS maintenance and development.
- Assigned measures and terms to upgrade the existing aids and to build new GLONASS facilities.
- Responsible customers appointed for all the principal elements of the Program.

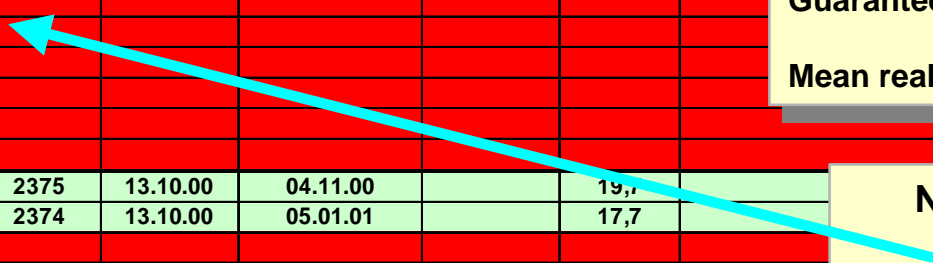
## Current Status of GLONASS

Plane N	N orbit cell	N GCS	Cosmos N	Launch date	Date of entry to the system	Date of withdrawal	Active service life months	Remarks
I plane	1	779	2364	30.12.98	18.02.99	31.01.2002	35,4	mainte
	2							
	3	789	2381	01.12.2001	04.01.2002		5,7	
	4							
	5	711	2382	01.12.2001				
	6	790	2380	01.12.2001	04.01.2002		5,7	flight tets
	7	784	2363	30.12.98	29.01.99		40,9	
	8	786	2362	30.12.98	29.01.99		40,9	
II plane	9							
	10							
	11							
	12							
	13							
	14							
	15							
	16							
III plane	17	787	2375	13.10.00	04.11.00		19,7	
	18	783	2374	13.10.00	05.01.01		17,7	
	19							
	20							
	21							
	22							
	23							
	24	788	2376	13.10.00	21.11.00		19,2	

**7SV in normal operation:**  
 1 plane – 4 SV of 8  
 2 plane – 0 SV of 8  
 3 plane – 3 SV of 8

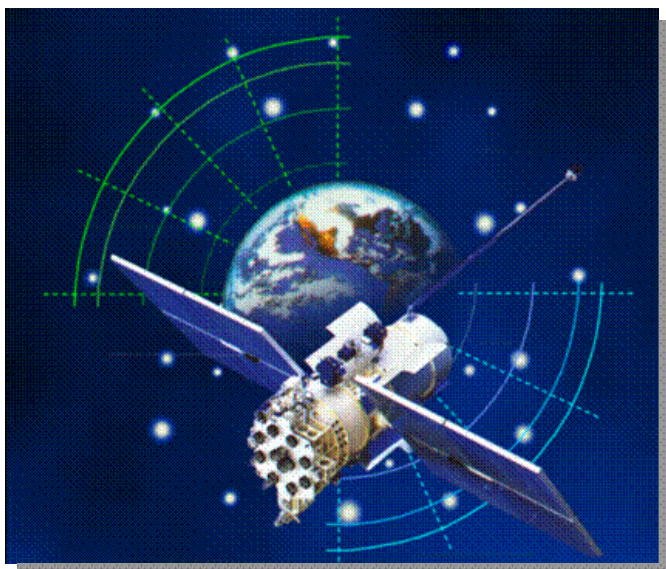
**Guaranteed active life - 36 months**  
 Mean real active life 52.6 months

**Next launch (3 SV):**  
 December 2002

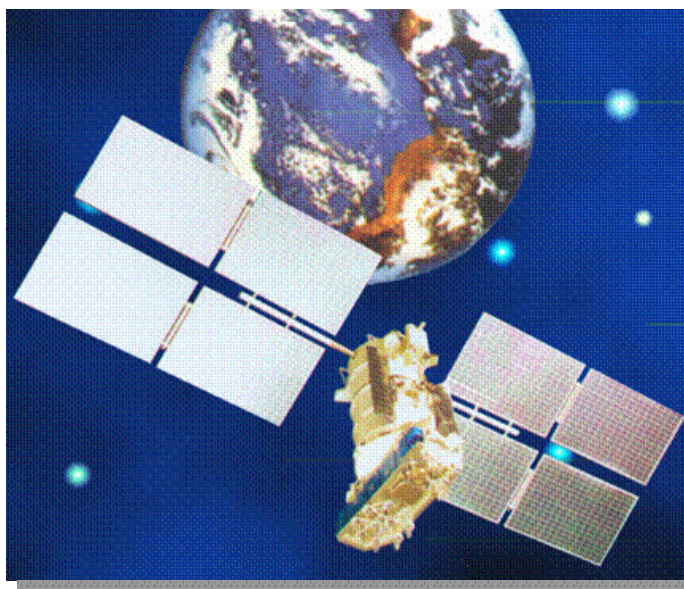


## Overall view of the GLONASS SV

**GLONASS**



**GLONASS-M**



**GLONASS-K**



## Target Program of GLONASS development 2002 – 2011

### Phase 1. Replenishment of the constellation with the existing GLONASS SV

- Maintaining the constellation at a minimal level.

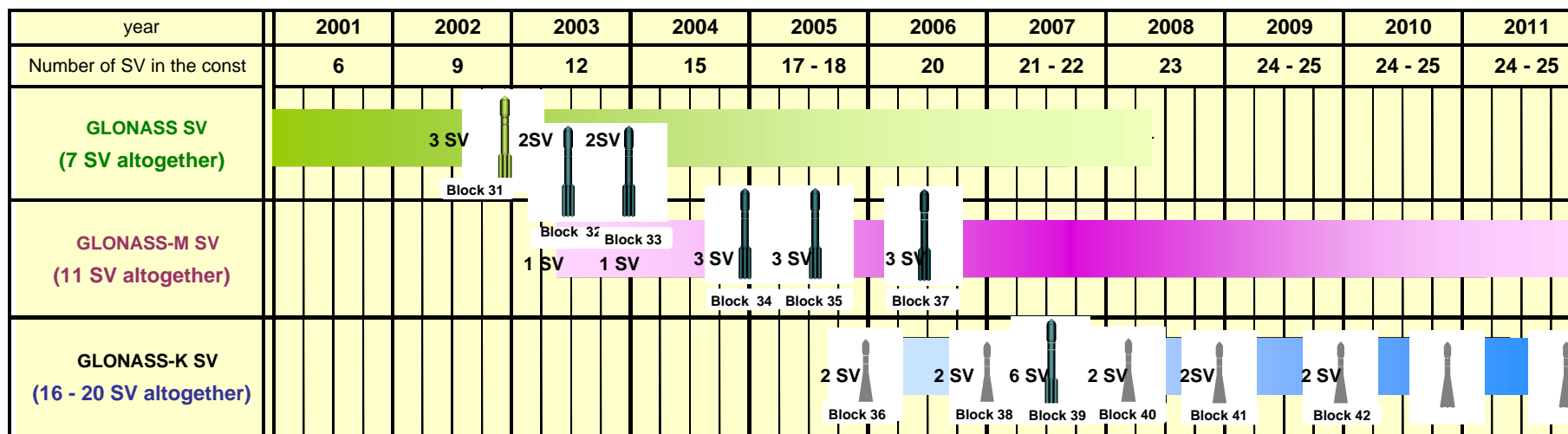
### Phase 2. System upgrade using GLONASS-M SV

- Flight tests of the GLONASS-M SV in 2003.
- Guaranteed active life of 7 years.
- Transition to the agreed frequency band.
- Introducing a second frequency for the civil community.
- Test trials of elements for the advanced SNS.

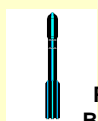
### Phase 3. Further system upgrade using GLONASS-K SV

- Further upgrade of the SV active life to 10 years and more.
- Reducing the overall SV mass to provide launches of 6 to 8 SV at a time by PROTON-M rocket launchers and 2 to 3 SV by SOYUZ-2 launchers.
- Upgrade of the ground control complex.
- Introducing a third frequency in the L-band.
- Improving navigation signal characteristics taking into consideration the growing navigation user requirements.

# GLONASS constellation replenishment program



PROTON RL  
Booster 117861



PROTON-M RL  
Briz-M booster



SOYUZ-2 RL  
"FREGAT booster"



## Activities to upgrade the SV

- Improving the round-the-clock on-board time scale stability to  $1 \cdot 10^{-13}$ .
- Engineering development of the on-board service systems.
- Upgrade of the on-board computer complex and modification of the ephemeris formation algorithm on board the SV.
- Incorporation into the navigation frame the GLONASS time scale correction relative to the UTC and the GPS time scale.
- Transition to the agreed frequency band of navigation signal transmissions.
- Increasing the active service life to 7 to 10 years.
- Introducing inter-satellite measurements.

## Activities on development and introducing monitoring aids, augmentations & navigation equipment

- Establishing a civil network for GLONASS and GPS status monitoring.
- Development of hardware & software facilities for the system status monitoring.
- Implementation of a differential network.
- Provision of manufacturing and introducing of 3rd generation combined user navigation equipment.

## Cooperation areas to provide SNS complementarities

- ▼ **Coordination of the programs of GALILEO development and implementation of the GLONASS Federal Target Program**
- ▼ **Joint solution of security provisions**
- ▼ **Optimisation of the GALILEO orbital constellation to provide optimal characteristics for joint GALILEO operations with GLONASS and GPS**
- ▼ **Selection of the civil signal structure**
- ▼ **Coordination of the geodetic reference system and the system time**
- ▼ **Joint design of the space vehicle**
- ▼ **Deployment of the GALILEO system using Russian launchers**
- ▼ **Unification of the ephemeris and time data**
- ▼ **Co-operation in implementation of the SNS status monitoring segment**
- ▼ **Joint development of the user navigation equipment**
- ▼ **Flight experiments on the GLONASS-M SV with the GALILEO payload**