FSA report to the CCSDS Management Council
Noordwijk, Netherlands, October 2009

Federal Space Agency
Vladimir Grishin
The Main Priorities of Russia Space Activity up to year 2020

Meet Social & Economic Demands of the Society in results of Science Space Activities

Fulfillment of Russian Federation International Commitments including ISS and Completion Deployment of the Russian ISS Segment

Solar System Planets and Bodies Investigation, Astrophysical Research
## The Main Directions of Sun and Solar System Planets Exploration

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<th>Direction</th>
<th>Description</th>
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<td>Mars Investigation of Physical Conditions and Delivery of Martian Soil</td>
<td>Study to deliver Martian soil and Phobos Substance to the Earth</td>
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<td>and Phobos Substance to the Earth</td>
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<td>Morphology and Mineralogical Structure Study of the Moon Surface</td>
<td>Study to find resources for practical use</td>
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<td>to find resources for practical use</td>
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<td>Sun Investigation to understand Solar Activity Drivers</td>
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<td>Investigation of Earth magnetic fields and interaction processes Sun</td>
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<td>Space-based facilities development for exploration of Mercury, Venus</td>
<td>Development of space-based facilities for exploration of Mercury, Venus, and the Jupiter system</td>
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<td>Anti-Asteroid and Comet Earth Security System Development (outlook)</td>
<td>Development of systems for asteroid and comet security</td>
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The main projects are Phobos-Grunt, Luna-Glob, Interheliozond, Resonance, Venus D.

The main perspective projects are Sokol-Laplas, Mars-NET.
**Luna-Glob**

**Purposes**
- Lunar Interior Investigation
- Lunar resources Search

**Characteristics**
- **Launch** – 2012
- **Carrier vehicle**: LV “Soyuz-2” + upper-stage rocket “Fregat”
- **Take-off mass**: 2125 kg
- **Payload**: 3 penetrators and an orbiter
- **Mission Status**: Draft Design
- **Mission Duration**: 3 years
Lunar Robotic Outpost

- **Orbiter**
- **Lunar rover**
- **Power module**
- **Launch module**
- **Telecom module**
- **Scientific module**
- **Gravimetric satellites**
- **Transponder**
- **Construction machine**
Main Objectives

- Phobos sample return
- Development of a unified service module to be used during missions to Solar System celestial bodies
- In-flight development of methods for birthing small celestial bodies with further return to the Earth

Characteristics

- Launch – October 2011
- Mission duration – 2.7 years
- Earth-to-Mars trip duration – 11 months
- Carrier vehicle – LV "Zenit-2SLB"
- Take-off mass – 12100 kg
- Earth reentry vehicle mass – 6 kg
Mars-NET

**Characteristics**

- **Launch**: 2016
- **Take-off mass**: 2500 kg
- **SC mass in a Mars satellite orbit**: 2380 kg
- **Network configuration**: 10 small stations (probes) and 3 penetrators
- **Small station mass**: 15 kg
- **Penetrator mass**: 55 kg

**Purpose**

Long-term Mars and near-Mars space exploration using remote and contact methods based on the exploratory facilities network.
Martian Robotic Outpost

- Orbiter
- Launch module
- Scientific module
- Power module
- Martian Rover
- Construction machine
- Transformer
Venus D

**Characteristics**

- **Takeoff mass** - 8120 kg
- **SC mass in a near-Venus orbit** - 1900 kg
- **Network configuration** - 10 small stations and 3 penetrations
- **Orbiter mass** - 600 kg
- **Lander mass** - 1100 kg
- **Launch** - 2016

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**Venus D Architecture**

1 – Lander  
2 – Orbiter  
3 – Solar batteries  
4 – RCS thrusters

The lander includes a long-term habitation module (up to 30 days) and 3-4 balloon probes.

The balloon probes will be deployed at different latitudes and altitudes from 60 km (in clouds) down to 10 km.
SC Design Configuration for Exploration of The Jupiter and Its Satellite Named Europe

**Sokol-Laplas SC design configuration**

**Characteristics**

- Launch 2020
- SC launching mass – 6800 kg
- Transit and retro module mass ~ 2000 kg
- Approaching probe mass ~ 500 kg

**Scientific objectives**

- Extraterrestrial life search
- Background radiation
- Origin and evolution

**Europe separated orbiter design configuration**
International Cooperation

Involvement of foreign partners in Russian missions

“Luna-Glob” SC
- Foreign tracking stations utilization
- Scientific data sharing

“Phobos-Grunt” SC
- Installation of a Chinese satellite
- Foreign tracking stations utilization

“Mars-NET” SC
- Installation of Finnish small landing stations
- Foreign transponders and tracking stations utilization

Jupiter and Europe exploration
- Foreign tracking stations utilization
- Scientific data sharing

Involvement of Russia in foreign missions

"Mars-Odyssey" SC (NASA)
- HEND instrument (planetary near-surface water finding)

"Mars-Express" SC (ESA)
- Spectrometers
- LV “Soyuz”

Mars rovers "Spirit" and "Opportunity" (NASA)
- Spectrometers

"Mars Science Laboratory" SC (NASA)
- Plutonium-238 Delivery for RTGs
- DAN spectrometer

LRO (NASA)
- Lunar exploration neutron detector LEND (search for hydrogen or water ice in the lunar polar shadowy areas)

Chandrayyana-2 (India)
- Lunar rover delivery
Medical and Biological Investigations: ISS and BION-M Biosattelites

BION-M - 2010, 2013, 2016

1998

ISS
Main Directions of Spacecraft Applied and Scientific Utilization

- Information and telecommunication service, the maintenance of country information
- The natural resources investigation and hydrometeorological vision
- The monitoring of emergency natural and technogenus phenomena and ecological disasters
- Presentation data of resources and objectives monitoring to users
- The improvement of producing technologies of new materials and high-quality substances in space
- The investigation of weightlessness physic problems, microgravitation researches
- The decision of space physic problems, the origin, evolution and further development the Universe, Solar System and Earth
Orbital Constellation for Meteorology and Ocean Observation

SC for the natural resources investigation
- Resurs DK (2006)
- Resurs PM (2015, 2016)
- Resurs P (2011, 2013)
- Arcon 2 (2012)
- Arcon-2M (2013, 2019)

High-Resolution Observation, Mapping
- SC of mapping (2013, 2017)

SC for the meteo and Ocean observation
- Meteor MP (2015, 2018)
- Ocean (2009, 2020)
- SC Arktika M (2012, 2013)
- Electro M (2015)
- MSO

Emergency monitoring

Extra-budgetory missions
- GSO
- Konopus-V, VM
- SS Smotr, Kovcheg
- SC Arktika R (2013, 2014)
- MSO

Molnia-type elliptic orbit
- All-weather radar observations. Mapping

Ocean observation
- SC for the natural resources investigation
- MSO
- Orbit constellation for Meteorology and Ocean Observation
SC Meteor M

Purposes

- Hydro-meteo observation
- Natural Resources Investigation
- Environmental monitoring

Characteristics

- Launch: 2009
- Orbit: SSO
  - Height (H): ~ 835 km
  - Inclination: ~ 98.85
- SC Mass: 2357 kg
- Carrier Vehicle: Souz-2 + usr Fregat
- Mission duration: 5-7 years
Electro L

**Purposes**

- Helio- and Geophysical Studies
- Clouds and Earth sub-laying surface real-time Imaging
- The collecting and relaying of hydro-meteorological and Auxiliary data

**Characteristics**

- Launch: 2009
- Mission duration: 10 years
- Carrier vehicle: RV Zenit + usr Fregat
- SC Mass: ~2000 kg
- Orbit: GSO 76° W

Mission duration - 10 years
Carrier vehicle: RV Zenit + usr Fregat
SC Mass ~2000 kg
Orbit - GSO 76° W
Kanopus

**Purpose**

Natural and Man-caused Emergency Situations Monitoring (earthquakes, forest fires, natural hydrometeorological phenomena, big pollutions and etc.)

**Characteristics**

- **Launch**: 2015
- **Mission duration**: 5-7 years
- **Orbit**: SSO (H-510 km, I-98°)
- **SC Mass**: 350 kg
- **Pointing accuracy**: 0,1°
- **Frequency Range**: Near – IR, optical
- **Frequency band**: S
Spectr R (Radioastron) 2009
Radiointerferometer SC,
range 1.35 sm, 6 sm, 18 sm, 92 sm;
Spectr UF – WSO 2010
UF astrovision
\( \lambda = 100 \) 3500Å, telescope \( \phi 1.7m \);
Spectr RG 2011
X-ray astrophysics
Range 0.08 100кэв
The Global monitoring of X-ray sources.
Microgravity Research SV

Foton-M №3 (2007)
Vozvrat- SSC (2014)

OKA-T-ISS  ISS-supported SC servicing in terms of microgravity research;
Photon, Bion – SC for microgravity research and experiments in biology, weightlessness physics and material science;
Vozvrat - SSC – small vehicle for specific tests.
Luch: Multifunctional Relaying Space System (MRSS)

**Purposes**

- Data Management and Relay from LEO Satellites & ISS
- The relaying of hydro meteorological data from data collection platforms and signals from emergency radio beacons
- The on-ground station feedback (including foreign operating and scientific centers, different department objects and another organizations which are participated in the space programs implementation)

**Characteristics**

- **Mission duration:**
  - 10 years (Luch 5)
  - 12-15 years (Luch 4)
- **GSO orbit**
- **SC mass:**
  - 1200 kg (Luch 5)
  - 3200 kg (Luch 4)
- **Orbital position:**
  - 16° E
  - 95° W
  - 167° W
- **Frequency range**
  - P, S, L, C, Ku, optical

**MRSS should supply:**
1. Continuity with existing space relaying systems.
2. Compatibility with similar foreign systems.
3. The possibility of another countries spacecraft service.
Luch multi-functional space data relay system objectives

Dedicated information management and delivery from low-orbit SC including MCC, transport and manned SC, observation SC

**Ku-band trunk channel**

- MCC command & program data reception by Luch-5 SC and its transfer to low-orbit SC
- MCC TV data reception by Luch-5 SC and its transfer to low-orbit SC
- MCC TV data reception to Luch-5 SC and its transfer from low-orbit SC

**Individually-access high data rate S-band channel**

- Command & program data transmission by Luch-5 SC to low-orbit SC
- TV data transmission by Luch-5 SC to low-orbit SC

**Multi-station access low data rate S-band channel**

- Command & program data transmission by Luch-5 SC to low-orbit SC
- TM data and GCC call signal transmission from low-orbit SC to Luch-5 SC

**High data rate subscriber’s Ku-band channel**

- TV and Command & program data transmission from Luch-5 SC to low-orbit SC
- Dedicated, TV and TM data reception by Luch-5 SC from low-orbit SC
MRSS Luch: Tasks

The relaying of hydro meteorological data from data collection platforms and signals from emergency radio beacons.

L-band Data Delivery from Kospas –Sarsat and Planeta S Ground Stations

P-band Data Delivery from Planeta S Hydro-meteorological Platforms and Kospas –Sarsat Emergency Radio Beacons

Planeta S Platforms

Planeta S Ground Stations

KOSPAS-SARSAT
MRSS Luch: tasks and decisions

Communication for Space Infrastructure Ground Objects including foreign centers for Deep Space Communication and Control

TV Data exchange from hot points to MCC (TV Center) via LUCH SC and Mobile Field Stations
SC Luch 5A

S-band follow-up individual access transceiving antenna

transceiving trunk retarget Ku-band antenna

Ku-band transceiving follow-up antenna

L-band transmission antenna

S-band multi-station access transmission antenna

P-band Receiving antenna

S-band multi-station access Receiving antenna

Ku-band transceiving follow-up antenna
Russian Deep Space Control System as to year 2020 (option)

Southern Deep Space Control Center (SDCC), Northern Caucus (Is projected)

Western SDCC Medvezhie Ozera

East SDCC Ussuriisk

Link and Transferring Data System *(onground link service, space link service through the SC MRSS Luch)*

Western Earth-part SDCC

Foreign Tracking Station

MCC Automated SC in deep space (RSC)

MCC control RSC TsNIIMash

Ballistic Centers (BC) IPM RAS TsNIIMash
End-to-end round-the-clock control and automatic spacecraft link in deep space with involvement of foreign tracking stations, including space internet services

Increase of coverage from ground radio-interferometers with super-long base and pointing accuracy improvement

Increase of reliability of responsible operations at Moon and Mars (launch, landing, etc) and deep space studies by automatic probes

Dear colleagues,
Thanks for your attention!