

SPUTNIK AND RUSSIA'S OUTER SPACE ACTIVITIES

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Activities in outer space, or what we also refer to as “astronautics”, are now part of mankind’s everyday life. People no longer can do without telecommunications, navigation and the information provided by remote sensing based on space systems.

Manned flights by cosmonauts and astronauts in near space are now commonplace. Space exploration has greatly accelerated scientific and technological progress. Space research has given life to new branches of modern science and technology, and has stimulated the development of existing ones. Astronautics has presented numerous challenges to science, has required urgent solutions to many scientific and technological problems and has put forward new research methods as a priority. Not so long ago, the most important task of a manned mission was to learn to survive in outer space, later it was to work in conditions of weightlessness, and now the task is to get the maximum benefit for mankind from outer space.

Russia stands out by right as a pioneer in space exploration. On 4 October 1957 it was the first in the world to place an artificial satellite into orbit.

There are three Russian names that the world well remembers, for they made history in development of cosmonautics:

- Konstantin Tsiolkovsky—the founding father of theoretical astronautics, the theory of interplanetary communications, and space philosophy;
- Sergey Korolev—a scientist and an organizer, chief designer of the first space launch vehicles, spacecraft and space complexes, as well as a pioneer of space exploration. Under his leadership, the Soviet Union began to realize its space programme during the late 1950s; and

- Yury Gagarin—the cosmonaut who completed the first space flight on 12 April 1961.

Even the initial successful steps into outer space raised the challenge of its practical use. Under the programme of research on upper atmospheric layers and outer space, the Soviet Union was the first to achieve the successful launch of a space system consisting of two satellites—Elektron-1 and Elektron-2—on 30 January 1964.

In 1967 Russia developed the space communications system Orbita using the Molnia-1 satellite. In 1971–1972 this system was placed into high elliptical orbit, which allowed international exchanges of television broadcasts.

In March 1969 the development of the first Soviet meteorological system began with the Meteor series of satellites.

Space missions created the possibility for the detailed study of celestial bodies in the solar system. The Moon, Mars and Venus were the first priorities. Lunar research by spacecraft began in the Soviet Union with the successful launch of Luna-1 on 2 January 1959. This was followed by a continuation of the series, from Luna-2 to Luna-24, automatic stations of the Zond type, and the self-propelled Lunohod automatic vehicle.

Exploration of Mars began with the mission of the Mars-1 interplanetary station which approached the planet on 19 June 1963. This work was continued with Mars-2 to Mars-7, and future exploration is intended in the framework of international projects.

Exploration of Venus began in 1961 with the flights of the Venera-1 to Venera-16 spacecraft, which determined the composition of the planet's atmosphere and delivered probes to the surface. Halley's Comet attracted special interest in 1986, which was studied by spacecraft of the Venera and Vega types. Investigation of the Sun also commanded great interest.

On 17 July 1975 the world witnessed the docking of spaceships of the two leading space powers—the Soviet Union and the United States. For about two days, Soyuz and Apollo continued their orbit around the Earth as an integrated space system. This was the first example of space cooperation, which continues to this day in multilateral space projects, including the construction and operation of the International Space Station (ISS).

Today, four and a half decades after the first flight of man into outer space, the number of cosmonauts and astronauts totals in the hundreds. Space missions with international crews are now commonplace.

At present, the Russian Federation is one of the leading space powers because of the existence, effective development and utilization of:

- its space systems, complexes and means (including orbital spacecraft groups and ground space infrastructure—cosmodromes (space centres), mission control centres, systems for collecting, processing and distributing information, etc.);
- its technical, technological, industrial and experimental foundation;
- its system of specialist training; and
- its support of science and technology, enabling and ensuring further exploration of outer space.

There is a limited number of countries that possess such comprehensive space potential. Maintaining the position achieved by Russian astronautics is one of the main goals of our Federal Space Agency.

During the 1990s, the intensity of “space life” of Russia declined noticeably. However, after that came a period of stabilization and, later, advancement.

The first years of this century were critical in the development of astronautics due to the implementation of the Russian Federal Space Programme for 2001–2005 (FSP–2005). Over this period, state financing of relevant activities increased by more than two and a half times. This created favourable conditions for building up our space potential. A great success of recent years was the increase in the inventory of our spacecraft (from 31 to 39) and the qualitative improvement of the Russian orbital group of spacecraft used for scientific and socio-economic purposes. Existing launch systems were modernized and new systems were developed. Soyuz-FG, Soyuz-2 and Proton-M launch vehicles successfully delivered payloads into orbit. We are also developing the Angara space rocket complex.

The space industry completed the FSP–2005 with good results, showing significant growth in production and productivity.

The prospects for Russia's space activities through 2015 include implementation of the Russian Federal Space Programme for 2006–2015 (FSP–2015) to meet the growing requirements of state entities, regions, businesses and the people for space systems and their services, as well as enhancing efficiency of the use of outer space, expanding international cooperation and fulfilling international obligations with regard to outer space.

Today, we have been able to reverse the reduction of our orbital groups, which are being increased along with the expansion of the services provided.

The Russian communications and television broadcasting orbital group, which is now operational, already makes it possible to offer up to 30% of orbital capacity to foreign markets. By 2015 we are planning to deploy 26 fixed communications and broadcasting satellites and 12 spacecraft for mobile personal communications. Realization of this programme will ensure a tripling of the total orbital capacity compared to 2005. National mobile and personal communications systems will be created and the potential to provide services to foreign customers will be even greater.

According to our plans, seven upgraded spacecraft of the Express-AM series will be launched, replacing the Gorizont and Express-A. In particular, in 2007–2009 we expect to launch the Express-AM33 and -AM44, which will have a greater number of transponders and an active life cycle of 12 years.

In parallel to developing the Express-AM series, we are developing the smaller Express-MD. The launch of four of these spacecraft, with an active life cycle of 10 years, is scheduled for 2008–2011.

The development of the orbital group after 2010 involves launching two upgraded Express-AMU communications and broadcasting satellites, and two Express-AT television broadcast satellites, developed from the Express-2000 heavy platform. Their active life cycles are 12 and 15 years respectively.

By 2015 we plan to develop an advanced remote-sensing satellite group that would ensure effective monitoring of the environment, and contribute

to work in hydrometeorology, ecology, the control and management of emergencies, and the rational use of natural resources.

At present, The Resource-DK spacecraft has been put into operation to provide detailed photography with a resolution of up to 1m for the mapping and monitoring of the environment in the interests of Russian and foreign customers. Quick access to information from the Resource-DK craft is particularly important to manage emergencies and to conduct relief operations. The spacecraft Monitor-E and Kompas-2 have also been placed into orbit. In the future, remote sensing of the Earth will be continued using specialized satellites of the series Resource-P (from 2010). It will provide images with a resolution of 1.5–2m in the visible spectrum and a resolution of 5 to 10m in the infrared, and will also collect data from various meteorological platforms. The latter is a technical product that Russia plans to offer to the world market.

Next, two meteorological space complexes will be developed based on the geostationary meteosatellite Electro, which will be part of the international satellite network of the World Meteorological Organization (WMO), and the mid-altitude meteorological spacecraft Meteor-M.

The task of short-term earthquake forecasting is becoming increasingly important for all mankind. In 2004 the world was shocked by the catastrophe in Asia that took a huge human toll—the tsunamis that occurred as the result of the earthquake killed more than 125,000, while 5 million lost their homes. Starting from 2007, we are planning to launch the Kanopus satellites equipped with sensors registering abnormal physical phenomena in the atmosphere, ionosphere and magnetosphere resulting from seismic activity, which can be detected before earthquakes occur. If this programme is implemented, it will be possible to use it as the basis for pulling together the efforts of various countries in finding effective methods for forecasting natural and technogenic disasters.

A group of scientific spacecraft will address the tasks of solar and astrophysical observation and planetary, medical and biological research. These efforts will be an important part of FSP–2015. We are planning a number of astronomic and astrophysical projects of which the development of the Spektrum-type observatories is the most important. We are also planning to launch the RadioAstron satellite (Spektrum-R, 2007) to perform observations in conjunction with a network of ground-based radio

telescopes, the Spektrum-UF (2010) with a main mirror of 1.7m in diameter, and the Spektrum-RG (2011) performing observations in the X-ray and gamma ray bands. In 2007 and 2014 we plan to launch the Coronas-Foton and Intergelozond research spacecraft to monitor the Sun. The projects Spektrum-RG and Spektrum-UF are pursued in broad cooperation with foreign partners from Europe, the United States and other countries.

An automatic station Fobos-Grunt will be launched in 2009 for the purpose of interplanetary research. Along with remote sensing, it will collect data from the Fobos satellite orbiting Mars and deliver its surface samples back to Earth. In 2012 we are also planning to establish a space complex to support the Luna-Glob research programme. Broad international scientific cooperation is expected in implementing this project.

As of now, Russia has fulfilled all of its obligations under the ISS programme to provide transportation and technical support to the station. Our foreign partners are participating in scientific and applied experiments on the Russian segment of the station. In 2008–2014 the Russian segment will be augmented with four new modules, the multipurpose laboratory and research modules being the most significant. This will help to expand research on board ISS.

Thus, in 2014 we are planning to complete the deployment of the Russian segment, which will comprise seven modules. This will involve the use of existing transportation and technical support systems. After 2015 we intend to begin flight tests of a new manned spacecraft. Also, work will be continued to develop a scientific and technological basis for the national multipurpose space station, the Moon base and the Martian expedition complex. Implementing the Moon and Mars exploration projects will require joint efforts by many states, and this effort is becoming one of the most important areas in Russia's international space activities.

When its orbital group reaches 18 spacecraft in 2007, the GLONASS system will be available to provide geopositioning data regardless of season, time or weather conditions across the whole territory of Russia, and in 2009 similar functions will be provided on a global scale (with the orbital group then comprising 24 spacecraft). The GLONASS space system is particularly important for the goals of economic development and national security. These goals include the organization of ground traffic; control of hazardous cargo transportation; support of geodetic activities; support of special

services operations, emergency and first aid services; and synchronizing energy and transportations systems, etc. India is participating in building the orbital group to the target composition, and will make use of the GLONASS system.

The Russian Federation is taking part in the development and operation of the Cospas–Sarsat international search and rescue satellite system. The Russian segment of the system will include two spacecraft and three ground stations. In 2007–2008 we plan to launch two Sterh spacecraft of the Nadezhda-M system. To date, 5,737 rescue operations have been carried out. These saved the lives of more than 20,000, of whom over 1,000 were citizens of Russia and other countries of the Commonwealth of Independent States.

We will continue work on space materials research, switching from the use of the Foton-M short-life-cycle spacecraft to longer life Oka-T-MKS and Vozvrat-MKA spacecraft, to be serviced within the ISS infrastructure.

The Oka-T-MKS 1 and 2 spacecraft are scheduled for launch in 2012 and 2015 respectively, and the launch of the Vozvrat-MKA in 2014. At present, the European Space Agency is participating in the Foton project. The realization of the Oka-T-MKS and Vozvrat-MKA projects will help strengthen international cooperation in outer space technologies.

By and large, Russia's partners in outer space activities know our potential and products which meet the requirements of other states. These include:

- Mission-oriented objects (those in operation) of the space infrastructure. These include reliable launch systems (above all, the Proton and Soyuz types), the ISS Russian segment, remote-sensing space systems, the GLONASS navigation system, and communications and broadcast systems.
- Rocket and space technologies. State-of-the-art national technologies include rocket motors using various fuels, on-board nuclear power units, docking devices and systems, certain materials (hydrocarbon composite materials, and non-ferrous and other special alloys), and certain technologies for manufacturing rocket and space components.
- Our history of space activities. We have vast experience in long-duration manned flights, remote sensing products, the organization

of experiments in conditions of microgravity, and the management of an orbital group of spacecraft and manned space objects.

The experience of research and use of outer space accumulated by the space powers, including Russia, is a valuable resource for the world community, which can be used to help resolve global problems of sustainable development.

The proper use of outer space could:

- ensure the continued progress of mankind;
- protect mankind and the Earth from asteroid or comet impacts;
- provide renewable energy sources;
- provide a global monitoring system for the environment to address questions of sustainability, pollution, and forecasting and emergency management; and
- aid in understanding the role and place of mankind in the universe, and increase mankind's scientific knowledge.

To these ends, Russia stands ready to take part in implementing the global projects listed below, relying on the existing space systems described earlier and developing national systems to meet its own needs.

[A unified space system to explore the natural resources of the Earth and to conduct global monitoring of geophysical processes](#)

This system would provide data on near-Earth outer space, atmospheric contamination, land and water resources, and global meteorological forecasts. This data would help to develop territories, to search for new sources of natural resources, and to make rational use of current resources. The system would be designed also for forecasting and monitoring of natural and technogenic disasters.

Provided that a mutual agreement is achieved and the project partners assume voluntary obligations, the functions of the system could be extended to ensuring and monitoring military security. Availability of international systems for global and regional monitoring could allow various centres, under UN auspices for example, to evaluate objectively the military environment in order for timely measures to be taken to ease tensions and settle arising concerns.

The European Global Monitoring for Environment and Security (GMES) programme could be used as a basis for this system.

An international communications, broadcasting and retransmission space system

Such a system would provide direct broadcasting (including to home receivers) to help reinforce political stability, provide timely warning to the population of emergency situations and measures to mitigate their consequences, hold teleconferences, ensure global multiprogramme television and radio broadcasting, transmit programmes in native languages, and organize the exchange of broadcasts among states.

The system's main functions would be to ensure diplomatic communication "hot lines" and effective and reliable communications for the control and management of international (coalition) forces. The system would also help to organize international telephone communications and would collect data received from automatic environmental sensors, meteorological stations and security alarms.

Currently a number of telecommunications systems of global, regional and national scale are being developed and used.

International integrated navigation system

This system ensures the high-precision real-time positioning of objects, which is needed for the functioning of all means of transport, and especially for the rescue of individuals and installations in emergency situations.

The main elements of the system are the US Global Positioning System (GPS), the Russian GLONASS and their updates, the European Galileo system, certain spacecraft of other space powers and the international Cospas-Sarsat system.

A system of forecasting and neutralizing the danger of asteroid or comet impacts

The purpose of the system is self-explanatory. The development of the programme was spurred by observations showing that in the last 30 years at least five large asteroids or comets passed close to the Earth in astronomical

terms. Such objects, were they to impact the Earth, would have the potential to bring an end to civilization.

At the moment, there are no national analogues of the proposed system. Nevertheless, there is a certain arsenal (tracking systems, for example) of means that would allow the project to be developed once the need to do so is realized.

An integrated system for the delivery of payloads to outer space

The purpose of such a system would be to provide for the reliable, economically viable and environmentally friendly delivery of payloads (manned or unmanned) to outer space.

Currently, a fleet of single-use launch systems for payload delivery to near-Earth outer space is available and is being operated and further developed (although there is need for some form of regulation). Multiple-use systems have been developed as well.

However, the systems being used at present and that will be used in the near future do not provide an acceptable level of confidence for missions into deep space, the reliability of interplanetary flight systems being insufficient. Within the framework of the project, single- and multiple-use international launch systems should be developed.

Operating the International Space Station for civil use

This project is being implemented and the partners recognize that cooperation within the framework of the ISS is necessary and extremely important for the whole of mankind. Scientific and applied studies on the ISS will enable the considerable expansion of knowledge about the properties of the space environment and its impact on humans. The unique environment provided for experiments in physics, biology, medicine and other fields will allow for the development of the fundamental technologies and expertise necessary for future extended space flights.

Fundamental space research programme

Solar research is among the highest scientific priorities. The implementation of individual projects would pave the way for the creation of a terrestrial

and space-based system for monitoring the Sun, as well as deep and near outer space, throughout the entire electromagnetic spectrum.

It is a matter of global importance to study the way natural crisis situations occur and evolve, as well as to obtain a better understanding of the models underpinning the processes in question. This can be done by conducting simultaneous observation of the surface, atmosphere and magnetosphere of the Earth, as well as of solar activity and the interplanetary environment.

The use of space assets will increase the reliability and utility of measures taken to monitor and forecast natural phenomena and disasters. Today there is no doubt that changes in the electromagnetic environment in circumterrestrial space are indicators of a coming earthquake, and practical conclusions should be drawn from that.

The programme could also include a project based on the idea of supplying energy to the Earth by using space-based solar power stations. The project is obviously an urgent one, given that the terrestrial energy resources are not endless.

Conclusion

Today, space assets are an indispensable component of world civilization. Ensuring safe operation of the outer space infrastructure is one of the main priorities in the activities pursued by the UN and by the leading space powers.

In particular, there is an urgent need to ensure the prevention of an arms race in outer space (PAROS). It is necessary to work persistently to reinforce international treaties, legal regimes and international regulations of issues pertaining to outer space security.

The existing legal regime for outer space does not guarantee the prevention of placement of arms of any kind in space.

The coordination of efforts among international organizations and states with a view to preventing the placement of weapons in outer space could ensure a comprehensive solution of the problems of outer space security. Therefore, in addition to the expansion of international cooperation aimed at the peaceful use of outer space, the prevention of the weaponization of

outer space is a priority for Russia. In recent years, Russia has put forward a series of initiatives to this end.

In particular, in October 2004 in the First Committee of the fifty-ninth session of the General Assembly, Russia made a unilateral and unconditional statement that it would not be the first to place weapons of any kind in outer space. Russia has also stated in the Conference on Disarmament that it has not developed outer space weapons and does not have plans to do so in the near future. Russia appealed to all space-faring states to follow its example. This statement demonstrates that Russia does not intend to pose a threat in or from outer space.

It is also noteworthy that on 8 December 2006 the General Assembly adopted by an overwhelming majority two resolutions introduced by Russia with a view to curbing a possible arms race in outer space.

The General Assembly approved the Russian draft resolution on developments in the fields of information and telecommunications in the context of international security by the majority of 176 votes. The objective of that document is to prevent dragging mankind into a new kind of arms race and to put a stop to the use of information and communications technologies to ends which are incompatible with the national security interests of states.

Another Russian draft resolution—on transparency and confidence-building measures in outer space activities—was supported by 178 countries.

The Russian Federation hopes that the approval of the international legal instrument, proposed by China, Russia and other countries, on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Space Objects (PPW) will be the next step on the road to assuring security in outer space.

Russia has prepared the draft PPW Treaty and after consultation with its partners intends to formally table it in the Conference on Disarmament. Adopting this treaty would be a major success for the Conference.

Here we cannot help mentioning the results of efforts aimed at mitigating the threat posed by technogenic debris in near-Earth outer space, and in this regard we might be witnessing the beginning of a new stage of development

of international space law, in terms of the regulation of traffic and the use of space technologies in near-Earth outer space.

Today various international organizations, such as the Interagency Coordinating Committee on Space Debris, the Science and Technology Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (COPUOS), the International Organization for Standardization (ISO) and others, are working on putting together international legal documents to regulate space objects and space activities as regards technogenic debris. For example, the Guidelines for Reducing the Production of Space Debris were prepared and adopted by the International Coordination Committee on Space Debris, and a similar document was prepared and adopted by the COPUOS Science and Technology Committee. In the framework of the ISO TC20/SC14 Working Group, already some 20 international standards have been established (for example, control of space activities in the context of technogenic debris in near-Earth outer space, curbing of emergence of space debris from launchers and space craft, limiting emergence of space debris as a result of collisions, space craft utilization procedures, and so forth).

All future-oriented programmes for the sustainable development of mankind can only be fulfilled in conditions of stable and comprehensive international cooperation. At the same time, in case of an arms race in outer space, resources would be used to build space weapons, and the implementation of national and international programmes aimed at, inter alia, global security and sustainable development would be delayed and many of them would simply be cut short. Therefore, mankind should do everything possible to avoid even the possibility of the weaponization of outer space for the sake of preserving civilization and its development. Russia is aware of its own responsibility in this process.