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Committee on the Peaceful Uses of Outer Space

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

Addendum

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II. Replies received from Member States

Armenia

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The Republic of Armenia attributes great significance to the development of its national space-related capacities and science, with a special focus on Earth observation, which has been one of the most impactful and dynamically growing subsectors in 2023.

In 2023, the closed joint-stock company Geocosmos of Armenia and Satlantis Microsats of Spain continued their cooperation in establishing a mission control centre and ground station in Armenia in the framework of the ArmSat-1 mission. The Armenian satellite operator team successfully completed the initial two stages of training, with ongoing training sessions for satellite operators on a regular basis.

The Ministry of High-Tech Industry of the Republic of Armenia, in cooperation with scientific institutions and private space research and remote sensing companies, initiated the Space Camp programme in 2021. In 2023, this one-week programme featured a series of lectures and practical training designed to introduce students aged 15–17 to the space industry and science, emphasizing Earth observation data and technologies and their various applications. Over 100 Armenian students across the world were selected to participate in the Space Camp programme in 2023, following admission examinations. Notably, efforts were made to ensure gender balance, resulting in the nearly equal participation of boys and girls.

In 2023, Armenia launched its first space Master programme, Aerospace Engineering, which is a collaborative effort of the International Scientific-Educational Center of the National Academy of Sciences of Armenia, the Engineering Association, a non-governmental organization, and the Enterprise Incubator Foundation. The programme combines professional courses with practical components and involves laboratory and research activities. This innovative model for education, science and production integration will not only facilitate educational processes and research projects but also apply fundamental research to achieve tangible results. This new Master educational programme is designed to give specialists robust scientific and practical potential, preparing them for the challenges of the present and paving the way for aerospace engineering development in Armenia.

In 2023, the Center for Ecological-Noosphere Studies of the National Academy of Sciences of Armenia, one of the leading research institutions widely using space and airborne data and technologies for assessing and monitoring the ecological state of the different environmental components (air, water, soil and plants), engaged in space-related activities, including:

(a) Conducting research on modelling urban air temperature (with a case study of the city of Yerevan) using open-source satellite images (Landsat Thermal Infrared Sensor) and advanced machine learning models. Furthermore, the correlation between land surface temperature and land surface patterns in local urban climatic zones, in particular in Yerevan Botanical Garden, has been studied, utilizing high-resolution multispectral and thermal data from unmanned aircrafts. This research was conducted in close collaboration with the University of Pavia in Italy and the results have been published in peer-reviewed scientific journals;

(b) Investigating the water quality parameters of Lake Sevan, such as water surface temperature, chlorophyll and harmful algae blooms, using daily satellite images from the European Earth observation satellite mission Sentinel-3. This was used to identify the blooming period of harmful algae in the lake based on remote sensing data. The research was carried out in cooperation with the Helmholtz Centre for Environmental Research in Germany, the Hydrometeorology and Monitoring Center of the Ministry of Environment of the Republic of Armenia, and the Institute

of Hydroecology and Ichthyology of the National Academy of Sciences of the Republic of Armenia;

(c) Developing methods for assessing the ecological state of agricultural lands (vineyards) and natural mountainous grasslands. PlanetScope data for the period 2016–2023 was processed to reveal the seasonal and inter-annual changes in the biomass in vineyards and natural grasslands associated with recent climate change. A machine learning model was adopted to estimate the amount of chlorophyll in grape leaves using very high-resolution airborne remote sensing data, unmanned aircrafts and in situ measured chlorophyll data.

In 2023, the first private space initiative was launched with the Bazoomq Space Research Laboratory Foundation, which became the first non-profit organization to receive a licence to conduct space activities in Armenia. The Foundation initiated the technology demonstration project “Hayasat”. This project involved testing and assembling FlatSat, programming and integrating flight modules, and developing a secondary payload. Hayasat is poised to be the first CubeSat launched into low Earth orbit (Sun-synchronous orbit), integrated and developed by an Armenian team. The Foundation is also actively working on technological solutions to mitigate space debris risks, including the development of a novel concept for a deorbiting system for low Earth orbit satellites, which is expected to be more lightweight, simple, reliable and cost-effective.

Meanwhile, the Byurakan Astrophysical Observatory of the National Academy of Sciences of Armenia has been diligently monitoring near-Earth space to detect space debris and accurately determine their coordinates. This work is conducted by the Center for Applied Astronomy of the Byurakan Astrophysical Observatory in collaboration with the Astronomical Research Center of the Russian Federation, marking almost a decade of partnership initiated by Roscosmos. In 2023, the final year of the contract between the parties, approximately 2 million measurements were taken on about 4,000 space objects.

These efforts reflect Armenia’s strong commitment to the development of national capacities and the promotion of the space industry and science. The implications of these developments are far-reaching, with potential positive impacts extending to sectors such as energy, public health and the environment, all of which are integral to addressing the global challenges outlined in the 2030 Agenda for Sustainable Development.

Germany

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[20 October 2023]

International cooperation in the peaceful uses of outer space is an overarching element in Germany’s space activities. The new space strategy of the Federal Government, published in September 2023, states that European and international cooperation – in particular cooperation within the framework of the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and the European Union – is the fundamental pillar for the successful implementation of German space policy. Global challenges can only be tackled effectively through targeted cooperation at the European and international levels. Moreover, certain types of technology development and research projects are also best carried out in cooperation. In particular, large-scale space missions are most feasible at the international level. We would therefore like to highlight some of our national space activities, in particular those carried out in international cooperation.

European Space Agency

Germany remains committed to a strong ESA as the primary pool of expertise in the European space sector. At the ESA Council meeting at ministerial level held in Paris on 22 and 23 November 2022, Germany contributed around 3.5 billion euros (mixed economic conditions, 2022) to ESA programmes focusing on climate protection, independent European access to space, “New Space” and international cooperation. With its commitment to ESA, Germany is living up to its leading role in a strong European space industry and scientific landscape. At the end of 2022, Germany took over the chairmanship of the ESA Council at Ministerial Level, which has increased the Federal Government’s sense of responsibility for moving ESA forward in cooperation with the ESA member States. The priorities for its chairmanship leading up to the next Council meeting at ministerial level in 2025 include advancing sustainability in ESA programmes, ensuring European space access, promoting commercialization and competition within the European space sector, and shaping the future of European involvement in global space exploration.

Heinrich Hertz satellite

On 5 July 2023, Germany launched the Heinrich Hertz communications satellite with the last European Ariane 5 launcher. One of the purposes of the geostationary satellite is to research and test new technologies and communications scenarios. The findings from the mission, along with other technological developments, can be applied to smaller, low-flying satellites, which can be manufactured cost-effectively and in series. The Heinrich Hertz mission is also an important step in the field of so-called “smart satellites”. The results of the mission can help to further advance the increased flexibility and digitization of satellite communications technologies and prepare for current issues such as artificial intelligence, quantum communications and flexible antenna technology for megaconstellations. The mission will thus make an important contribution to Germany’s information society.

The Heinrich Hertz mission is being managed by the German Space Agency at the German Aerospace Center (DLR) in Bonn on behalf of the Federal Ministry for Economic Affairs and Climate Action and with the participation of the Federal Ministry of Defence. Forty-two industrial and research partners were involved, including many European companies. Fourteen partners worked on the scientific payload.

Jupiter Icy Moons Explorer mission

The Jupiter Icy Moons Explorer mission (JUICE) was selected in 2012 as the first L-class (large) mission in the ESA Cosmic Vision programme. JUICE will be the first spacecraft to enter orbit around a moon of another planet, in this case, Jupiter’s moon Ganymede. After launch in April 2023, JUICE began an eight-year journey to Jupiter. JUICE will first fly past Earth three times and our inner neighbour Venus once to gain the energy needed to cross the asteroid belt between Mars and Jupiter and set course for the giant planet. JUICE will arrive in the Jupiter system in 2031.

JUICE is an ESA-led mission and Germany is part of this journey. The German Space Agency at DLR is supporting JUICE as a major contributor. These funds are part of the financing of the spacecraft, the launch with an Ariane 5 launcher and the mission operations. In addition, approximately 100 million euros went towards German contributions to 7 of the 10 scientific instruments on-board the spacecraft. Through its Institute of Planetary Research, DLR is involved in two of these instruments – the GALA (Ganymede Laser Altimeter) instrument was developed under DLR leadership and DLR was part of the Italian-led consortium for the JANUS camera. The main task of GALA is to measure the topography of Ganymede and to detect the ocean within by measuring the tidal effect of Jupiter on the ice surface. JANUS will map the entire surface of Ganymede and, using data collected during fly-bys, map the surfaces of Europa and Callisto and map specific regions in high resolution. JANUS will also be used to characterize Jupiter’s atmosphere, the surface of the most volcanically active

body in the Solar System, Io, Jupiter's numerous small moons and its ring system. The Max Planck Institute for Solar System Research is responsible for the Submillimetre Wave Instrument and is contributing one sensor to the Particle Environment Package. The Submillimetre Wave Instrument will investigate the chemistry, meteorology and structure of Jupiter's middle atmosphere and the Galilean moons. The particle spectrometer Particle Environment Package will measure neutral and charged particles in the Jupiter system.

In addition, the National Aeronautics and Space Administration (NASA) of the United States of America has contributed one instrument (Ultraviolet Spectrograph) and hardware for two European-provided instruments (Radar for Icy Moon Exploration antenna and Particle Environment Package), while the Japan Aerospace Exploration Agency (JAXA) has contributed hardware for several European-provided instruments (Submillimetre Wave Instrument, Particle Environment Package, Ganymede Laser Altimeter and Radio and Plasma Wave Investigation).

Euclid spacecraft

Euclid is another mission in the ESA Cosmic Vision programme launched on 1 July 2023 from Cape Canaveral in the United States. The objective of the mission is to uncover two great unknowns in the universe – dark matter and dark energy. Placed in an orbit around the second Lagrange point about 1.5 million kilometres from Earth, the telescope will look back 10 billion years into the cosmic past to study the geometry and expansion of the universe. It will map the distribution of dark matter across more than a third of the sky in three dimensions and study the distribution of galaxy clusters during this period when dark energy played a major role. For this purpose, the spacecraft is equipped with a telescope and two instruments, the Near Infrared Spectrometer and Photometer (NISF) and the Visible Instrument.

Germany is the largest contributor to the ESA science programme and the German Space Agency at DLR is responsible for coordinating the country's ESA contributions on behalf of the Federal Ministry for Economic Affairs and Climate Action. The Agency is also funding one of the telescope's two instruments, including the development of the data processing software and a data centre. Several German scientific institutes and universities have contributed to the mission, in particular to studies on the NISF instrument and software development.

Matroshka AstroRad Radiation Experiment on Artemis I

The NASA Artemis I mission carried two female mannequins for taking measurements on-board. One of them, called Zohar, was equipped with a radiation vest to shield her from cosmic radiation, while the other, Helga, did not have this additional protection. The purpose of this set-up was to study the radiation exposure of the female body during a flight to the Moon and back. The objective of the Matroshka AstroRad Radiation Experiment (MARE) is to help protect humans in space and support terrestrial applications. A predecessor project has already been used for basic research into cancer therapy.

The MARE is a collaboration between DLR, the Israel Space Agency, the Israeli industrial partner StemRad, Lockheed Martin and NASA. Numerous universities and research institutes in Europe, Japan and the United States of America are also involved in this experiment.

After the successful completion of Artemis I, Helga and Zohar were handed over in January 2023 at the NASA Kennedy Space Center and returned to the DLR Institute of Aerospace Medicine in Cologne, Germany. There, researchers are analysing more than 12,000 passive radiation detectors made of small crystals that are distributed throughout the two measuring bodies. Reading out the information stored by the crystals creates a three-dimensional image of the human body, showing the overall radiation exposure to bones and organs during a flight to the Moon and back. Detailed results are expected in early 2024.

United Nations Platform for Space-based Information for Disaster Management and Emergency Response

The collaboration between the Bonn office of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) and the Center for Remote Sensing of Land Surfaces (ZFL) of the University of Bonn, under the Space-borne Earth Observation Applications for Emergency Response and Disaster Risk Reduction (SPEAR) project, continued in 2023. Major activities included an institutional strengthening mission to South Africa in May 2023 conducted in coordination with the National Disaster Management Centre of South Africa, the South African National Space Agency and other national institutions. The mission focused on the use of space technologies in early warning and disaster management efforts. In July 2023, UN-SPIDER and ZFL, together with DLR and the International Charter Space and Major Disasters, organized a training workshop in Bonn for 15 project managers and value-added providers from different countries on the use of the Charter Mapper during activations.

Japan

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[20 October 2023]

International Space Station

Japan has been an active participant in the International Space Station (ISS) programme for the peaceful uses of outer space since its inception. ISS is the largest international science and technology cooperation programme ever attempted in the new frontier of space. Participants in the ISS programme seek to advance the use of outer space for the benefit of all on Earth. In November 2022, Japan announced its participation in extending the operation of ISS until 2030.

One of Japan's notable contributions to the ISS programme is the Japanese Experiment Module "Kibo". Japan has been promoting the utilization of Kibo to maximize its benefits. For example, various experiments have been conducted aboard Kibo, including materials and physical science, medical science, life science and capacity-building. From October 2022 to March 2023, the Japanese astronaut Wakata Koichi completed a long-duration mission in ISS. Most recently, in August 2023, the Japanese astronaut Furukawa Satoshi began a long-duration mission aboard ISS.

Kibo also allows Japan to help build capacity in developing and emerging countries as it is the only module on ISS equipped with both a robotic arm and an airlock. The unique capability clears the way for various outboard projects, such as the deployment of small satellites. The Japan Aerospace Exploration Agency (JAXA) and the Office for Outer Space Affairs have been collaborating on the KiboCUBE programme, which offers developing and emerging countries the opportunity to deploy CubeSats from Kibo. So far, satellites from Guatemala, Indonesia, Kenya, Mauritius and the Republic of Moldova have been deployed using Kibo through this programme. In June 2023, JAXA and the Office for Outer Space Affairs extended the KiboCUBE programme for three more rounds.

In 2019, JAXA launched a new educational competition called the "Kibo Robot Programming Challenge", in collaboration with the National Aeronautics and Space Administration (NASA), and held the third series of the competition in 2022. The number of participating countries increased dramatically in the third series with a total of 1,431 students from 351 teams and 12 countries and subregions in the Asia-Pacific region.

Space transportation

JAXA is developing the H3 Launch Vehicle, Japan's next-generation heavy-lift launch vehicle. Unfortunately, its inaugural flight was unsuccessful, but JAXA is making maximum efforts for a successful return to flight. The H3 Launch Vehicle will play a key role in international cooperation, such as the transportation of HTV-X to ISS. HTV-X is the new unmanned cargo transfer spacecraft currently under development for resupply missions to ISS.

In addition, JAXA is developing the Epsilon S Launch Vehicle, based on the technical achievements of the Epsilon Launch Vehicle, to strengthen Epsilon's international competitiveness in the satellite launch market. For example, a contract was announced in 2020 to launch the Vietnamese Earth observation satellite LOTUSat-1 using the Epsilon S Launch Vehicle.

JAXA is also collaborating with the National Centre for Space Studies (CNES) of France and DLR on the Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory project, for space transportation technology innovation. The joint project is expected to demonstrate the reusability of launch vehicles leading to a significant reduction in the cost of space transportation.

Space exploration and science

Space exploration

Collaboration with international partners is a key component of Japan's space exploration missions. In October 2020, Japan signed the Artemis Accords, an important political commitment for the governance of civil space exploration and the peaceful uses of outer space, as one of the first signatories. As part of the Artemis programme, Japan is participating in the Lunar Gateway by leveraging the knowledge and technology gained from the ISS programme and space science missions. In November 2022, Japan signed an implementing arrangement in cooperation with NASA on the Moon-orbiting space station, Gateway. Japan is expected to provide the habitation capability and logistics resupply services for Gateway using technology acquired through the operation of ISS.

In the area of lunar surface exploration, JAXA launched the Smart Lander for Investigating Moon (SLIM) in September 2023 to demonstrate pinpoint landing technology. JAXA is also collaborating with the Indian Space Research Organisation and ESA on the Lunar Polar Exploration Mission and is working with NASA on a launch expected in 2025. The mission is aimed at exploring potential resources, such as water ice in the lunar polar region, to investigate the feasibility of future resource utilization. Moreover, JAXA is conducting joint research with Japanese private companies to develop a crewed pressurized rover as a means of transportation to support sustainable lunar surface exploration in the late 2020s and beyond.

Regarding Mars exploration, JAXA plans to launch the Martian Moons Exploration (MMX) mission in the Japanese fiscal year 2024, which is aimed at investigating Mars and its moons, Phobos and Deimos, and collecting samples from Phobos. MMX is the next sample-return project following the successful mission of Hayabusa 2, which explored the C-type asteroid Ryugu and returned samples to Earth in December 2020. As an international collaborative mission, NASA, CNES, DLR and ESA will contribute to MMX.

Space science

JAXA continues to plan and execute various space science missions with its international partners. In October 2018, BepiColombo, the ESA-JAXA joint mission to explore Mercury, was successfully launched by the Ariane-5 rocket from French Guiana. BepiColombo is currently on a seven-year journey to Mercury using multiple planetary swing-by manoeuvres and is scheduled to arrive at Mercury in December 2025.

In September 2023, JAXA launched the X-Ray Imaging and Spectroscopy Mission, a collaborative mission with NASA and ESA, to investigate X-ray objects in the universe with high-throughput imaging and high-resolution spectroscopy.

JAXA is also developing a project called Demonstration and Experiment of Space Technology for Interplanetary Voyage with Phaethon Flyby and Dust Science (DESTINY+) for a planned launch in the Japanese fiscal year 2024. DESTINY+ will fly by and observe the asteroid Phaethon. It will also conduct an in situ analysis of cosmic dust, which is believed to be a source of organic matter on Earth, and demonstrate future technology for deep space exploration.

Remote sensing

Earth observation satellites can observe not only Japan but also the entire globe. Utilizing the capabilities of such satellites, data are used in Japan and around the world for various purposes, from monitoring daily changes, such as weather forecasting and disaster management, to predicting future climate change.

The objective of JAXA is to provide solutions and services to the world to contribute to addressing global societal issues such as climate change, disasters, water resources, food insecurity and biodiversity, and to achieving the Sustainable Development Goals by utilizing the space-based data collected by Earth observation satellites.

The Ministry of the Environment of Japan, the National Institute for Environmental Studies and JAXA have developed a series of Greenhouse Gases Observing Satellites, known as GOSAT. The first GOSAT, launched in 2009 as the world's first satellite dedicated to monitoring greenhouse gases, has been collecting data for more than a decade. In October 2018, Japan launched a follow-up mission, GOSAT-2.

JAXA is also promoting international cooperation in the utilization of satellite data to increase global understanding of environmental changes caused by human activities. In 2020, JAXA, together with ESA and NASA, released the Earth Observing Dashboard, a website that integrates indicators derived from Earth observation data from the three organizations to visualize the impact of the coronavirus disease and track changes in air and water quality, greenhouse gases, economic activity and agriculture. In 2022, the Earth Observing Dashboard expanded its scope to global environmental change with additional indicators and stories.

Space-based positioning, navigation and timing system

Japan has built a space-based positioning, navigation and timing system called the Quasi-Zenith Satellite System (QZSS). QZSS has been operating as a four-satellite constellation since November 2018. Three satellites are always visible from locations in the Asia-Oceania region. QZSS can be used in an integrated manner with the Global Positioning System, ensuring a sufficient number of satellites for stable, high-precision positioning. Japan is also planning to establish a seven-satellite constellation to maintain and improve capabilities for sustained positioning and plans to launch satellites sequentially, starting in 2024. Japan is also developing a high accuracy augmentation service known as Multi-GNSS Advanced Orbit and Clock Augmentation – Precise Point Positioning (MADOCA-PPP), which began a trial service on 30 September 2022 and an early warning service for the Asia-Oceania region. MADOCA-PPP and the early warning service are expected to provide operational services in 2024 and 2025, respectively.

Space weather

With the increasing number of space operations, it is important to monitor solar activity and the space environment as a whole for the safety and sustainability of our outer space activities. The National Institute of Information and Communications Technology has continuously contributed to the formulation of an international space weather framework, including the publication of the “Draft final report of the Expert Group on Space Weather: towards improved international coordination for space weather services” (A/AC.105/C.1/L.401) in 2022.

Asia-Pacific Regional Space Agency Forum

The Asia-Pacific Regional Space Agency Forum (APRSAF) was established in 1993 to promote space activities in the Asia-Pacific region. Each year, APRSAF brings together space agencies, governmental bodies and international organizations, such as the United Nations agencies, as well as companies, universities and research institutes from more than 40 countries and regions. It is the largest space-related conference in the Asia-Pacific region.

In 2023, Japan and Indonesia hosted the twenty-ninth session of APRSAF in Jakarta from 19 to 22 September, under the theme “Accelerating space economies through regional partnership”. In 2024, Japan and Australia will host the thirtieth session of APRSAF in Perth from 26 to 29 November. In 2025, Japan and the Philippines will host the thirty-first session of APRSAF.

The National Space Legislation Initiative, under the auspices of APRSAF, provides a regional opportunity to contribute to shared goals. Under this initiative, a second report was submitted to the sixty-sixth session of the Committee on the Peaceful Uses of Outer Space in 2023 by a total of 12 countries, namely Australia, India, Indonesia, Japan, Malaysia, New Zealand, the Philippines, the Republic of Korea, Singapore, Thailand, Türkiye and Viet Nam. With the wide support of the APRSAF community, the third phase of the Initiative was launched at the twenty-ninth session of APRSAF.

Lao People’s Democratic Republic

[Original: English]
[19 October 2023]

Summary

LAOSAT-1 was launched successfully, using an LM-3B/E rocket, from the Xichang Satellite Launch Center on 20 November 2015, at 16:07 (UTC). After the launch and early orbit phase, the satellite was positioned successfully at 128.5 degrees East on 27 November 2015.

So far, the spacecraft (subsystems and units) and all the payload equipment have been performing normally without experiencing any critical mission anomalies. The satellite is operating well and all on-board equipment, including the primary and redundant equipment, are functioning correctly.

The measured performance of the solar array and battery indicates that sufficient power margin will be available until the satellite end of life.

Satellite payload

LAOSAT-1 is equipped with a C-band and Ku-band payload consisting of the antenna subsystem and the repeater subsystem. There are two antennas, 14 C-band active transponders and eight Ku-band active transponders.

Station keeping

LAOSAT-1 is positioned at 128.5 degrees East and the station-keeping manoeuvres performed include: East-West station-keeping manoeuvres, North-South station-keeping manoeuvres and double-pulse manoeuvres.

With regard to current orbital elements, the orbital elements, as calculated on 5 October 2022, were as follows:

- (a) Semi-major axis (m): 42165231.667
- (b) Eccentricity: 0.000211
- (c) Inclination (degree): 0.14856
- (d) Right ascension of ascending node (degree): 90.514425
- (e) Argument of perigee (degree): 47.326129
- (f) Mean anomaly (degree): 17.105827

Satellite ground control stations

The single ground control station for the monitoring and control of LAOSAT-1 is located at a satellite control facility in Vientiane.

The Ministry of Technology and Communications of the Lao People's Democratic Republic has been actively involved in the design, development, launch and operation of satellites since 2015. Moreover, the LAOSAT-1 operation team was initially trained in all aspects of LAOSAT-1 control and operations in China. The operation team has the backup support of a large number of LAOSAT-1 engineers who have been extensively trained by the China Association for Science and Technology in satellite design, development, manufacturing and testing in China. The team also has the support of other highly qualified, trained and experienced LAOSAT-1 engineers who have been closely involved in the system and subsystem design of LAOSAT-1 satellite and its product assurance.

Payload operations

The LAOSAT-1 payload services are being monitored 24/7, 365 days a year, at the stations in the Lao People's Democratic Republic by LAOSAT-1 engineers. All the equipment used for this purpose also has sufficient redundancy on-site. A payload capacity of more than 12 transponders has been leased to numerous national and international customers and the quality of the services supported by the satellite meets the customers' satisfaction.

Conclusion

No mission-critical or major anomalies have occurred or been observed on the satellite. Since its launch on 20 November 2015, at 16:07 (UTC), the satellite has been performing in line with its design specifications and supporting various types of communication services, and the status of the satellite is normal. Most of its payload capacity has already been leased to numerous national and international customers, and most of the services are running on the satellite.

Poland

[Original: English]
[25 October 2023]

Poland continued its efforts to pursue and develop national space activities on many different levels. Poland is carrying out activities related to space under the leadership of the Ministry of Economic Development and Technology in close cooperation with the Polish Space Agency (POLSA). National space activities are strongly connected

to European and international collaborations, in particular within the European Space Agency (ESA) and Artemis Accords Signatories communities. The present summary provides a number of select examples of Polish space activities conducted with international partners.

International cooperation within ESA activities

In 2023, Poland increased its contribution to ESA. The enhanced participation of Poland in ESA programmes will result in access to research on the ISS, construction of Polish observational satellites and internships for Polish citizens at ESA. Furthermore, based on the agreement signed between the Ministry of Economic Development and Technology and ESA, Polish astronauts will test the technologies developed by national space entities, carry out experiments and contribute to an educational programme aimed at schoolchildren and students. The second Polish citizen to ever fly into outer space in the history of human spaceflights will be transported to ISS by Axiom Space – an American company that provides services to ISS on behalf of the National Aeronautics and Space Administration (NASA).

In addition, at the Global Space Conference on Climate Change in May 2023, POLSA, on behalf of Poland, signed the Statement for a Responsible Space Sector. ESA and other signatories to the Statement were guided by values that emphasize the respect for natural resources while promoting harmonious and ethical societal development. By accessing such international initiatives aimed at protecting the space environment, Poland is strengthening its commitment to the implementation of the Sustainable Development Goals and the 21 Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space at the national level.

National engagement in Artemis Accords community-building

Participation in the Artemis Accords signatories workshop, held in Gdansk, Poland from 19 to 21 June 2023 was an important step in enhancing cooperation among Artemis Accords signatories. Experts from 15 out of (at the time) 25 Artemis Accords signatory countries worked collectively in two working groups: the Working Group on Mitigation and Avoidance of Interference to Promote Safety in Lunar Operations, co-chaired by NASA and the State Department of the United States of America; and the Artemis Accords Emerging Space Actors Working Group, aimed at strengthening international cooperation and engagement among countries less experienced in space research and exploration, based on the principles and values embodied in the Artemis Accords, co-chaired by Poland and Brazil since the beginning of 2023. The results of the workshop were:

- (a) The development of recommendations for the Artemis Accords Heads of Agencies meeting at the 74th International Astronautical Congress held in 2023 in Baku;
- (b) The exchange of experiences among signatories in their approach to the development of the space sector;
- (c) The identification of the need to coordinate the work of the Artemis Accords Working Groups with the work of the Committee on the Peaceful Uses of Outer Space;
- (d) Discussion about the potential risks of conducting uncoordinated missions on the lunar surface and possible ways to mitigate such risks.

National activities related to space safety

Poland participates in the implementation of tasks of the European Union Space Surveillance and Tracking Partnership, along with space agencies and other institutions from 15 European Union member States. The Partnership carries out tasks entrusted to it by the European Commission, aimed at organizing the European Union Space Surveillance and Tracking system, in order to protect European Union space

infrastructure, economy and population. POLSA is investing in the modernization of a globally distributed network of optical sensors used for monitoring objects near Earth, mainly satellites and space debris. This project represents the largest Polish astronomical investment of its kind in years. The acceptance process for three new sensors, which are sets of telescopes, was completed in 2023. These are modern, technologically advanced, remotely operated observational robots that work within the framework of four collaborating optical systems. Each of the three sensors consists of a set of four telescopes. They can conduct observations independently or collectively observe a larger portion of the sky.

The primary task of these new telescopes will be to survey and analyse the night sky to search for and track artificial satellites and space debris. In June 2023, POLSA delivered three sets of sensors to locations on three continents:

- (a) In Australia at the Siding Spring Observatory – POLSA Optical Network (POLON) Australia;
- (b) In South America at the Deep Sky Observatory in Chile – POLON Chile;
- (c) In Africa at the South African Astronomical Observatory in South Africa – POLON Africa.

The chosen locations have been providing some of the best astronomical observation conditions in the world for years (each of them has around 300 observing nights per year). In each of these locations, the set of four telescopes can perform up to 100,000 individual measurements of the positions of artificial satellites in a single night. The development of such a network could result in becoming a leading European provider of observational data.

In addition, with regard to capacity-building in the area of space safety and in order to facilitate the data exchange process, in April 2023, POLSA along with the United States Space Command and the Ministry of National Defence of Poland signed an agreement to share space situational awareness information under the so-called United States Space Command data-sharing programme. Participation in the programme will contribute to enhancing the safety, stability, security and sustainability of current and future space operations.

Türkiye

[Original: English]
[24 October 2023]

Turkish space activities are conducted in accordance with the National Space Programme for the period 2022–2030. Ongoing space projects are briefly outlined below. Apart from these projects, new space initiatives are under way under the leadership of the Turkish Space Agency (TUA).

Ongoing project activities

Moon Research Programme Phase I

A satellite capable of orbiting the Moon and making a hard landing is being developed. The preliminary design phase has been completed. The critical design phase activities are ongoing. As part of propulsion system development activities, a sounding rocket which includes an indigenously developed hybrid space propulsion system reached 103 km altitude in May 2023.

Space qualified atomic clock development

A space-qualified rubidium-based atomic clock is being developed under the leadership of TUA. Once developed, the atomic clock will be tested and verified through a CubeSat mission. The conceptual design phase has been completed for the project.

Regional navigation and timing system

Plans are in place to establish a regional navigation satellite constellation under the Turkish National Space Programme which will increase the accuracy and availability of the existing global navigation satellite systems in the region. TUA continued conducting expert group meetings at the national level in 2023 in order to determine national needs and capabilities and coordinate activities related to satellite-based navigation.

Access to space and spaceport programme

Türkiye has been reaching above 100 km altitude using sounding rockets since 2020. Under the National Space Programme, the aim is to accelerate the activities in this area. Sounding rocket development and test activities continued in 2023. Several payloads related to the Moon Research Programme and scientific instruments were tested with the sounding rocket missions in 2023. The short-term goal is to place satellites into low Earth orbit while the medium-term goal is to reach geosynchronous orbit and Lunar orbit with nationally developed launch vehicles.

Turkish astronaut and science mission programme

Two Turkish astronaut candidates were selected and announced in January 2023. The candidates are continuing their training with international collaboration. The selected astronaut will be sent to ISS with the SpaceX Falcon 9 launch vehicle in January 2024. The Turkish astronaut will perform 13 different scientific experiments on ISS. After the 10-day mission, the Turkish astronaut will return to Earth.

TURKSAT 6A national communication satellite project

TURKSAT 6A is the first communication satellite indigenously developed by Türkiye. Flight model tests are ongoing.

IMECE optical remote sensing satellite project

IMECE is a submetre resolution remote sensing satellite for which many parts, including payload, were developed in Türkiye. The satellite was placed into orbit in April 2023 and is operational.
