United Nations
A/AC.105/729

General Assembly

Distr.: General
3 December 1999

Original: English/Spanish

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

Contents

V.99-90383 (E)

I. Introduction

1. In the report of its fifty-fourth session,[1] the Committee on the Peaceful Uses of Outer Space recommended that the Secretariat invite Member States to submit annual reports on their space activities. In addition to information on national and international space programmes, the reports could include information on spin-off benefits of space activities and other topics as requested by the Committee and its subsidiary bodies.

2. Pursuant to the recommendation of the Committee, in a note verbale dated 30 August 1999, the Secretary-General requested Governments to submit any information on the above questions by 31 October 1999 so that it could be submitted to the Scientific and Technical Subcommittee at its next session. The present note has been prepared by the Secretariat on the basis of information received from Member States by 30 November 1999. Information received subsequent to that date will be included in addenda to the present document.

II. Replies from Member States

Argentina

[Original: Spanish]

1. The National Commission for Space Activities (CONAE), which is attached to the Ministry of Foreign Affairs, International Trade and Religion, is the Argentine space agency, which coordinates all activities connected with the peaceful uses of outer space. CONAE is currently executing the National Space Plan “Argentina in Space” for 1995-2006.

2. The cornerstones of the National Space Plan are constituted by the following facts:

(a) Argentina is a country that, owing to its particular characteristics, makes and will make intensive use of space science and technology;

(b) An analysis of the different “products” that space activities contribute to social and economic development reveals the importance for the country of the generation of complete space information cycles and the identification of the respective applications.

3. The National Space Plan has been viewed as an investment project where, on the basis of fiscal returns, it is possible to determine rationally the internal rate of return of the Plan, which shows very advantageous values for the country.

National Space Plan

4. Under the general guidelines of the National Space Plan, it is necessary to revise the Plan every two years and, on each such occasion, its scope must be extended for a further two years, so that there is always a target period of at least one decade. In the course of each revision, the Plan is adapted in line with the country’s capacities and requirements and with the progress made during the previous biennium, with an evaluation of the operations to be continued and the addition or deletion of projects or activities as appropriate. For

[1] *Official Records of the General Assembly, Fifty-fourth Session, Supplement No. 20* (A/54/20), para. 119.

such purposes, it is necessary to take particular account of global advances in space technology, the relevance of new concepts and developments and achievements in cooperation programmes that have been reached.

5. The last biennium has shown a substantial increase in the supply of information provided by third-party space resources. This growth in international information-sharing is linked to a large extent to increasing global awareness of the need for continuous monitoring of the environment, natural resources and changes stemming from human activity, together with the free use of previously restricted technologies.

6. As a result of this increase in the international supply of information, the effects of which will become apparent on a very wide scale over the next five years, the need has emerged for the development of new ways and means of gathering, processing, analysing and using information, with particular emphasis on the last two activities, which are connected with research and development operations and with the development of human resource skills.

7. The resources for implementing the National Space Plan are obtained from the following three sources: direct contributions from the Treasury; indirect contributions from the Treasury; and third-party contributions.

8. The budgetary restrictions that have arisen with regard to the funding originally anticipated under the Plan have had repercussions on direct contributions from the Treasury and have necessitated the reprogramming of the operations scheduled under the five action areas constituting the Plan.

9. The following sections describe activities in each action area.

1. Ground infrastructure

(a) Ground station for satellite data acquisition

10. The station continued to operate, without interruption, using an antenna with a diameter of 7.3 metres, and the installation of a further antenna, 13 metres in diameter, was completed. The second antenna also has satellite-tracking, telemetry and command capacity. The new equipment has made it possible to improve data reception from the Land Remote Sensing Satellite (Landsat), the European remote sensing satellite (ERS) and the French Système pour l'observation de la Terre (SPOT) Earth observation satellite, which has resulted in a significant improvement in the station's productivity. The station also receives data from the National Oceanic and Atmospheric Administration of the United States of America and Sea-viewing Wide Field-of-view Sensor (SeaWiFS) satellites, and is expected soon to have the capacity to receive data from the Indian Remote Sensing (IRS) satellites. The installation of the new 13-metre antenna will mean a significant increase in the capacity to receive data from national and third-party satellites, in particular in anticipation of the forthcoming launch of the SAC-C satellite.

(b) Ground station for satellite tracking, telemetry and command

11. The station became fully operational during 1998 and has been used since December of that year for carrying out the SAC-A mission.

(c) New ground station for data acquisition and satellite tracking, telemetry and command

12. Work has proceeded on the design and development of a second ground station, which will be installed in the Province of Tierra del Fuego, in the extreme south of the American continent, in the year 2000.

(d) Multi-beam and multi-band systems

13. The design of advanced multi-beam and multi-band systems for simultaneous reception from several satellites is currently under examination.

(e) Integration and Test Laboratory

14. Work is being carried out for the purpose of adapting one of the laboratories at the Teófilo Tabanera Space Centre, where two inertia test benches have been installed. Owing to budgetary restrictions, it has been necessary to postpone the entry into operation of the complete laboratory until the period 2000-2002. As a result, the facilities of the Brazilian National Space Research Institute (INPE) in São José dos Campos were again utilized, under a cooperation agreement, for environmental tests in connection with the SAC-C satellite mission system. These same facilities had previously been used for the tests on the SAC-B satellite.

2. Satellite systems

(a) SAC-C satellite mission

15. During 1998 and 1999, the flight operations of the SAC-C satellite were examined and the environmental qualification tests were completed at the INPE integration and test laboratory in Brazil. The satellite will shortly be transported to the Vandenberg base in the State of California, United States of America, where it will be launched from a Delta launch vehicle in early 2000.

(b) SAC-A satellite mission

16. As part of the SAC-C project, the SAC-A technology satellite has been developed for technological demonstration purposes with the specific objectives of gathering experience in the area of satellite mission operations and of testing critical satellite components, in particular for the SAC-C satellite. The SAC-A satellite was placed in orbit on 14 December 1998 from the Space Shuttle Endeavour and is operating successfully. The technological tests conducted on SAC-A involve: (a) a differential global positioning system; (b) a panchromatic remote-sensing camera; (c) a magnetometer; (d) a system for tracking the movements of the Southern Right whale; (e) solar cells developed in Argentina by the National Atomic Energy Commission; and (f) a momentum wheel developed and manufactured in Argentina.

(c) Other missions in the SAC series (main payloads in the optical range)

17. Other missions in the SAC series include:

(a) Central European Satellite for Advanced Research (CESAR) mission. Aspects related to the definition of the mission have been formulated jointly with Spain and the mission's viability phase was completed during 1998 with the definition of the configuration of the satellite, the payload and the ground segment. Phase B is currently being developed and is expected to be finalized by March 2000;

(b) Argentine-Brazilian food, water and environment data satellite (SABIA3) mission. This joint mission with Brazil forms part of the objectives set out in the space cooperation agreement signed by the two Governments and was reaffirmed in the joint declaration made by the Presidents of both countries in November 1997. The work relating to phase A, the viability stage, has begun and the relevant agreement has been signed by CONAE and the Brazilian Space Agency (AEB).

(d) Observation and communications satellite (SAOCOM) missions (main payloads in the microwave range)

18. The different operational frequency possibilities available have been examined on the basis of the mission's main applications and operating characteristics, taking into account the latest progress in the field, and a mission definition in terms of its final technical parameters has been prepared. In addition, advances have been made in the acquisition of knowledge of the applications that are being extensively developed at the global level, such as radar interferometry and the uses of different polarizations for improved identification of terrain characteristics. Meetings have been held with the Italian Space Agency (ASI) in view of the possibility of combining the SAOCOM mission with the ASI SkyMed-COSMO mission for the purpose of its joint operation by both agencies.

3. Information systems

19. This action area is designed primarily to ensure appropriate management of the gathering, reception, transmission, storage, processing, use and dissemination of information derived from space or through the use of space resources. The activities are to a large extent centred on remote-sensing issues, in particular the identification of the requirements to be met in order to generate complete space information cycles.

(a) Regional Satellite Data Centre

20. During 1999, the CONAE Regional Satellite Data Centre (CREDAS) continued to maintain national and international Internet links for CONAE and other governmental agencies of the country, providing access to satellite image and related space information databases.

(b) Telemedicine project

21. The objective of the telemedicine project is the development of applications and communications technologies for setting up a pilot scheme operating from the Province of Córdoba. A network has been established with its central node at the Teófilo Tabanera Space Centre, three principal nodes at hospitals in the city of Córdoba, five remote nodes in the interior of the Province and one at the Marambio base in the Antarctic. Medical inter-consultations and continuing education events have taken place involving physicians at the remote nodes. The transmission of electrocardiograms and X-ray, tomography and other images has been established.

(c) Applications in flood control

22. In view of the emergency situation caused by coastal flooding as a result of the El Niño phenomenon, CONAE has implemented a nationwide programme involving the delivery of satellite images to public agencies directly involved. All the requested images received at the CONAE ground station in Córdoba from the Landsat-5 and ERS-1 and -2 Earth observation satellites have been supplied. These images have made it possible to monitor the flood line, estimate and predict soil moisture levels, monitor the entire area liable to flooding, carry out ground mapping in order to assess moisture levels and implement a programme for the generation of a flood valley model in the medium term.

(d) Applications in non-renewable resources

23. In connection with mining operations, CONAE has maintained close links with the Argentine Geological Mining Service (SEGEMAR) and makes satellite images available to its members. The images will be used for the related mapping work. With regard to the oil industry, human and equipment resources have been developed at the University of Cuyo in order to process and analyse satellite information. A geographic information system has been developed for use by the private sector and a digital terrain model is being finalized. CONAE provides the Military Geographic Institute with satellite images received at the Córdoba ground station for the cartographic updating work carried out by the Institute on the territory of Argentina.

(e) Applications in agriculture

24. CONAE and the Federation of Grain Harvesting Associations and Centres (FECEACOP) are conducting a joint initiative that is of considerable benefit to Argentine farmers and to all sectors concerned with marketing and industrialization. An agricultural crop information system has been developed that incorporates harvest technology and is based on the use of satellite products and climatic and hydrological variables. The Entre Ríos agricultural monitoring project involves the use of satellite technology for the purpose of obtaining accurate and updated information on agricultural production in the pilot area of Chilcas in the Province of Entre Ríos. Through the use and processing of satellite images, estimates have been made of areas of citrus fruit and cereal cultivation and of sugar-cane production in Tucumán, in collaboration with the Ministry of Production in the Province of Tucumán.

25. An inventory of renewable natural resources in Córdoba has also been carried out in collaboration with the Ministry of Production in the Province of Córdoba.

(f) Terrestrial validation

26. Work is continuing on the creation of a database containing spectral signatures of the main areas under cultivation and relevant geographical parameters on the basis of a planning operation covering different geographical zones of the national territory. Measurements have been carried out in Barreal del Leoncito, in the Province of San Juan, during the passage of the Landsat-5 satellite with a view to establishing a zone for future satellite calibration. CONAE has signed an agreement with the Argentine air force for the purpose of calibrating the measurements of the multimode radar system sensor on board the Argentine SAC-C satellite.

(g) Distribution of satellite images and promotion of their applications

27. During 1998, the Unit for Satellite Image Distribution and Promotion of Satellite Image Applications was established. Since its establishment and up to October 1999, the Unit has distributed more than 2,000 images to public and private organizations.

(h) Data-gathering network

28. The development of a data-gathering network using the SAC-C satellite has commenced.

4. Access to space

29. Under Decree No. 176/97, the National Executive instructed CONAE to incorporate the item "Means of access to space and launch services" into the revision of the National Space Plan on an equal basis with the generation of complete space information cycles.

30. This has been achieved by making the relevant amendments to the "Access to space" action area by the appropriate means and mechanisms, in conformity with the current national and global technological situation and in line with Argentina's foreign policy, its non-proliferation policy and the international undertakings assumed by the Republic in this connection, and by encouraging a gradual and continuous increase in the country's intellectual and technological participation. In accordance with the provisions of Decree No. 176/97, the advanced technology development work will be carried out within a framework of complete transparency and in close liaison with national bodies and international organizations in countries that are members of the Missile Technology Control Regime, primarily with Brazil and the United States of America.

31. Technical meetings have continued with the Brazilian counterpart for the purpose of analysing the possible joint development of vehicles for placing satellites in orbit. A specific agreement has been signed for carrying navigation units developed at CONAE on board Brazilian sounding rockets as a joint initiative.

32. In late 1998, the firm Veng S.A. was set up with the aim of developing new-generation space vehicles through unconventional mechanisms of financing by the private sector and scientific and technological bodies.

5. Institutional development and basic operations

(a) J. M. Gulich Institute for Advanced Space Studies

33. CONAE has signed an agreement with the National University of Córdoba establishing the J. M. Gulich Institute for Advanced Space Studies, which provides post-graduate training and conducts research in space science and technology. The Gulich Institute is also required to become involved in CONAE's links with the national higher education and university system through workshops, post-graduate courses and projects relating to emergency management, exploitation of natural resources and environmental monitoring. In order to ensure the viability of this information technology programme, CONAE cooperation with Italy has been strengthened with a view to facilitating access to supercomputers having high processing capacity.

(b) Scientific activities

34. Other significant activities include:

(a) Selection of the second group of Argentine experiments to be carried on board the STS-101 space shuttle mission. The participants in this project are primary and secondary schools, tertiary educational establishments and universities in the federal capital and the Provinces of Buenos Aires, Santa Fé and Chubut;

(b) Continuation of the Total Ozone Mapping Spectrometer Earth Probe (TOMS-EP) programme for ozone measuring from satellites, in cooperation with the National Aeronautics and Space Administration (NASA) of the United States and the National University of Rosario; development of schemes to measure ultraviolet radiation from the Atacama plateau to Tierra del Fuego; and the evaluation of the erythemic dose and solar risk factors. The regular operation of a light intersection direction and ranging (LIDAR) system for atmospheric aerosol and ozone profile measurement has been initiated at the Laser Research and Applications Centre (CEILAP), where a system for data collection via the Aeronet network has been set up under a CONAE/NAS agreement;

(c) Cooperation between CONAE and the French space agency, the Centre national d'études spatiales (CNES), through the Stratéole project, which is a major international project concerned with the study of the dynamics of the ozone in the Antarctic polar vortex;

(d) Continuation of the ChagaSpace project, involving the search for drugs to combat Chagas' disease, in cooperation with NASA, the Institute of Parasitology attached to the Ministry of Health and Social Welfare and research institutes in Brazil, Chile, Costa Rica, Mexico and Uruguay;

(e) In September 1998, issuance of an opportunity announcement for the use of data from Argentine instruments on board the SAC-C satellite. Over 80 proposals from Argentina and several neighbouring countries have been received and approved;

(f) Coordination of Argentina's participation in future space missions of other space agencies concerning the measurement of soil moisture levels, aurorae borealis and solar-terrestrial physics;

(g) Institutional links. CONAE provides necessary support to the National Executive on specific topics, such as the Missile Technology Control Regime and the National System of War Material and Sensitive Imports and Exports pursuant to Decree No. 603/92. In 1995, the National Registry of Objects Launched into Outer Space was set up and CONAE was designated the authority responsible for its administration. The entry relating to the SAC-A satellite was recorded in 1998.

(c) Cooperation with national institutions

35. The execution of the National Space Plan involves the participation of various Argentine scientific, technological and industrial bodies. CONAE is accordingly making progress in the related negotiations with several such bodies. A number of framework agreements have been signed with various institutions, and six of these agreements were implemented in 1998. In line with the framework agreements, a number of specific agreements have been signed, seven of which were concluded in 1998. In December 1998, CONAE instituted the "space provinces cycle" with the Province of Santa Cruz for the purpose of involving community leaders within each province in the use of space information.

(d) International cooperation

36. Cooperation at the international level has included the following:

(a) *Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)*. CONAE participated and assisted in the preparations for this international conference and also attended the plenary meetings and meetings of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space;

(b) *Brazi*l. Three specific cooperation agreements have been signed with the Brazilian Space Agency (AEB): (i) the development of SABIA3, the Argentine/Brazilian food, water and environment data satellite; (ii) the launch of a sounding rocket developed by the Brazilian Aerospace Centre with an Argentine payload; and (iii) the harmonization of ground systems operations on space missions;

(c) *Canada*. During 1999, CONAE continued its activities as coordinator of the Argentine groups participating in the GlobeSar2 programme sponsored by Canada. The final project meeting was held in Buenos Aires and attended by researchers from all the Latin American countries involved;

(d) *France*. An agreement has been signed with CNES regarding its provision of the Icare instrument to form part of the payload of the SAC-C satellite for the mission's scientific purposes;

(e) *Germany*. Work has continued in Córdoba on the telemedicine programme, which includes the Argonauta project and is financed in part by the European Community, and the agricultural applications project in Entre Ríos, both in cooperation with the German Aerospace Centre (DLR);

(f) *Italy*. A cooperation agreement has been signed with the Italian Space Agency (ASI), in connection with the SAC-C project, for the provision by Italy of the instruments and solar panel mechanisms for the SAC-C mission. Progress has also been made in the negotiations regarding Argentina's participation in the SkyMed-COSMO constellation;

(g) *Spain*. A joint declaration on cooperation in space science and technology was signed with the National Institute for Aerospace Technology (INTA) of Spain. Phase A of the joint CESAR satellite project has been successfully completed;

(h) *United States of America*. Work relating to the SAC-C project is continuing with NASA and the satellite will be placed in orbit in early 2000. As technological proof of new developments made in the country, the SAC-A satellite was placed in orbit, in collaboration with NASA, on 14 December 1998 from the space shuttle Endeavour. Discussions have continued with NASA on extending current cooperation to incorporate the next satellite missions under the SAC programme and on including issues concerned with education in space science and technology and telemedicine. In October 1998, the NASA space shuttle Discovery carried into space experiments proposed by primary and secondary school pupils under the Germinar education project of CONAE. As stated above, the second group of Argentine students' experiments is awaiting the launch of the STS-101 mission. Argentina was again invited, in 1999, to participate in the International Space Camp sponsored by NASA.

Canada

[Original: English]

1. The past year marked the tenth anniversary of the Canadian Space Agency (CSA), capping not only a number of significant accomplishments in space during the year but also accompanying the announcement of a new Canadian space programme.

Accomplishments during 1999

2. In human space flight, 1999 marked the delivery of Canada's new space robotic arm, the International Space Station's (ISS) remote manipulator system, to the Kennedy Space Center of the National Aeronautics and Space Administration of the United States of America. Over 17 metres long and able to relocate itself and travel along the Station to perform tasks where required, the new space station arm is bigger, more sophisticated and more versatile than the space shuttle robotic arm (Canadarm). Also in 1999, CSA astronaut Julie Payette flew on board STS-96, a mission involving a rendezvous and docking with the ISS to outfit the Station for future flights and occupants. CSA announced a partnership with Spacehab, Inc., for the commercialization of Canada's allocation of the ISS, a global first that positions CSA in a leadership role for ISS commercialization. The Government of Canada also introduced legislation that gives Canada's partnership in the ISS a legal basis: the Civil International Space Station Agreement Implementation Act stakes out a long-term formal role for the Station in the Canadian space programme, setting out the broad principles and legal basis for Canada's participation.

3. In space science, the CSA announced a new satellite, SCISAT-1, to be launched in December 2001, to study global ozone depletion and help Canada meet its international environmental commitments. Canada also participated in NASA's Far-Ultraviolet Spectroscopic Explorer (FUSE), an Earth-orbiting astronomical observatory. The Canadian fine error sensors aided in navigating the satellite and guiding the FUSE observatory to point in precisely the right direction to make its exacting scientific observations.

4. In remote sensing, Canada's RADARSAT-1, a C-Band synthetic radar aperture (SAR) satellite, continued its extraordinary success in helping a growing user community around the world work in the fields of forest and crop management, oil, gas and coal exploration, underground well exploitation and flood management operations. This past year marked a continued effort in expanding the satellite's utility through the development of products and services using spacial data from RADARSAT-1 for ever new and improved uses and applications. Also during 1999, CSA employed RADARSAT-1 for the first complete view of Canada. The 276 images used in the mosaic were captured over a seven-day period in January 1999, producing a near instantaneous "snapshot" of the entire country. The international Antarctic mapping effort was also completed in 1999, the result of images acquired by RADARSAT during autumn 1997, when it undertook a 180-degree rotation in relation to its normal flight path. Finally, work continued on RADARSAT-2, a joint government-industry partnership that will further strengthen Canadian expertise and leadership in SAR remote sensing.

1. The new Canadian space programme

5. 1999 marked the inauguration of a new Canadian space programme, which provides CSA with a new financial base to plan, implement and adapt Canada's space activities. The budget allocates 430 million Canadian dollars in new funds over the next three years, stabilizes the Agency's budget at $300 million per year, starting in 2002/03, and gives the

Agency much greater programmatic flexibility to adjust its programmes to the rapidly evolving environment.

6. The new Canadian space programme is structured around five priority areas.

(a) Earth and the environment

7. The objective of the new Earth and environment programmes is to enhance Canada's ability to understand, monitor, predict and protect the Earth and its environment and to ensure that Canadian industry maintains leadership in the emerging global Earth observation market. In addition to participating in the global effort to understand climate change processes and effects, Canada is a recognized leader in the acquisition and commercialization of space-based remote sensing data. By modernizing the country's data reception infrastructure and encouraging industry to develop the products and services demanded by world markets, Canada's Earth observation support programmes are playing an essential role in ensuring Canada's position in international markets. Moreover, the development of a high-performance RADARSAT-2 will further enhance Canada's position in Earth observation.

8. The programme elements include:

(a) The space environment programme (the development of technologies for *in situ* studies of space plasma and the Earth's electromagnetic field);

(b) The atmospheric environment programme (the development of space-borne payloads to study the dynamic of the atmosphere, the ozone layer, greenhouse gases and other climate change phenomena);

(c) The surface environment programme (the development of technologies aimed at studying the cryosphere, forests, ecosystems, coastal zones and the offshore marine environment);

(d) The advanced imager component programme (the development of next generation space-based technologies for natural resource management and environment monitoring);

(e) The ground infrastructure and resource monitoring applications programme (the development of technologies and applications aimed at enhancing ground-based systems to receive, process, distribute and use satellite remote sensing data);

(f) The disaster management and surveillance programme (the development and demonstration of technologies and applications to plan, predict, mitigate and assess disasters, as well as technologies for near real-time surveillance).

(b) Space science

9. In addition to participating in the global effort to understand the universe and our solar system, the objective of space science programmes is to enable the Canadian science community to use the unique environment of space to advance knowledge in material as well as life sciences. The programme will also maintain Canadian industry's expertise in the development of leading-edge space science instruments and keep Canada moving forward in the knowledge-based economy.

10. The programme elements include:

(a) The space astronomy programme (aimed at understanding the past and present state of the universe and predicting its evolution);

(b) The space exploration programme (aimed at understanding the solar system in relation to the origin of life and evolution of the Earth's environment);

(c) The life science programme (aimed at generating advanced knowledge related to the cardiovascular system, bone research, neurology, early development and radiation effects on living organisms);

(d) The microgravity science programme (aimed at generating advanced knowledge related to proteins and biotechnologies, fluid and combustion sciences, advanced material sciences and fundamental physics and chemistry).

(c) Human presence in space

11. The objective of the human presence in space programmes is to maintain Canada's leadership in space robotics, its meaningful and visible role in the ISS and the active involvement of Canadian astronauts in human space flight missions. Such programmes will ensure Canada's visible presence in space and position it to participate in future, long-term human space flights to other planets. Canadian astronauts will continue to inspire Canada's youth to reach for excellence and pursue careers in science and technology.

12. The programme elements include:

(a) The International Space Station programme (the development, maintenance and operation of the mobile servicing system, maintaining Canada as a full partner in the ISS;

(b) The Canadian astronaut programme (maintaining a group of competent and well regarded astronauts to participate regularly in human space flight missions; to instill a sense of pride among all Canadians; and to promote scientific literacy and careers in science and technology among Canadian youth).

(d) Satellite communications

13. The objective of the satellite communications programmes is to maintain or increase Canadian industry's share of the rapidly growing worldwide market for satellite communications and to ensure that Canadians have access to the world's most advanced satellite communication technologies. Satellite communications are an essential tool for Canada in meeting its objective of becoming the most connected nation in the world and are expected to expand considerably to meet the growing demand for advanced multi-media and mobile personal services.

14. The programme elements include:

(a) The flight demonstration programme (the development and demonstration of next generation multimedia payloads, satellite access technologies and networks);

(b) The applications development programme (the development and demonstration of advanced applications in which satellite networks have unique advantages).

(e) Generic/enabling space technologies

15. The objective of the generic/enabling space technologies programmes is to develop, flight-demonstrate and ensure the commercialization of next-generation technologies of strategic importance for the Canadian space programme. Canada needs to develop new technologies that cut across many activities and investigate innovative technologies for potential use in future missions. Space technology programmes help industry develop strategic technologies in specific niches, establish links with foreign firms and improve

access to international markets and facilitate the transfer of space technologies towards non-space applications.

16. The programme elements include:

(a) The leapfrog technology programme (the development of technologies of next-generation spacecraft subsystems aimed at enhancing the international competitiveness of Canadian industry and at preparing Canada for future space missions);

(b) The flight demonstration programme (the development of international cooperation ventures to flight-demonstrate the capability and reliability of new Canadian space technologies);

(c) The technology commercialization programme (aimed at the protection, diffusion and commercialization in Canada of intellectual property generated by government investments).

2. Partnership

17. Partnership remains the cornerstone of Canadian activity in space under the new space plan. Canada's domestic partnerships are extensive, involving some 350 companies, dozens of academic and research institutions and numerous provincial and federal government departments. Canadian space activities are developed through broad and extensive consultation with the country's space stakeholders. Similarly, given that some 75-80 per cent of Canada's space budget is outsourced, Canadian space activities are implemented through extensive partnerships between CSA, industry, academia, and other government departments, most important of which are the Canada Centre for Remote Sensing and the Communications Research Centre.

18. Canada's international partnerships are also extensive, as virtually all of Canada's space activities entail some kind of international partnership or collaboration. Canadian space technology development activities are undertaken in extensive collaboration with the European Space Agency, with which Canada has for 20 years enjoyed a unique status as the only non-European cooperating State and with which Canada's partnership was renewed in October 1999. Canada's commitment to being a full partner in the largest and most complex international science and technology project in history, the ISS, is shown in Canada's contribution to the project, the mobile servicing system, the robotic system that will be used to assemble and maintain the Station in orbit. Similarly, Canada's RADARSAT-1 programme involved close cooperation with NASA, as does the Canadian astronaut programme. Canadian space science activities are also pursued in collaboration with countries such as Japan, the Russian Federation, Sweden, the United States of America and with other member countries of the European Space Agency.

19. International cooperation will be equally important in Canada's future space activities. Canada anticipates developing further and stronger international partnerships in space under the aegis of its new space programme.

Worldwide Web sites

Canadian Space Agency: http://www.space.gc.ca

Canada Centre for Remote Sensing: http://www.ccrs.nrcan.gc.ca

Communications Research Centre: http://www.crc.doc.ca

Government of Canada: http://canada.gc.ca

Egypt

[Original: English]

1. Since the early part of the twentieth century, Egypt has been interested in space sciences and their use, including:

(a) Astronomical studies. The Helwan Observatory has enjoyed a wide reputation for decades;

(b) Meteorological applications, including the use of satellite data and their relation to global climate change;

(c) Communications, with space segments and ground networks;

(d) Remote sensing applications in a multitude of fields, including geology, soil and agriculture, urban planning, antiquities, environment, engineering and natural hazards.

2. In order to achieve more coordination and cooperative thinking, the Egyptian Space Science and Technology Research Council was recently established. The Council is affiliated to the Egyptian Academy of Scientific Research and Technology and comes under the aegis of the Ministry of State for Scientific Research. The Council includes 125 members who represent the main Egyptian actors in the field of space research and studies.

3. The structure of the Space Science and Technology Research Council includes the following four divisions: Peaceful Uses of Space and Strategic Studies; Space Technologies and Space Vehicles; Applications and Technologies of Remote Sensing and Climatic Change; and Communications, Navigation and Basic Space Sciences.

4. The Council has set up an Egyptian national space programme in order to accelerate the peaceful applications of space and to help Egypt achieve its technological and development goals. The main objectives of the programme are:

(a) To achieve scientific distinctiveness by manufacturing and launching an Earth observation remote sensing satellite designed to serve desert territories in particular;

(b) To build and develop capable scientific and technological cadres. Back-up training and education in the field of space technology and related industry, coupled with support for scientific departments, and specialized training programme abroad will be conducted. The United Nations specialized space training centres may provide support for this activity;

(c) To take advantage of international space cooperation to enhance and expedite the Egyptian space programme by: obtaining international funding to cover at least some aspects of the programme; enhancing national expertise by participating in bilateral/multilateral joint projects; and organizing exchange visits between Egypt and developed countries on the basis of specific protocols for cooperation;

(d) To use space technology as an incentive and catalyst for advanced technological industries in Egypt. Meanwhile, Egypt is focusing on the spin-off benefits of the products that space technology will generate;

(e) To encourage the private sector to cooperate in space activities. This will support and maintain the Egyptian programme and is in line with Egypt's philosophy as regards privatization and the market economy.

5. Egypt launched its NILESAT-1 satellite (in geostationary orbit at 7° W) for direct television broadcasting in April 1998 and is currently preparing to launch its second satellite, NILESAT-2. The two satellites are to cover Egypt, the Arab States and the Middle East, allowing for Egypt's cultural message to reach a broader effective spectrum.

6. In the field of navigation, there is a need to support the establishment of a space navigation system for the area of North Africa. Egypt has submitted a proposal, currently under study, to promote use of such a satellite navigation system over the area to serve the civil aviation of Egypt and other beneficiary countries.

7. In the field of remote sensing, Egypt has its own advanced and integrated capability for processing and analysing images that are obtainable from international commercial satellite systems. Those images are used efficiently in development plans in various fields.

8. In the same field, Egypt intends to build a ground receiving station for satellite images during the year 2000. This will lead to enhanced capabilities in remote sensing and will provide speedier and cheaper access to satellite data and their wider use for development purposes.

9. Egypt plans to collaborate with interested developing nations in the region in designing and building an experimental satellite during the next few years to improve its scientific and technological capacity in the space field. That work will be carried out by a number of scientists and researchers from Egyptian universities and scientific associations related to the space industry. Egypt believes that such technology is a good entry for developing countries into space industry owing to the comparatively low cost and capabilities of using other technologies and new duties specifically tailored to medium developing countries.

10. In the legal domain, Egypt is particularly eager to see a precise definition of the limits between the local space and outer space over the territory of each State. This is one of the points of international law that has challenged the international community since the beginning of the space era and concerning which no satisfactory conclusion has yet been reached. This definition would ensure the State's interests, sovereignty and security, and would not interfere with the freedom of outer space and the uses of outer space in the interest of humanity as a whole.

Finland

[Original: English]

1. Space plays an increasingly important role in Finnish society. Satellites and space-related techniques are used as a tool for improving scientific knowledge, increasing the effectiveness of public sector services and for developing new businesses.

2. Space activities are a part of Finland's overall science and technology policy. The research and development activities in the field of space contribute to an overall increase in scientific and technological expertise and know-how in Finland. In terms of industrial and technological development, space activities are expected to increase the technological competitiveness and diversification of Finnish industry. The exploitation of space-based applications, such as remote sensing, telecommunications and navigation, has increasingly important socio-economic effects in addition to the prospects of generating new business based on space applications and services.

3. Space administration and funding matters in Finland are run in a decentralized fashion, involving mainly the National Technology Agency (*www.tekes.fi*) and the Academy of Finland (*www.aka.fi*) with the Finnish Space Committee acting as the overall coordinating body. The Committee, established in 1985, includes representation from several key ministries, as well as from industry, science and research, and from users of space applications.

4. Finland has been a full member of the European Space Agency (ESA) since 1995 and the Agency forms the main international forum for Finnish space research and development activities. At present, Finland participates in the ESA scientific, telecommunications and Earth observation programmes and the related technology research and development programmes. Moreover, in the field of space applications, Finland belongs to the European Organization for the Exploitation of Meteorological Satellites, the European Telecommunications Satellite Organization, the International Telecommunications Satellite Organization and the International Mobile Satellite Organization. Finland participates in the development of the joint European Union/ESA satellite navigation programme (Galileo), initiated in June 1999. Finland also played an active role at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in Vienna in July 1999.

National objectives of space activities

5. At the request of the Council of State, the Finnish Space Committee revised the Finnish national strategy for space research and development. The new strategy[2] was published in March 1999 and it is based on the following main national objectives:

(a) The internationally high level of Finnish space science will be maintained by participating in key scientific international collaborative projects;

(b) The use of emerging methods of remote sensing by satellite will be extended in the public sector data collection and geographic information systems. Commercialization will be further stimulated by increasing the outsourcing of public sector services;

(c) Industrial competitiveness will be strengthened in the growth areas of satellite telecommunications;

(d) The development of new navigation and positioning applications will be stimulated. Participation in the GNSS-2 satellite (ESA Galileosat) navigation system development programme will be pursued;

(e) The competitiveness of the space industry will be strengthened with a view to expansion to markets outside of ESA;

(f) In international research and cooperation, the emphasis will be on ESA and European Union programmes and on bilateral research activities with ESA and European Union member States and the United States of America;

(g) National activities will support the expansion of the use of space technology and its applications, strengthening of technological competitiveness and utilization of international cooperative frameworks.

6. In view of the above national objectives, the estimated requirements for public funding of space activities, in millions of United States dollars, are as follows:

[2] *Space Activities in Finland, National Strategy and Development Objectives*, Ministry of Trade and Industry, National Technology Agency report, July 1999 (ISBN 952-9621-49-9).

Year	*1998*	*1999*	*2005*[a]
Space science	9.5	9.6	12.9
Remote sensing	18.3	18.5	19.7
Satellite telecommunication	2.5	1.6	1.6
Satellite navigation and positioning	2.2	2.9	7.2
Space equipment and technology	7.2	7.2	7.7
ESA fees	2.3	2.3	3.6
National regulation and administration	0.7	0.7	0.7
Total	**42.7**	**42.8**	**53.4**

[a]Estimates.

7. For further information, please contact:

Finnish Space Committee/National Technology Agency
P. O. Box 69
FIN-00101 Helsinki
Finland

Telephone: +(358) (10) 521 5852
Facsimile: +(358) (0) 521-5901
URL: http://www.tekes.fi/space

Ireland

[Original: English]

Ireland does not have a specific national space programme, choosing to participate in the programme of the European Space Agency, the European Union for the Exploitation of Meteorological Satellites and the European Telecommunications Satellite Organization, and to some extent in remote sensing activities promoted by the Joint Research Centre of the European Union. In addition, there is occasional bilateral cooperation between Irish scientific research teams and teams in other countries (e.g. the Russian Federation and the United States of America) on space scientific missions.

Israel

[Original: English]

The main activities of the Israel Space Agency in the year 1998 were as follows:

(a) Launching of the Technion students' satellite (Techsat) Gurwin on 10 July 1998 from the Baikonur Cosmodrome in Kazakhstan by the Ukrainian Zenit launcher;

(b) Preparations for transferring the Israeli our ultraviolet Tauvex telescope to the Russian spectrum roentgen gamma (SRG) satellite;

(c) Continuation of regular activities with the Israeli geostationary communication satellite Amos and the remote sensing satellite Ofeq;

(d) Regular reception and distribution of remote sensing images from the Système pour l'observation de la Terre (SPOT) and European remote sensing (ERS) satellites;

(e) Organization of a bilateral Israeli-French scientific workshop on space-sharing ideas for future possibilities of scientific cooperation;

(f) Continuing support by the Israel Space Agency for Israeli scientists performing research in the field of remote sensing utilizations and tectonic plate motion measurements using global positioning satellite systems and so on;

(g) Continuation of scientific preparations for the Mediterranean Israeli Dust Experiment (MEIDEX), which is expected to fly in 2001 on the space shuttle of the National Aeronautics and Space Administration of the United States of America and to be operated by an Israeli astronaut;

(h) Continuation of other activities as reported to the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (see A/CONF.184/AB/9).

Malaysia

[Original: English]

A. Introduction

1. In view of the immense benefits of space technology and its tremendous potential impacts on all aspects of life, Malaysia is committed to the development and advancement of space science and technology applications.

B. The strategic programmes

1. Space laws

2. As a new player in the field of space, Malaysia must establish the legal infrastructure needed to guide its future involvement. International treaties and conventions are waiting for the approval by the Government. Malaysian membership of the Missile Technology Control Regime is also being studied.

2. International Telecommunication Union/Malaysia Task Force

3. Under the International Telecommunication Union (ITU)/Malaysia Task Force, four working groups have been established, on time and frequency standards, on radio astronomy, a space science and a remote sensing.

3. Malaysian space policy

4. The Malaysian Space Agency (MASA) is to be formed by the end of 1999 and will subsequently approve Malaysian space policy.

C. The Earth and its environment

1. Remote sensing applications

5. Remote sensing data was first used for forestry applications in the 1970s. Today the use of remote sensing imagery is widespread.

6. In an effort to make fully operational the utilization of remote sensing and related technologies such as geographic information systems (GIS) and satellite-based positioning in the country, a national resource and environmental management programme has been undertaken under the auspices of the Malaysia Centre for Remote Sensing (MACRES) to establish an operational remote sensing-based integrated natural resource and environmental database at the national level to support planning and decision-making. The programme encompasses three subsystems: (a) a satellite-based information extraction subsystem; (b) a spatial modelling subsystem utilizing GIS and an expert system; and (c) a decision-making subsystem. Focus is being placed on the development of technology in agriculture, forestry, geology, hydrology, environment, coastal zones, marine, topography and socio-economic applications. Among the important achievements of the programme to date are (a) the development of remote sensing and GIS applications for the monitoring of forest fires, the monitoring of water catchment areas and detection of change in forested areas; and (b) the development of a database and decision-making application tools for the system of national resource and environmental management.

7. South-east Asian countries are frequently affected by the smoke haze caused by forest fires and open burning of agricultural wastes. The haze episode of July-October 1997 was the worst environmental disaster recorded in recent years and resulted in considerable economic loss and as yet unquantified health repercussions on Malaysia and neighbouring countries in the region. In response to this, a total forest fire management plan was initiated utilizing the integration of remote sensing and GIS technologies to assist the Government in providing an operational system for management of forest fires. The plan consists of three components: (a) an early warning system; (b) a detection and monitoring system; and (c) measures and procedures for mitigation. The early warning system is aimed at producing maps that indicate areas that are susceptible to forest fires. The detection and monitoring component is being carried out via Earth observation satellites such as the French Système pour l’observation de la Terre (SPOT) satellites and meteorological satellites such as those of the National Oceanic and Atmospheric Administration (NOAA) of the United States of America, and ground surveillance to provide the coordinating authority with near real-time information on the exact locations and extent of forest fires/open burning. The measures and procedures for mitigation are inter-agency activities implemented through a forest fire management and coordination centre to fight forest fires.

8. While MACRES is the leading agency for remote sensing applications, research on the subject is also carried out by universities such as Universiti Teknologi Malaysia (UTM), Universiti Putra Malaysia (UPM) and Universiti Kebangsaan Malaysia (UKM). Remote sensing user agencies include the Malaysia Agriculture Research and Development Institute (MARDI) and the Forest Research Institute of Malaysia (FRIM).

9. Research carried out at the UTM Department of Remote Sensing covers bathymetry, seabed features, vegetation index mapping, sea surface temperature, seagrass mapping, study of landslide-prone areas, oil slick studies and land use mapping.

10. The UPM Centre for Remote Sensing and Geographic Information Systems is conducting research programmes on a pavement management system, a road accident

information system, coastal zone management, irrigation resources and environmental changes.

11. Remote sensing for forestry applications undertaken by FRIM include forest inventory, mapping, rehabilitation and monitoring. Microwave remote sensing is expected to improve the coverage of critical areas. At MARDI, past research included crop surveillance and a land resource inventory, while current research activities cover, among other things, spatial modelling for regional agricultural development and characterization of plant species.

12. Several companies offering remote sensing applications services have emerged. A ground receiving station able to receive optical and radar images is currently under construction under the coordination of MACRES.

2. Meteorology

13. There are six meteorological satellite ground stations in Malaysia operated by the Department of Meteorology, one high-resolution picture transmission station, three medium data utilization stations and two secondary data users stations, which receive and process data from the NOAA geostationary meteorological satellites (GMS). The present applications of meteorological satellite data and image processing are intended to support operational weather forecasting, weather warning and other applications, including cloud type identification, cloud top estimation, weather system detection, monitoring cloud system evolution, detection of forest fires, smoke plumes and hazes and a vegetation index to assess crop yield.

14. Future plans include the extension of applications to volcanic ash cloud detection and discrimination, post-flood assessment, rainfall estimation and oil slick detection.

3. Atmospheric science

15. Atmospheric science research is carried out by UPM and Universiti Sains Malaysia (USM). The former focuses on air pollution studies, while USM has led stratospheric ozone research in the country for more than a decade.

D. Satellite communications and global positioning

1. Telecommunications

16. Binariang Satellite Systems Sdn Bhd (BSS) is the owner and operator of Malaysia’s first regional satellite system called MEASAT (Malaysia East Asia Satellite), which provides optimum coverage of the East Asian region. The MEASAT system comprises two high-powered HS376 spacecraft built by the Hughes Space and Communications Company.

17. MEASAT-1, an advanced hybrid 12 C-band and 5 Ku-band payload satellite system, was launched on 13 January 1996 (Malaysian Time) from Kourou in French Guiana by Arianespace. Situated at 91.5° E, its C-band footprint covers a major part of East Asia (which includes the Philippines, Cambodia, parts of southern China, Hong Kong SAR and Taiwan Province of China, the Lao People’s Democratic Republic, Malaysia, Myanmar, Singapore, Thailand and Viet Nam), northern Australia, Guam and Papua New Guinea.

18. MEASAT-2 was launched on 14 November 1996 (Malaysian Time). It serves up to four 72-MHz C-band and nine 48 MHz Ku–band transponders. At the orbital location of

148° E, MEASAT-2 provides reliable C-band broadcasting and telecommunications services in East Asia, eastern Australia, Guam and the mainland United States via Hawaii.

19. The Ku-band capacity of the MEASAT system (MEASAT-1 and MEASAT-2) offers reliable direct-to-user broadcasting services over eastern Australia, India, Indonesia (Sumatra and Java), eastern and western Malaysia, the Philippines, Taiwan Province of China and Viet Nam. It provides point-to-point and point-to-multipoint communications and broadcasting services within its footprints. Telemetry tracking and control is monitored from the MEASAT Satellite Control Centre in Pulau Langkawi, an island off the north-west coast of peninsular Malaysia, which has been identified as the nation’s aerospace centre.

20. Telekom Malaysia, the largest telecommunications company in Malaysia, accesses the INTELSAT satellite systems located at the orbital slots of 60° E, 62° E, 177° E and 180° E for its international public switched networking, including the Internet backbone traffic and broadcast services. It also assesses the regional MEASAT and PALAPA satellite systems for domestic applications and ASIASAT, PANAMSAT and APSTAR for broadcast services. Together with a joint venture company, Telekom Malaysia offers Iridium services.

21. Telekom’s current satellite services include an international public switched network using intermediate data rate (IDR) and low-cost time division multiple (LCTDMA); very small aperture terminal (VSAT) services for domestic and international applications; and television-based satellite services that include broadcast activities, digital satellite news gathering (DSNG) and television uplinking.

22. A third major telecommunications company, CELCOM, offers Orbcomm services. A ground station is now operating at Kijal, Terengganu, on the VHF frequency of 137-150.5 MHz. The footprint, which covers an area with a 3,000-mile diameter, includes Brunei Darrusalam, Malaysia and Singapore. Commercial services will officially begin in July 1999. Typical applications include river data collections, flood monitoring and fleet management.

2. Global positioning and mapping

23. The national satellite image map project initiated in 1977 utilizes satellite-based positioning for the establishment of the ground control points required for geometric correction of satellite images. To date the project has produced a database for hydrography and contour and administrative boundaries for selected areas and 14 ground control points have been set up.

24. The commercial utilization of the NAVSTAR Global Positioning System (GPS) is currently limited to very few transportation operations. Its use for mapping, scientific studies and recreation is, however, rapidly on the rise and global positioning presents the largest potential commercial utilization of space technology in Malaysia.

E. Satellite technology and payloads

1. Microsatellites

25. In view of the great potential for applications and the affordability of small satellites, Malaysia is committed to research and development of such satellites and to innovative exploitation of their advantages.

26. Malaysia has built its first microsatellite, TiungSAT-1, in collaboration with the University of Surrey, United Kingdom of Great Britain and Northern Ireland. Named after a variety of a singing mynah bird, the satellite will operate on amateur radio frequencies and carry onboard store-and-forward communications and remote sensing capability. A meteorological Earth imaging system with a resolution of 1,200 m accompanies three narrow-angle multispectral cameras with a resolution of 80 m at an altitude of 700 km. TiungSAT-1 also carries a cosmic energy deposition experiment. The satellite awaits a piggy-back launch in April 2000 aboard the Zenit-II rocket to Sun-synchronous orbit. This satellite launch is much delayed, owing, firstly, to the unavailability of affordable launch opportunities for small satellites globally and, secondly, because, having once acquired a launch, of uncertainties in the rocket launches.

2. Satellite constellation

27. The design of a constellation of low equatorial orbit satellites is now under way under the coordination of a government-owned company, Astronautic Technology Sdn Bhd (ATSB), which was set up under the Space Science Studies Division (BAKSA) for the purpose of manufacturing TiungSAT-1.

3. Satellite technology development facilities

28. Dedicated satellite technology development facilities can be found at ATSB, UKM, UTM and USM. Other organizations that have facilities relevant to satellite fabrication include the National Aviation Design Centre, the Standards and Industrial Research Institute of Malaysia (SIRIM), the Malaysian Institute of Microelectronic Systems (MIMOS) and the Technology Park of Malaysia (TPM).

29. It should be mentioned that the scarcity of launch opportunities for small satellites will ultimately curb the usefulness of such satellites. Similarly, expensive launches will negate their affordability and limit the number of countries that will develop and advance small satellite technology. An effort on a global scale to address the issue will be needed if small satellites are to retain their unique attributes.

4. Scientific payloads

30. A Malaysian scientific experiment has been flown in the University of Stellenbosch's SUNSAT microsatellite.

F. Training and education

1. Workshops

31. Malaysia has hosted several regional training workshops on remote sensing. Participants came from several countries, including Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, Thailand, Viet Nam, while experts conducting the courses came from Australia, Canada, France, Japan and the Netherlands.

32. Training workshops on satellite technology have been conducted by BAKSA and ATSB with experts from India, the Russian Federation, South Africa, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

2. University courses

33. A Bachelor's degree in remote sensing is offered by UTM. It also offers a post-graduate Master's course, as does UPM. Other universities that offer a variety of undergraduate remote sensing courses include UKM and Universiti Malaya (UM).

34. Astronomy and astrophysics are offered in UKM and UM at undergraduate levels, the former offering post-graduate options as well. Aerospace engineering degrees covering selected aspects of astronautics are offered by UTM, UPM and USM, while UKM offers specialized undergraduate and postgraduate courses in telecommunications engineering. Notwithstanding the availability of such courses, many students continue to be sent for training in these subjects in Australia, the United Kingdom of Great Britain and Northern Ireland and the United States of America.

3. Space science education

35. Space science is a compulsory subject in schools in the sixth and ninth years. It is an important component of extracurricular activities and school astronomy clubs abound in all parts of the country. Educational activities are also undertaken by amateur societies such as the Malaysian Planetary Society and the Astronomical Society of Malaysia.

36. There are three planetariums in Malaysia, two in the Peninsula and one in eastern Malaysia. One more is being planned in the latter. The National Planetarium in Kuala Lumpur under BAKSA conducts courses for teachers and the public and organizes regular educational activities on space science for teachers, students, professionals and the public. It publishes magazines, newsletters, books and brochures on a regular basis.

G. International and regional cooperation

37. Malaysia follows an open policy as regards collaboration in science and technology. In the field of satellite technology cooperation has been forged with Brazil, India, Republic of Korea, the Russian Federation, South Africa, the United Kingdom of Great Britain and Northern Ireland and the United States of America. Future programmes are expected to involve Australia, France and some African countries, Germany, Italy, Japan and Singapore.

38. Strong links have already been established with members of the Association of South-East Asian Nations (ASEAN) in training in and development of remote sensing and for strengthening existing networking between ground receiving stations for satellite data reception and distribution in the region. Close cooperation also exists among ASEAN nations on the monitoring and prevention of haze. Bilateral projects in remote sensing have been implemented with the European Space Agency/European Union, Canada, China, Japan and the United States of America.

39. International cooperation and joint ventures have been instituted by the country's satellite communications service providers, as mentioned above.

H. Closing remarks

40. Aware of the fact that the country is a new participant in the space arena and conscious of the limitations of its resources, Malaysia will actively seek international cooperation in all aspects of space activities while at the same time vigorously nurturing its own indigenous capability.

Netherlands

[Original: English]

A. Introduction

1. Space activities in the Netherlands comprise a broad spectrum of scientific endeavours, the use of space missions and the application of space products and data in a wide variety of terrestrial projects. Industries, laboratories and institutes in the Netherlands are actively involved in different space projects in the fields of science, remote sensing, communications, manned space flight, space transportation and technology. They develop and build sophisticated instruments and subsystems for space missions and launchers under contract to the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA), of the United States of America, the Centre national d'études spatiales of France (CNES), the Italian Space Agency (ASI), the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), international industries and other organizations. Several universities, scientific institutes and industries in the Netherlands are active in different fields, including astronomy, meteorology, remote sensing, environmental research, water management, communications, material sciences and life sciences. This brief overview will survey some aspects of the space activities in the Netherlands. The most important national activities relating to scientific programmes, remote sensing instruments and national technology projects will be mentioned. ESA is very important for the Netherlands and therefore some important Netherlands products in ESA projects will be highlighted.

B. Policy, budgets and markets

2. The national space policy is based on three interconnected objectives. The first relates to industry and technology, the second to the users and the third one is political. The first objective is to maintain and expand a knowledge-intensive and high-quality capability, both in industry and in research institutes. Secondly, promoting the use of data acquired from space programmes is important, as is encouraging the dialogue between active and potential users on the one hand and developers of space projects on the other. This policy fully exploits the potential applications of and investments in space activities. The third objective of the Netherlands space policy is European cooperation to add substance to the collective responsibility of solving global problems, for instance, in the areas of environmental protection and climatology.

3. Six government departments provide funding for space programmes in the Netherlands. The average space budget amounted to 250 million Netherlands guilders (approximately 120 million euros) in recent years. The greater part of the country's space budget (65 per cent) is used to fund ESA programmes. The Netherlands also participates in programmes of EUMETSAT. About 25 per cent of the country's space budget is spent on national space research, technology projects and cooperative projects with agencies such as NASA, the German Aerospace Centre (DLR), CNES and ASI. In addition, the commercial market for Netherlands products increases. In recent years, the country's industry has been heavily involved in international and commercial space projects for which products such as solar arrays, gloveboxes and remote sensing instruments have been produced. Most of these instruments and components were developed in the framework of ESA programmes.

4. Scientists from the Netherlands have provided instruments for NASA and ESA satellites, whereas the country's industry participated in launch vehicle development and satellite projects. Since 1969, when the Government approved the project for the Astronomical Netherlands Satellite (ANS) and established the Netherlands Agency for Aerospace Programmes (NIVR) as the national space agency, space activities have included several national projects, mostly as cooperative projects with one or two other countries. Other activities in the national framework comprise a space technology programme managed by NIVR and a space science programme managed by the Space Research Organization of the Netherlands (SRON). However, the majority of space-related activities are carried out in the framework of ESA programmes. The average contribution from the Netherlands to ESA currently amounts to about 3 per cent of the total ESA budget. In addition to its ESA membership, the Netherlands is involved in a number of international space organizations in the area of satellite operation, such as EUMETSAT (meteorology), the International Mobile Satellite Organization (navigation and communications) and the European Telecommunications Satellite Organization and the International Telecommunications Satellite Organization.

C. Organization

5. Several ministries are involved in space and its applications. Within the Government, the Minister for Economic Affairs, being responsible for technology policy, holds primary responsibility for space policy. Space policy is dealt with in the Interdepartmental Committee on Space (ICR), in which all ministries with an interest in space are represented. ICR has three advisory members: NIVR, SRON and the Netherlands Remote Sensing Board (BCRS). Part of NIVR functions as the national space agency. It is the national focal point for space and its specific objective is the promotion of industrial activities. It directly manages national and multilateral space projects and technology programmes. NIVR is involved in monitoring national participation in the European space programmes. SRON is responsible for the national space research programme. Its research fields are astrophysics, astronomy and Earth observation. SRON also coordinates national space research activities, including remote sensing and microgravity research. The task of BCRS is to coordinate and initiate the application-oriented use of Earth observation data. Industrial cooperation in space, including research institutes, is institutionalized in the Netherlands Industrial Space Organisation (NISO). The National Aerospace Laboratory (NLR) of the Netherlands is a research establishment specializing in the field of aeronautics and space technology. Fokker Space represents the principal space capability in the country's industry. In addition, a number of high-technology industries take an active share in space.

D. National activities

6. In order to allow industry and user communities to gear their activities as close as possible to ESA programmes, industries and institutes in the Netherlands perform a number of national supporting activities. Through its space technology programme (NRT), NIVR stimulates industrial technological research in order to give companies a sound technological starting point in international space programmes. SRON has a budget for scientific research and for the construction of instruments for science and Earth observation. There are also specific user programmes to stimulate the use of Earth observation data. Finally, the Netherlands cooperates in multilateral projects with other

countries. Some of these projects, the satellites ANS, the Infra-red Astronomical Satellite (IRAS) and the X-ray Astronomy Satellite (SAX) and the Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) and the Ozone Monitoring Instrument (OMI), will be highlighted.

1. Space Technology Programme of the Netherlands Agency for Aerospace Programmes

7. Through its Space Technology Programme, NIVR supports space technology developments in the nation's industry. Studies within the framework of the Programme focus on priority areas for the Netherlands in structures, solar arrays, payloads, remote sensing, robotics, data handling and propulsion. Annually, over 100 dedicated technology projects are carried out on solar arrays and structures, components for gloveboxes, instruments, workstations and tools for remote sensing, crew workstations, man-machine interfaces and new propellants. Several breadboards and validated products have been developed and demonstrated under the aegis of NRT to agencies such as ESA, NASA, CNES and DLR and to international companies such as MMS, DASA, Alenia, Aérospatiale, Technospazio, TRW and Boeing.

2. Space research programmes

8. Under the SRON umbrella, scientific space instruments were, and are, developed for gamma-ray, X-ray, infra-red and submillimetre astronomy for the ANS and IRAS satellites, as well as for a number of NASA and ESA projects. Examples are Solar Max, the Gamma-Ray Observatory (GRO), ESRO-IV, TD-1, COS-B, the International Sun-Earth Space Observatory (ISEE-B), the European X-ray Observatory Satellite (Exosat), Ulysses, the Infra-red Space Observatory (ISO), SAX, the X-ray Multi-Mirror (XMM) satellite, the Chandra telescope and the Far Infra-red Space Telescope (FIRST). SRON also sponsors ongoing experiments in the field of microgravity research and Earth observation.

3. National remote sensing projects

9. Many organizations, institutes and industries in the Netherlands are active in remote sensing. BCRS coordinates most of the remote sensing projects and the NEONET Web site describes all the important remote sensing projects.

4. Cooperative projects

10. The 129-kg three-axis stabilized Astronomical Netherlands Satellite (ANS), with one ultraviolet (UV) and three X-ray experiments (one from the United States), was launched in a polar orbit in August 1974. It fully met its objectives to study young hot stars and soft and hard X-rays from cosmic sources. ANS re-entered the Earth's atmosphere in June 1977. ANS improved the Netherlands industrial participation in space projects and helped local scientists to maintain their strong position in astronomy.

11. The Infra-red Astronomical Satellite (IRAS) was a joint Netherlands/ United Kingdom/United States project. The Netherlands (Fokker, Philips, Signaal, SRON and NLR, under the management of NIVR) was responsible for the spacecraft, the overall design, the integration and testing and an infra-red instrument. The United States took care of the superfluid helium-cooled infra-red telescope, the final data handling and launch, while the United Kingdom was committed to satellite operations and preliminary data processing. The 1,080-kg satellite was launched into a 900-km polar orbit in January 1983

and successfully operated until depletion of the helium coolant in November 1983. IRAS fully met its objective to make a complete survey of the infra-red sky in the 8,120 micrometre wavelength. Science working groups in the Netherlands, the United Kingdom and the United States are still analysing the observations. The X-ray Astronomy Satellite (SAX) is a joint Italian/Netherlands programme. Alenia Spazio was the prime contractor and Fokker Space was responsible, with direct funding from NIVR, for the Attitude and Orbit Control System (AOCS). Fokker built the solar panels under a separate contract. The Italian scientific institutes, SRON and ESA provided the scientific instruments. SAX was launched from Cape Canaveral by an Atlas Centaur launch vehicle on 30 April 1996. The satellite is observing celestial X-ray sources in the broad energy band from 0.1 to 300 keV to achieve a systematic, integrated and comprehensive exploration of galactic and extragalactic sources. The wide-field cameras, a contribution of the Netherlands, were able to locate gamma-ray bursts very accurately.

5. Instruments

12. The Scanning Imaging Absorption Spectrometer for Atmospheric Cartography (SCIAMACHY) is an advanced, extremely accurate spectrometer. The project is a trilateral co-production, headed by NIVR and its German counterpart, DLR, while Belgium supports the project by developing one of the subsystems. SCIAMACHY will fly on the ENVISAT-1 polar platform, scheduled for launch in 2000. SCIAMACHY will take continuous readings of trace gases in the troposphere and the stratosphere in order to understand the complicated physical and chemical processes in the atmosphere connected to the greenhouse effect and depletion of the ozone layer. The Netherlands Ozone Monitoring Instrument (OMI) monitors upper- and lower-atmosphere chemical processes that are important determinants in global warming measurements and climate modelling. OMI is one of the four instruments to fly on the NASA Earth Observing System Chemistry (EOS CHEM) mission. It is a charge-coupled device (CCD)-based imaging spectrometer observing and measuring ozone and related trace gases in the ultraviolet, visible and near infra-red wavelengths. Fokker Space and TPD will build the instrument, with Finnish companies also involved. The CHEM mission (launch planned for 2003) will provide measurements of ozone, chlorine monoxide, hydroxyl radical and water vapour.

6. Small satellite facility

13. The small satellite SLOSHSAT Facility for Liquid Experimentation and Verification in Orbit (SLOSHSAT-FLEVO) will be launched in 2000. SLOSHSAT is a harmonized programme between ESA and NIVR. The main contractor is the National Aerospace Laboratory (NLR) of the Netherlands, with the participation of Fokker Space, Verhaert and Newtec (Belgium), Rafael (Israel) and NASA. The 115-kg free-flying satellite will be deployed by a space shuttle Hitchhiker-C to study fluid dynamics in low gravity. The mission will consist primarily of the excitation of a tank partially filled with liquid. The main mission objective is to obtain experimental data to verify existing models for fluid dynamics.

E. Participation of the Netherlands in the programmes of the European Space Agency

14. ESA activities can be divided into two categories, mandatory and optional programmes. Programmes carried out under the general budget and the science programme

are mandatory. The Netherlands contributes as a full member of ESA to the mandatory programmes on a gross national product basis and at present its contribution amounts to 4.7 per cent of the ESA budget. Optional programmes are in areas such as Earth observation, telecommunication, space transportation and manned spaceflight. The Netherlands participation in these projects is diversified and amounts to an average of 3 per cent of the ESA budget.

1. Mandatory programmes

15. The general budget programmes include basic ESA activities such as system studies for future projects, the Technology Research Programme, shared technical investments, information systems and training programmes. In the framework of the Programme, industries in the Netherlands have undertaken several important studies on robotics, informatics, propulsion and others. Its institutes and industries are also heavily involved in various ESA scientific programmes. The present programmes are set out in a long-term plan called Horizon 2000. Local scientists play an important role in projects such as XMM and FIRST, while local industries have delivered many products for those satellites, for example, scientific instruments for TD and ISO, thermal control for Giotto, solar arrays for Hipparcos, attitude control for ISO and ground test equipment for XMM, Integral and Rosetta.

2. Optional programmes

16. Since the 1970s, the Netherlands has been participating with Meteosat in various ESA programmes concerning Earth observation. In the 1990s, ERS-1 (launched in 1991) and ERS-2 (launched in 1995) were the complex forerunners of a new generation of even more ambitious missions such as Envisat, Metop and the second-generation Meteosat. Fokker Space and other national industries have been involved in ERS activities concerning thermal control and integration and testing of the payload module. The payload of ERS-2 included a new instrument for ozone measurements, the Global Ozone Monitoring Experiment (GOME), in which Netherlands institutes (the Institute for Applied Physics (TPD) of the Organization for Applied Scientific Research (TNO) and others) were involved. Local industries (Fokker Space, TPD and subcontractors) developed and built important parts of the polar platform on which Envisat-1 is based. For the Envisat-1 mission, the Netherlands is involved in the development of a wide array of instruments, such as SCIAMACHY, the Michelson Interferometric Passive Atmospheric Sounder (MIPAS) and the Medium-Resolution Imaging Spectrometer (MERIS). ESA started developing telecommunication satellites in 1968 and has since launched the Orbital Test Satellite (OTS) (1978), four ECS and two Marecs satellites (1983-1988), and the large Olympus satellite (1989). Artemis will be launched in 2000. ESA implements technology programmes to explore the technology required for future missions. The Netherlands contributes to most of these programmes, for example, Artemis (1.5 per cent) and ASTE (3 per cent). Fokker Space has provided the solar arrays for almost all ESA communication satellites. TPD provided attitude sensors, whereas industries such as Bradford and Satellite Services have been involved in the development of components, sensors and ground test equipment.

17. ESA commenced its Ariane programme in 1973. Since the first launch, in 1979, some 120 launches have been completed and about 200 satellites have been put into orbit. Fokker Space and many national subcontractors (Genius Klinkenberg, Stork Aerospace and Polymarin) built interstages, engine frames and nose caps for Ariane-1, -2, -3 and -4. The

first successful launch of Ariane-5 took place in 1997. Fokker Space and partners produce the engine frame for Ariane-5. Ignitors and turbo pump starters for the main engine were developed and built by SPE, APP and the Prins Maurits Laboratory of TNO. The participation of the Netherlands in Ariane programmes is 2.3 per cent on average. Furthermore, the Netherlands participates in technology projects such as the Future European Space Transportation Investigation Programme (FESTIP) and in Ariane-5 follow-on programmes.

18. The Spacelab programme was the first step of ESA in manned space programmes. The programme started in 1974 and 24 missions have been carried out since the first flight in 1983. ESA participated in many missions. Netherlands astronaut Dr. Ockels performed experiments proposed by Netherlands and other scientists in 1985 on board the Spacelab D1 mission. Netherlands industries built the airlock and the Biorack glovebox for Spacelab. In the early 1990s, several manned space projects were defined to develop and build products such as the European robotic arm (ERA) and the microgravity science glovebox (MSG). These systems will be used during the initial development phase of the International Space Station (ISS). Industries in the Netherlands are heavily involved in those projects. Fokker Space is the prime contractor for the ERA, which will be used in the Russian part of the ISS to move large objects and for inspection and exchange of units. Bradford will build an important part of the MSG. The manned-space programme (MSP) started after the Ministerial Conference of 1995. The most important MSP projects are the Columbus Orbital Facility, the automated transfer vehicle (ATV) and the utilization programme. Furthermore, smaller projects can also be identified, such as external payloads and parts of crew rescue vehicles (CRV) for which Netherlands industry will develop rudders. Industries and institutes in the Netherlands will contribute to the Columbus Orbital Facility by developing and building mass memories, software modules and valves, while for the ATV the most important contribution will be the solar arrays, simulation facilities and components. As for utilization projects, the Netherlands provides facilities, instruments and products such as thermal control units for user facilities and user support activities. European space research experiments in the fields of life sciences and fluid sciences under microgravity conditions have been performed in Spacelab, rocket flights and other space missions. The present most important ESA programmes are European Microgravity Research Programme (EMIR) and microgravity facilities for Columbus (MFC). Scientists from a dozen universities and institutes in the Netherlands have performed more than 30 experiments on biology, life sciences, physics and fluid sciences on board Spacelab and with re-entry modules and sounding rockets. Netherlands industry has built several instruments and components: different types of gloveboxes, blood pressure devices, biological facilities (e.g. cells in space modules and biopack), parts of fluid science facilities and experiment units.

19. The following technology programmes were defined for various ESA programmes on communication, Earth observation and launch vehicles: the Advanced Telecom System Technology Programme (ASTP), the Earth Observation Preparatory Programme (EOPP), FESTIP and the General Support Technology Programme (GSTP). The Netherlands participates with various percentages in those programmes. GSTP is a general technology programme covering almost all ESA projects. Industries and institutes in the Netherlands (e.g. Fokker Space, NLR, Bradford, Stork and Origin) are involved in more than 20 technology items, for example, thermal knives for solar arrays, simulation facilities, microscopes for microgravity research, biological facilities, biological filters, sensors, microtechnology and crew support systems.

F. Commercial projects

20. A range of products have been used in international and commercial programmes that were developed in the framework of ESA technology programmes (ASTPE, GSTP and others), communication projects, manned space programmes and of course Ariane programmes. Examples of those products are solar arrays, components such as sensors, valves and torquers, gloveboxes, blood pressure devices, structures for Ariane and ignitors. Obviously, full details could not be included in this brief overview. Nevertheless, some commercial projects will be mentioned to reflect the importance of this commercial market for the Netherlands. Fokker Space has delivered more than 35 solar arrays, not only to ESA for scientific, remote sensing and communication satellites and other projects (Eureca and ATV), but also for commercial satellites such as Telecom-2, Skynet, Hispasat and Hotbird, and for the Chandra telescope. More than 20 solar arrays are in the development phase. TPD has produced many Sun sensors for commercial communication satellites and Urenco has delivered torquers and nutation dampers for American and Chinese customers. Bradford has developed valves and thermal control systems for manned systems under contract with Alenia and Boeing. Furthermore, Bradford is a world leader in gloveboxes. Gloveboxes were developed for the United States microgravity laboratory (Spacelab) missions and for ISS under ESA contract, but in close cooperation with NASA. Owing to that success, NASA placed commercial orders for gloveboxes for use in the shuttle middeck (also used in Spacelab and Spacehab) and in Mir. Under contract with Boeing, Bradford is at present developing parts of the large life sciences glovebox for the ISS centrifuge. Bradford, the National Space Development Agency (NASDA) of Japan, Japanese industry and NASA closely cooperate in this project. TPD has developed blood pressure devices for use in ESA facilities for human research, which have also been delivered to CNES (for Mir and the ISS) and to NASA. TPD also produces such devices for military purposes (tests on pilots). The market is substantial.

G. Technology transfer

21. Organizations and industries in the Netherlands such as NIVR, NISO and Fokker Space promote technology transfer. Many symposiums on technology transfer in the field of informatics, simulation, electronics, mechanical systems and others, have been organized by NIVR in close cooperation with the European Space Research and Technology Centre of ESA. Organizations in the country are also actively involved in ESA programmes to stimulate the wider use of space technology. Many space systems and products for possible dual use originating in the Netherlands have been described in ESA brochures, for example, simulation facilities, Eurosim, informatics, crew support systems, mass memories, biological air filters and structures. NISO has issued a brochure mentioning spin-offs from space systems and components such as ignitors, propellants, propulsion components, simulation facilities, mechanisms, electronics and data-handling systems.

22. With respect to additional information on the spin-off from space activities in the Netherlands, the following might be useful. In early 1999, NISO carried out a small evaluation of the volume and character of spin-off in the Netherlands. Firstly, "spin-off'" effects were defined as the "technologies designed for space that are also used in sectors outside the space sector". Secondly, it turned out that spin-off effects are fourfold: one should take into account technological, organizational, commercial as well as economic effects. This information paper will not go into the spin-off of international programmes

in which the Netherlands participates (mainly ESA), but focus on the spin-off from national activities.

23. Three illustrative examples are given below:

(a) The Delft-based firm ALE (Advanced Lightweight Engineering) has developed a lightweight LPG-tank for use in cars by applying space technologies (fibrespin). The tank has 70 per cent less weight than a regular steel LPG-tank;

(b) Bioclear has developed an air-clearing system that is based on biofiltration. Developing an air filter for use in space required a technology for the screening of organisms, based on a DNA-technique, that could also be used for water-clearing filters on Earth;

(c) Signaal Special Products (SSP) has obtained a contract to develop a CD-player for the Columbus project. The CD-player was subject to severe demands with respect to being shockproof and stable, but SSP was able to build a hard disc for the Space Station that was not sensitive to shocks or vibrations. In the end, the Columbus project was cancelled, but based on the Columbus technique, SSP has developed a CD-ROM player for the air force and has derived players that serve as reference players for quality measurement of CDs.

H. Further information

24. The NIVR Web site (www.nivr.nl) describes most of the space activities in the Netherlands. The Space Catalogue lists nearly all important industries and institutes in the country. Space research activities are also well described at the SRON Web site (www.sron.nl). Details of remote sensing activities can be found at the NEONET Web site (www.neonet.nl), which also covers BCRS and NLR.

Republic of Korea

[Original: English]

A. Introduction

1. The main objective of the present annual report is to review briefly the space activities of Republic of Korea in 1999, including those in the area of space science and technology, in particular from the perspective of international cooperation. The highlights of space activities of 1999 were the launching of three satellites and participation at the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).

2. The Korean space programme covers space communications, satellite development and Earth observation. The key research areas as regards space applications, other than space communications, are satellite remote sensing, geographical information systems (GIS) and the Global Positioning System (GPS). Current research activities are undertaken by various government branches and agencies, including research institutes and universities, at the national and local levels. At the national level, the Ministry of Science and Technology and the Ministry of Information and Communication play central roles in coordinating and implementing space technological policy as well as in funding space development research. At the local level, local authorities conduct their research based on

satellite information for the development of their communities in the areas of environment, water resources, forest, fishery and industries.

B. Satellite programme

3. A new space era has begun recently for this country with ambitious planning for space development. In 1999, two satellites, including one geostationary communications satellite, were launched successfully and one more satellite launch is planned.

1. KITSAT programme

4. KITSAT-3 was launched on 26 May 1999 into a Sun-synchronous orbit with an altitude of 720 km. The Satellite Technology Research Centre of the Korea Advanced Institute of Science and Technology (KAIST) is responsible for the development of the KITSAT satellites. The Korea Aerospace Research Institute (KARI) participated in the environmental tests of the KITSAT using the KARI test facilities.

5. KITSAT-3 carries a multispectral charge-coupled device (CCD) camera developed in cooperation with the University of Stellenbosch, South Africa, and several scientific instruments are on board the satellite: an instrument to measure radiation effects on micro-electronics, a high-energy particle detector, a magnetometer and an electron temperature probe.

6. The KITSAT-3 satellite bus system can be utilized for engineering test satellites and education and training of engineers, which will be discussed below. Considerable interest has been shown and advances in the technology of small satellites have been made in many countries. Small satellites are highly effective in terms of cost investment and experience in technology development.

2. KOREASAT programme

7. KOREASAT is the first geostationary communication and broadcasting satellite of the country. The primary purpose of the communication satellite project is to prepare proactively for the upcoming age of competition in space development in the twenty-first century, with a view to delivering advanced telecommunication services, including wide-band, high-speed voice and images to the general public, to lay the groundwork for the nation to enter the world space market, to push the nation into the rank of technologically advanced nations and to utilize the satellite orbit effectively.

8. KOREASAT-3 was launched into a geosynchronous orbit on 5 September 1999. Its major goal is to enhance the level of localization significantly, based on the technologies accumulated through the development of KOREASAT-1 and -2. The improvement of various service qualities is also expected from the KOREASAT-3 payload capabilities.

3. KOMPSAT programme

9. KARI has been developing Korea Multi-purpose Satellite (KOMPSAT), a small 500-kg Earth observation satellite with an orbital altitude of 685 km, jointly with TRW Inc. of the United States of America. KOMPSAT is expected to help raise the country’s space technology level to make it one of the world’s top 10 nations by the year 2010. The KOMPSAT payloads include a high-resolution electro-optical camera, an ocean observation camera, an ionosphere measurement sensor and a high-energy particle detector.

10. KOMPSAT is scheduled to be launched into orbit in December 1999. The satellite will travel along its 685 km Sun-synchronous circular orbit at a inclination of 98.14°, passing the ascending node at 10.50 a.m. To acquire satellite design technologies, 25 technical staff of KARI have joined the some 125-member TRW design team. Seven Korean industrial enterprises have also dispatched some 30 engineers for the same programme. The participating Korean industries are responsible for the Koreanization of satellite components. KARI has mobilized some 50 researchers in the Republic of Korea to study satellite design data at TRW and to learn about satellite systems and components.

11. The high-resolution optical payload, a panchromatic electro-optical camera, has a ground resolution of 6.6 metres. It will be used mainly to collect geological data for cartography missions and more efficient land use. The ocean observation payload is a wide-band camera, which can obtain data from six spectral bands. The payload has 1 km resolution, with the swath of 800 km, which can be used to observe and examine the world's ocean resources and pollution or atmospheric pollution and sandy dust phenomena. The ionosphere measurement sensor and the high-energy particle detector, comprising the scientific instruments, are expected to provide data on the temperature and density of electrons in the ionosphere and on the distribution of high-energy particles in space. The payloads will provide data on the scientific experiments, including the effects of space radiation on satellite sub-units.

12. The flight model of KOMPSAT is currently being assembled at the Satellite Integration and Test Centre at KARI. The Centre houses a 3.6-m thermal vacuum chamber, a 150 kN-class vibration tester and thermal shock test facilities. By using the experience accumulated from the proto-flight module of KOMPSAT at TRW, Korean engineers and scientists are working on assembling and testing the flight model of KOMPSAT.

13. In addition to securing technologies to build satellites, Korea has been making efforts to build the operational capability for satellite systems. The Electronics and Telecommunications Research Institute is responsible for the development of ground control stations for KOMPSAT, based on the Institute's accumulated experience in development, tracking, controlling and operating satellite systems for KOREASAT-1 and -2. A ground station for KOMPSAT is in final preparation for operation at KARI. The ground station facilities include S-band and X-band antennae, data-storage and -processing equipment, satellite operation software, mission analysis and planning software, and a satellite simulator.

C. Satellite meteorology

14. On 15 December 1998, the Korea Meteorological Administration (KMA) headquarters moved to a new 10- storey building located about 10 km south-west of central Seoul. Detailed information on the move of the Satellite Division and/or the Remote Sensing Research Laboratory (METRI/KMA) can be obtained at the KMA homepage (http://www.kma.go.kr and/or http://www. metri.re.kr).

15. There are 5 radar weather stations, 88 weather stations and about 400 automatic weather stations throughout the country. KMA contains the Satellite Office (14 employees), equipped with a new dual-satellite data receiving/analysing system and with the receiving system for GMS-5 and NOAA satellites. Reception of future meteorological satellite data is also being prepared, like FY-2b from China, the Geostationary Operational Meteorological Satellite (GOMS) from the Russian Federation and MTSat from Japan.

16. For the general public, satellite imaginary is serviced through the KMA home page since 1997. Because of the direct access, the number of hard copy images requested from the public decreased dramatically, from 3,200 to 1,700 and 103 images for 1996, 1997 and 1998, respectively. Currently, infra-red, visible, fog and yellow sand images for the latest 24 hours are available. For in-house users, an Intranet server is being prepared by the MSD. The Intranet server provides more items and for longer time periods (at present data for one month) than the Internet server.

17. In the case of the numerical weather prediction model, the global data assimilation and prediction system (GDAPS) uses satellite data for data assimilation. Currently, the GDAPS uses the weekly averaged global sea surface temperature (SST) from the National Environment Satellite, Data and Information Service of the National Oceanic and Atmospheric Administration of the United States of America through the Internet. Inclusion of the weekly averaged SST data has significantly improved the assimilated temperatures and wind fields, especially over the southern hemisphere. The GDAPS also uses gridded data, which are useful for the improvement of humidity sounding, especially over the ocean. Although SST data, upper tropospheric water vapour data and data on total precipitable water near the Korean peninsular are generated, they have not been used for GDAPS input because of quality control and other problems.

D. Geographic information systems

18. A nationwide information super-highway plan has been established in the Republic of Korea for promoting public use of GIS and other information services. A national GIS project covering technical development, standardization, a national base map and land information and management has also been conducted since 1995 and large-scale national thematic maps have been prepared by remote sensing data. The Republic of Korea is willing to propose technical assistance programmes to underdeveloped countries for help in the establishment of national spatial databases and for international cooperation in the development of next-generation techniques for the handling of spatial data.

19. GIS software has been developed by the Electronics and Telecommunications Research Institute since 1998 and the national GIS training centre was established in July 1996.

1. General status

(a) Background

20. The national GIS project has been ongoing since 1995. Since 1999, the Ministry of Information and Communication has been supporting GIS software development for public and local government uses, distributed information interoperability and GIS database building for public services.

(b) Achievements

21. As the main products of the national GIS project, nationwide spatial data sets were digitally generated and released from October 1998 for public and private use. Approximately 1,000 persons with GIS knowledge and skill have been trained annually. Geo-processing core technologies were acquired: system integration, spatial database development, GIS basic operation function technology and digital mapping. Some 10 local authorities have established GIS-based operable information systems: land information systems, utility management systems and urban planning systems.

(c) Universities and institutes

22. Universities offering GIS courses have included over 20 civil engineering departments, over 10 geography departments and some 10 computer sciences departments. Government-supported institutes working in the field include the Electronics and Telecommunications Research Institute and the Korea Research Institute for Human Settlements.

(d) State-of-the-art research issues

23. These have included the following:

(a) A 3D GIS geo-processing engine for digital Earth realization with 3D spatial database building;

(b) An array of nationwide orthophoto imagery and GIS-based geo-processing;

(c) Component-based GIS development for official use by public services;

(d) A study for an interoperable computing environment to be followed by activities of the Open GIS Consortium, Inc.;

(e) Development of specific application systems with GIS analytical functionality based on domestic GIS tools;

(f) International cooperation in GIS information technology development with a view to a global digital Earth.

(e) Major results of the national geographic information project

First phase (1995-1999)

24. During the first phase of the project, major focus will be placed on the construction of various databases as well as the research work of pilot studies, which will include studies to assist the other Subcommittees in their work, *inter alia*:

(a) Various decision support systems as pilot studies (the main task of the Administrative Subcommittee);

(b) Digital mapping of various maps, such as topographic, thematic and underground facility maps (the main task of the Geographic Information Subcommittee);

(c) Import and/or development of required GIS techniques: training of GIS specialists (the main task of the geographic information systems Technology Subcommittee);

(d) Pilot study and model calibration of GIS standardization (the main task of the geographic information systems Standard Subcommittee);

(e) Pilot study and digitization of a cadastral map (the main task of the Cadastral Information Subcommittee).

2. Activities of the Steering Committee

(a) Geographic Information Subcommittee

25. The Geographic Information Subcommittee will focus on developing three different categories of digital maps: topographic, thematic and underground facility maps. A total

budget of 288.5 million United States dollars would be provided for this Subcommittee, whose programme is as follows:

1996-1999 Digital mapping of underground facility maps

1996-1998 Six major cities

1999- Other cities

(b) Geographic information systems Technology Subcommittee

26. This Subcommittee focuses on the development of GIS techniques and training of GIS specialists. Approximately $22.75 million is allocated to this Subcommittee, whose programme is as follows:

1995-1999 Procurement of the required GIS techniques from overseas and adaptation to the Korean prototype

2000- Development of Korean GIS

(c) Geographic informations systems Standard Subcommittee

27. The geographic information systems Standard Subcommittee places major emphasis on international standardization of GIS by complying with the codes to be established by TC211 of the International Organization for Standardization, of which the Republic of Korea is a member. The following two categories will be standardized for NGIS: (a) base maps, the widely used topographic and cadastral maps; and (b) applications, or programmes that will utilize the base maps.

E. International cooperation

28. With the rapid development and changing political environment in space science and technology, international cooperation is gaining more importance. In the twenty-first century, space applications and technology will certainly contribute to the prosperity of human beings. As space applications become more diverse and dedicated to promoting human welfare more and more, the scale of international cooperation is increasing in proportion. This trend is because space development is now no longer a domain traditionally limited to a few leading countries, but an essential element in the improvement of the quality of life of humankind all over the world.

29. The Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) was an important forum whose goal was to review implementation of the recommendations of UNISPACE II, in particular in the area of international cooperation in space development. There was consensus as to the substantial benefits to be derived from cooperation in space and the Conference established a new framework for future international cooperation. It is expected that UNISPACE III will certainly contribute to facilitating international cooperation in the coming space age.

30. In 1999, the Republic of Korea participated in the meetings of the Committee on the Peaceful Uses of Outer Space, in UNISPACE III and the related exhibition and so on. UNISPACE III was an event of utmost importance for the space development of the Republic of Korea. On that occasion, it was important to evaluate the current status and establish the future direction of the national space programme. The Government of the Republic of Korea sent a large group of delegates from government organizations, research

institutes and private industries to participate actively in the different forums. (Eleven representatives and 8 advisers attended UNISPACE III, including 6 participants at the exhibition and 2 at the Space Generation Forum.) The head of the delegation was the Deputy Minister of Science and Technology.